appreciable rise and fall of the tide. The Admiralty tables give a range of 3¾ft.

Mr. Webster suggests the low range of tide in Ballycastle Bay may be due to the narrowness of the inlet, but he does not offer any explanation of the range, almost equally low, at the Mull of Cantire. Is he aware that the tide is detained four hours at the entrance of the Straits of Cantire? Mr. Webster appears to overlook the fact that every obstruction to the passage of water increases the friction, and so diminishes the effective head. The range of tide on the west coast of England is much greater than on the east coast of Ireland, and I do not think either the funnel theory or simple obstruction offers a satisfactory explanation. It is very difficult to determine the energy of the tide at any part of its course; but it is obvious that the slight range in mid-ocean offers no analogy to the greater range elsewhere, unless we suppose the force to pervade the whole depth of the ocean. Then the apparent increased effect elsewhere is not inconsistent with diminished energy, because the depth of water is less.

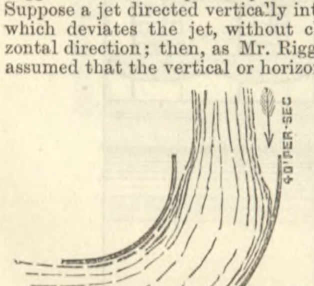
The tidal phenomena of the Irish Sea are very interesting and very instructive. Their careful study will throw light upon many branches of tidal action, including the identity, or the reverse, of the half tide and mean sea levels.

JOSEPH BOULT.

Liverpool, October 6th.

THE REACTION OF JETS.

SIR,—In THE ENGINEER for September 12th you publish a paper by Mr. Arthur Rigg, in which experiments are described on the reaction of jets. The author thinks that these results conflict with the ordinarily accepted theory, and that they are practically important in leading to a modification of the theory of turbines. It may be useful to point out that the apparent discrepancy Mr. Rigg has found is probably due to his method of experiment. Suppose a jet directed vertically into a curved right-angled bend, which deviates the jet, without change of velocity, into a horizontal direction; then, as Mr. Rigg rightly states, it is ordinarily assumed that the vertical or horizontal pressures on the bend will be equal. Mr. Rigg's jet was ¼in. in diameter, and to verify the above law, this should have been directed into a bent pipe of the same diameter, so that the velocity in passing round the bend should have remained unchanged. Making the experiment thus would probably have been difficult, because some of the water would have hit the receiving edge of the bent pipe. Mr. Rigg therefore directed his ¼in. jet into a ⅜in. bent pipe. But that very seriously disturbs the conditions of the experiment. If the bend were long enough and the jet steady enough, the stream would expand to fill the bend, and issue with only half the velocity of entry; consequently, the horizontal momentum generated would be only half the vertical momentum destroyed, and the horizontal pressure only half the vertical pressure. Mr. Rigg did not find so great a difference as this, and, indeed, that is what might have been expected. In his very short bend some of the water would get round with little change of velocity, and the rest would be diminished in velocity, the bend not giving a steady full-bore stream. The variation in Mr. Rigg's results is sufficient to show that he had not secured definite conditions of experiment.



W. C. UNWIN.

October 4th.

THE HIGH LEVEL SHIP CANAL SCHEME.

SIR,—Accept my thanks for the favourable notice in your issue of 3rd October inst. I should be truly fortunate could I boast of your good offices in proving the still more sinister host of difficulties not considered—not difficulties merely, but impossibilities in the path of the financial progress of the original scheme. I admit even that the difficulty applies to my own scheme, viewed in the same light and conditions; but these are totally changed—for, that besides a permanent weekly expenditure of £710 to be paid in perpetuity of the existence of such canal—and this is, be it understood, an expenditure for working swing bridges and mid-way locks, &c., totally unnecessary in an orthodox canal, thus at once an embargo for ever, against every sail—*pro rata* of 40 per cent. stands levied. Thus at one swoop more than one-third of the income is gone; yet this great dilemma pales before the long-drawn and inflated share list of £8,500,000 in sum total. But the effect of the whole is that of this sum no less than £7,000,000 shall be liquidated through the convenience of bankruptcy before one farthing of dividend shall reach the shareholders, and a new company formed.

The following statement will elucidate this matter sufficiently:—The ship canal costing £8,000,000, and of forty miles in length, gives £200,000 of cost per mile; and this cost per mile is actually forty times greater than the cost of the canal which I propose to vie with in identity of circumstances.

Will this bear a moment's thought—that a water-way of forty times greater cost per mile can vie with a pigmy, in everything; the difference being 40 to 1.

Again, comparison with the railways is not more reassuring. The best railways do not cost over £50,000 per mile; but canal having a four times greater share list, all advantage is lost, pretended to be claimed in another direction; whilst the weekly outlay for lock and swing bridges disposes of all pretence to economise upon railway working expenses.

I conclude, under any circumstances, it would be only calamitous that the ship canal, as it is at present known, should be further proceeded with; being a canal for goods only, and seeing that a canal could be made for the same money in amount that would elevate Manchester to the position of a first-class seaport, for through express steamships, without a lock, without a bridge.

October 7th. JAMES JOHNSON.

CONTINUOUS GIRDERS.

SIR,—In reply to Mr. Mackenzie's letter, I beg to say that the deduction of the formula on page 244 is the same as of that on page 206, taking into account the altered conditions. On page 206 m consisted of the moment $\frac{w\,x}{2}(l-x)$ and the two moments $\frac{x}{c}\,X^{11}$ and $\frac{l-x}{c}\,X^{1}$. On page 244 the first moment consists of two expressions, viz., one for the loaded portion and the other for the unloaded portion, and the summation extends accordingly only over the corresponding portions of l. The calculation presents no difficulties, but it is too long to be stated here. The moment m at an intermediate point is derived from the moments X over the adjoining supports, the values of which are now known by putting these values into the expression for m. This can also be done graphically. I may add that the calculation is analogous to that required if the moment of inertia of the cross section of the beam changes by steps.

M. AM ENDE.

3, Westminster-chambers, S.W.,
October 4th.

GAS ENGINES.

SIR,—Referring to an article on the above subject which appeared in your influential journal on the 26th ult., we beg leave to say, in the interest of a number of persons who are trying to make gas engines resembling the "Otto," that we do not share your views about the judgment in the Court of Appeal in the case of Otto *v.* Linford. You seem to think that the Master of the Rolls, in saying that "compression" is old, referred to the particular mode of compression and the cycle of operations for the first time adopted in the Otto engine. That in our opinion is a mistake, and we fancy we know something about it. If persons adopt your view of the matter and make engines with the Otto cycle, though without stratification, we think it is only fair to caution them that for so doing they will have to try conclusions with Mr. Otto in court. We trust to your justice and courtesy to insert this, as your article should not go before the public with no statement from the opposite side.

CROSSLEY BROTHERS, LIMITED.

Openshaw, Manchester,
October 3rd.

THE INNER CIRCLE AND HAMMERSMITH LINES.

SIR,—Permit me to indicate a most inconvenient break in the system of suburban railways. At Hammersmith the absurdity of two stations immediately opposite one another has to be done away with. The construction of a line less than half-a-mile in length would enable all trains from the Inner Circle to be run through Hammersmith, and thus another outer circle railway would be completed.

C. G. ETHELSTON, C.E.

Balham, S.W., October 6th.

ON THE MOST RECENT RESULTS OBTAINED IN GERMANY IN UTILISING THE BYE-PRODUCTS FROM HOFFMANN COKE OVENS.

By Dr. C. OTTO, Dahlhausen, Ruhr.*

IT is long since attempts have been made to construct coke ovens in such a manner as to produce not only coke, but also to utilise the bye-products of coking. The first coke ovens on this system were built in France in 1862, while England and Germany have only begun within the last few years to construct coke ovens with extraction of the bye-products. To my own knowledge, about 150 coke ovens in France and fifty in England are now working on this principle. In Germany there are now working 190 of these ovens, which number will be increased in a short time to 390. I comply with the desire of your President by describing in this paper a system of coke ovens designed for the extraction of the bye-products, of which ninety are working in Germany, while 200 more are about to be constructed. In Austria, again, thirty of these ovens will shortly be set to work. The inventor of the system in question is Herr Gust. Hoffmann, of Gottesberg, in Silesia. Its essential features consist in the combination of coke ovens with the Siemens regenerator, in order to heat the air serving for the combustion of the gas to as high a degree as possible. The temperature necessary to maintain the coking process is obtained in common coke ovens by the combustion of the gases evolved in the interior of the oven, or of its side flues, the hot gases being burnt in the immediate proximity of their place of origin.

The coke oven illustrated by Figs. 1 and 2 on page 274, has no direct communication between the coking space and the side flues. In fact, except the openings for charging, FO, and for discharging the oven, which are closed during the coking process, there are only two openings, GA, in the roof of the oven by which the gases escape. The side wall of the the coke oven contains, under the abutment, a horizontal canal, which passes over the entire set of vertical flues, and which is the means of communication between these side flues. Every bottom flue is divided across its length by a partition wall into two equal lengths, SK_1 and SK_2. Each of these lengths communicates with a regenerator, which serves for heating the air destined for the combustion of the gases. SK_1 communicates with LR_1, and SK_2 with LR_2. These regenerators are long flues filled with firebricks on the Siemens regenerative plan, in order to obtain a great surface. They extend below the whole of the coke ovens, and communicate at one end, by means of a clack valve, either with the pipe conveying air or with the chimney. On two sides gas-pipes are placed along the battery, of which I will speak immediately. Imagine, now, that the ovens are hot, and that the coking process is going on. The gases from the coal escape by the openings GA in the roof of the oven into the rising pipes SR and into the receiver VL. The valve V placed between the rising pipe and the receiver, by which the communication between the oven and the receiver can be interrupted, is now opened. From the receiver VL the gases go to the condensation house, where they are cooled and washed by different apparatus. The gases returning from the condensers, where they have lost their tar and ammonia, are forced back to the ovens through the gas pipe GDR by the same exhauster which had sucked them to the condensers, and by means of which the whole motion of the gases is caused. According to the position of the clack valve in the gas pipe, the gases enter now either into the gas pipe on one side or into the gas pipe on the other side of the oven. The bottom flue of every coke oven communicates with the gas pipes by means of a nozzle pipe furnished with a tap. Assume that the clack valve, inside the gas pipe, is placed in such a manner that the gas goes to the gas pipe GDR_1, then the clack valve W of the air regenerators must be placed so that the air is forced by a fan into the air regenerator LR_1. The air regenerator LR_1, and the nozzle pipes of the gas pipe GDR_1, discharge at every coke oven into the bottom flue SK_1. In this manner gases and hot air enter into the bottom flue SK_1. The combustion of gases takes place first in the bottom flue, and continues in the side flues. The whole current of the burning gases and of the very hot products of combustion rises by the parallel side flues VZ_1 into the horizontal flue HK, and thence falls down through the side flues VZ_2 into the bottom flue SK_2, whence the gases, which may now be considered as completely burnt, pass through the air regenerator LR_2 and then escape through the chimney, delivering their heat to the lattice work of the air regenerator on their way. After a certain time, say about an hour, the position of the clack valves in the gas pipe and in the air flue are changed, so that the direction of the gas and air is reversed. The gases escape out of the gas pipe GDR into the pipe GDR_2, while air enters into the air regenerator LR_2. Combustion takes place in the bottom flue SK_2, and the current of gases, air, and products of combustion passes through VZ_2, HK, VZ_1, SK_1, and the air regenerator LR_1 into the chimney. In this manner the current of gases passes alternately in the two directions through the bottom flue and side flues of the coke oven, whereby a remarkably even temperature is obtained in the oven. The heat of the products of combustion is for the most part absorbed by the regenerator for heating air, which attains a temperature of 1800 deg. F. In one of our German coking works we produce per coke oven per day 24,700 cubic feet of gas, whereof we require for the coking process only 17,700, so that we have a surplus of 7000 cubic feet of gas per oven per day. The bottom flues and side flues are so extremely hot that with a charge of 5 tons 13 cwt. of dry coal the coking process lasts only forty-eight hours, or the same time as in coke ovens without extraction of the bye-products. In general, we have it in our hands to regulate the temperature of these coke ovens by augmenting or reducing the quantities of gas and air, which can be exactly adjusted. The quality of the coke is at least equal to that which we obtain in the ordinary coke ovens. The yield of coke in coke ovens with extraction of the bye-products is always several per cent. higher than in common coke ovens, on account of the air-tightness of the charging and discharging openings, and a slight pressure of gas in the ovens. We have proved the following temperatures:—

	Deg. Fah.
In the bottom flue	2200—2550
In the side flues	2000—2200
In the regenerator, when the current of air was first admitted	1800
One hour afterwards	1330
In the chimney	800— 932

The drawings represent a coke oven with vertical side flues. This construction finds great favour in Germany, because the arrangement of the bricks makes it possible to give very small dimensions between the side flues and the coking space. Ordinarily we make these wall bricks $3\frac{9}{16}$in. thick; by way of trial we have even diminished this thickness to $2\frac{3}{4}$in., and we have found that in the latter case the coking is completed several hours sooner than in the former. The combination of Siemens regenerators with coke ovens is independent of the construction of these ovens, and can be applied to coke ovens on other systems. The coolers, Figs. 3 and 4, are vertical iron cylinders closed at each end, in which are vertical iron tubes fastened to the top and the bottom, and open at each end. Above the cover is placed a cylindrical iron reservoir. The water flows through the tubes, while the current of gas passes outside them in the opposite direction. These coolers have a cooling surface of 5·72 square feet, 1000 cubic feet of gas passing through. To the coolers now in construction we give as much as 7·6 square feet of cooling surface for every 1000 cubic feet gas, having found that a great cooling surface is very advantageous for condensation. Condensers placed behind coke ovens must have a cooling surface proportionally greater than those of gasworks, because the production of gas in coke ovens is less regular than in retorts. We have measured the temperature of the gas after it passes out of the coke oven, and we have found—

	Deg. Fah.
In the rising tubes	1200—1300
In the receiver (according to the distance from the oven)	400— 750
Before the coolers	170— 250
Beyond the coolers	65— 85

Our washers, Figs. 3 and 4, are vertical cylinders of cast or wrought iron, in which a great number of perforated plates are placed horizontally over one another. A continual stream of cold water trickles down upon the uppermost plate and through it to the others, so that from plate to plate a rain of drops is constantly passing in the opposite direction to that of the gas, the latter in its upward passage giving up to the water the ammonia which it contains. The washers retain the whole of the tar and ammonia not yet condensed in the coolers. If we have cold enough water at our disposal, the temperature of the gas will be lowered in the washers to 55 deg. Fah. Our washers offer to the gas a surface of 7·8 square feet to every 1000 cubic feet gas.

Figs. 3 and 4 show a condensing apparatus sufficient for twenty coke ovens. The gas comes out of the ovens through the gas pipes GAR. Then one-half of it passes through the three condensers C_1 and through the three scrubbers SC_1, while the other half goes through the three condensers C_2 and the three scrubbers SC_2. Beyond the scrubbers SC_1 and SC_2 the two halves unite and pass through the exhauster EX, which forces the gases through the gas pipe GDR back to the coke ovens. EXR is a spare exhauster. The air of combustion is forced in by the fans V_1 and V_2, the second of which is kept as a reserve. P_1, P_2, P_3, P_4, and P_5 are small pumps for tar and ammoniacal liquor. M_1 is the driving engine; M_2 is a spare engine. The condensers C_1 let fall tar and ammoniacal liquor into the vessels t_1, and the condensers C_2 into t_2. The products of condensation deposited in the scrubbers SC_1 run into the vessels T_1, and those in SC_2 into T_2. Out of the vessels T_1, t_1, and T_2, t_2, tar and ammoniacal liquor run through the pipes R_1 and R_2 into a tank situated outside the condensation house, out of which tank they are raised, when required, by small pumps into another tank above the gas coolers.

The gain of ammonia, counted in sulphate of ammonia, amounts in Westphalia to 1 per cent. of the weight of dry coal put into the coke oven. This gain corresponds exactly with the contents of ammonia as ascertained by analysis. The quantity of ammonia contained in the coal varies in different districts, and even in the same coal district. In the Saarbrücken district the coal yields only 0·7 to 0·8 per cent. of sulphate of ammonia, whereas this figure rises in Upper Silesia to 1·1 to 1·7 per cent. The yield of tar at one of our coking establishments amounted in seven months to an average of 3 per cent. on the dry coal put into the coke ovens. The tar contains less benzene than that produced in gasworks, but the amount of naphthaline and anthracine which it contains is equal to that contained in gas tar. We have analysed the gas produced during the coking process after its passage through the condensers. It contains a smaller amount of light-giving elements than the gas supplied by gasworks; in other respects its composition is the same:—

	Volume per cent. of the dry gas.
Benzine vapour	0·61
Athylene	1·63
Sulphuretted hydrogen	0·43
Carbonic acid	1·41
Carbonic oxide	6·49
Hydrogen	53·32
Methylene	36·11
	100·00

I have already said that the gas which returns from the condensers is not all used in the coking process. The surplus can be converted into money. By the use of very large burners it can be applied to purposes of illumination in factories, iron or coal works, or for heating boilers, &c. For heating purposes it has the great advantage that it can be conducted to very great distances without suffering in quality. We have ascertained that by the daily combustion of 2 tons 14 cwt. of coal per oven we can depend upon obtaining sufficient waste heat from every oven to heat 54 square feet of boiler surface. A heating surface of 54 square feet per coke oven corresponds with an evaporation of 1 lb. of water for every pound of coal coked. I cannot say whether or not these figures are surpassed by English coals. They refer to trials made with Westphalian coal, and can therefore be compared only with results obtained with those coals. In Westphalia, with an ordinary coke oven without extraction of the bye-products, containing 5 tons 18 cwt. of coal, we heat 80 square feet of boiler surface, or we evaporate 1½ lb. of water by every pound of coal coked. We see, then, that the gas produced by coke ovens loses less heating power in its passage through the condensers than we might have supposed, and that we can not only extract the bye-products, but also heat boilers with the gas which has undergone this process, together with the highly heated products of combustion which have passed through the air regenerator.

* Iron and Steel Institute.

THE launching of the third caisson in connection with the building of the Forth Bridge cantilever piers took place on Monday afternoon from the south shore. This caisson is larger than either of its two predecessors.

OVERWORK IN GERMAN SCHOOLS.—After forty-two years' experience it is now virtually conceded in Germany that physical exercise is not a sufficient antidote to brain pressure, but that where the evil exists, the remedy must be sought in the removal of the cause. Official action with reference to over-pressure has been taken in Prussia, Saxony, Würtemberg, Baden, Hesse, and Alsace-Lorraine. The commission appointed by the Stadtholder of Alsace-Lorraine recommended that the number of study hours should be restricted to twenty-six a week for the lowest classes of the gymnasia, and to twenty-eight and thirty-two for the higher; that the hours of home study should be eight, twelve, and eighteen a week, progressing from the lowest class to the highest; and that six hours a week should be devoted to general physical exercise, including swimming, open air sports, skating, and excursions. While the existing conditions will be somewhat ameliorated by these decrees, they do not seem to have brought about a final solution of the difficulty. Last year a petition upon the subject, signed by eminent teachers, physicians, and other citizens, was addressed to the Prussian Chamber of Deputies. After setting forth the deplorable effects of the excessive strain upon the nervous system of scholars, it appeals to the patriotism of the deputies to put an end to the abuse, which, the petition aserts, "threatens little by little to reduce the cultivated classes of society to a state of moral weakness that shall render them incapable of great and manly resolution."

HOFFMANN'S REGENERATOR COKE OVENS.

(*For description see page 273.*)

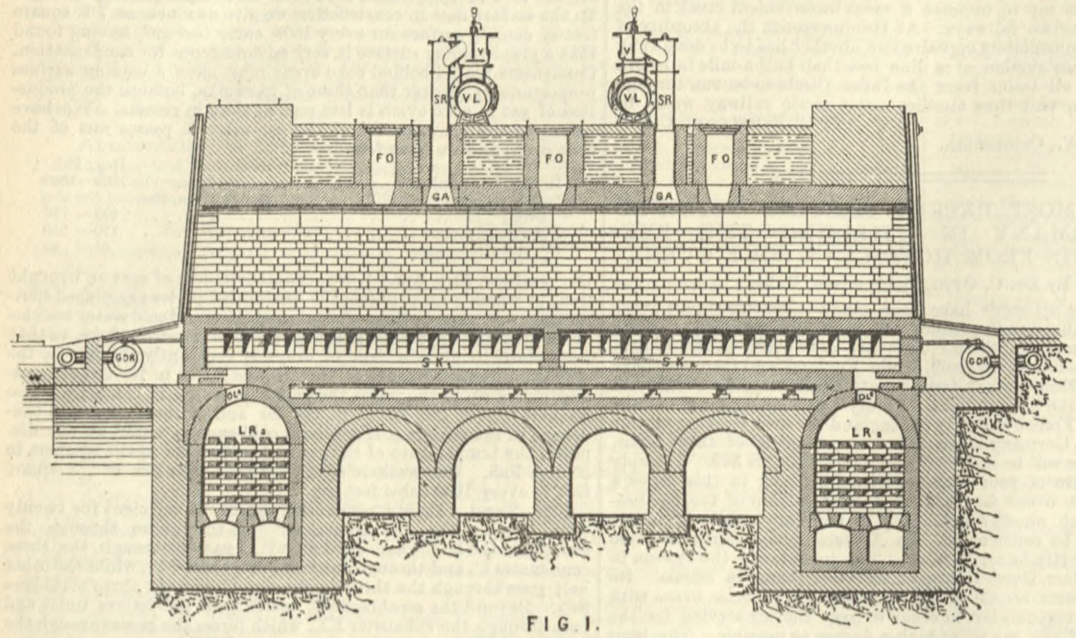


FIG. 1.

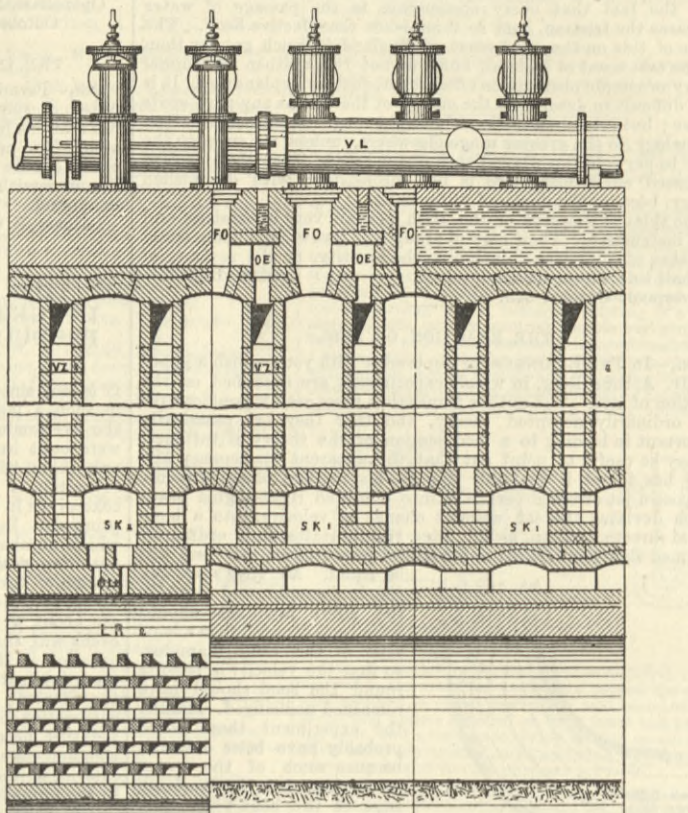


FIG. 2

FIG. 3.

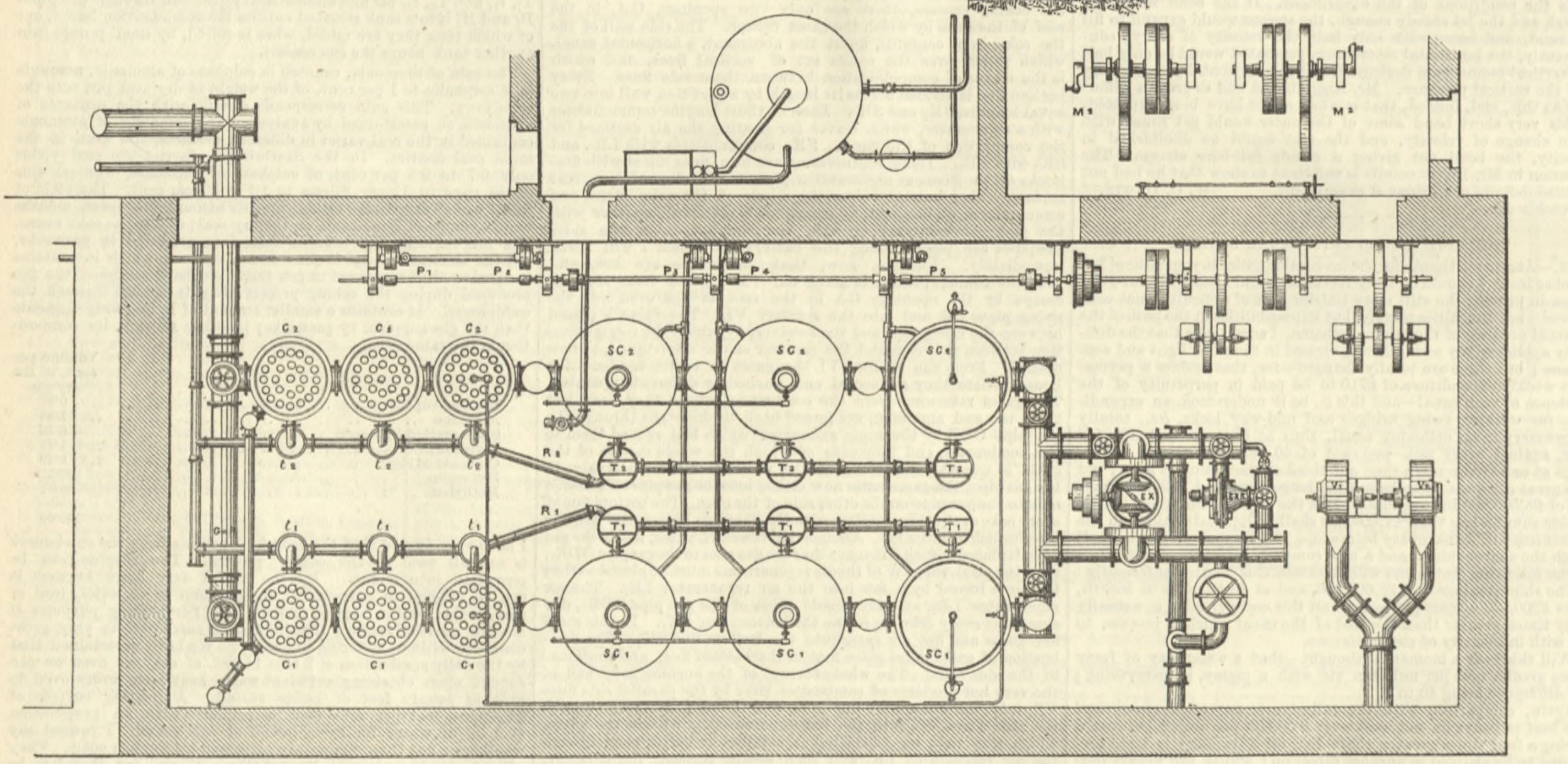
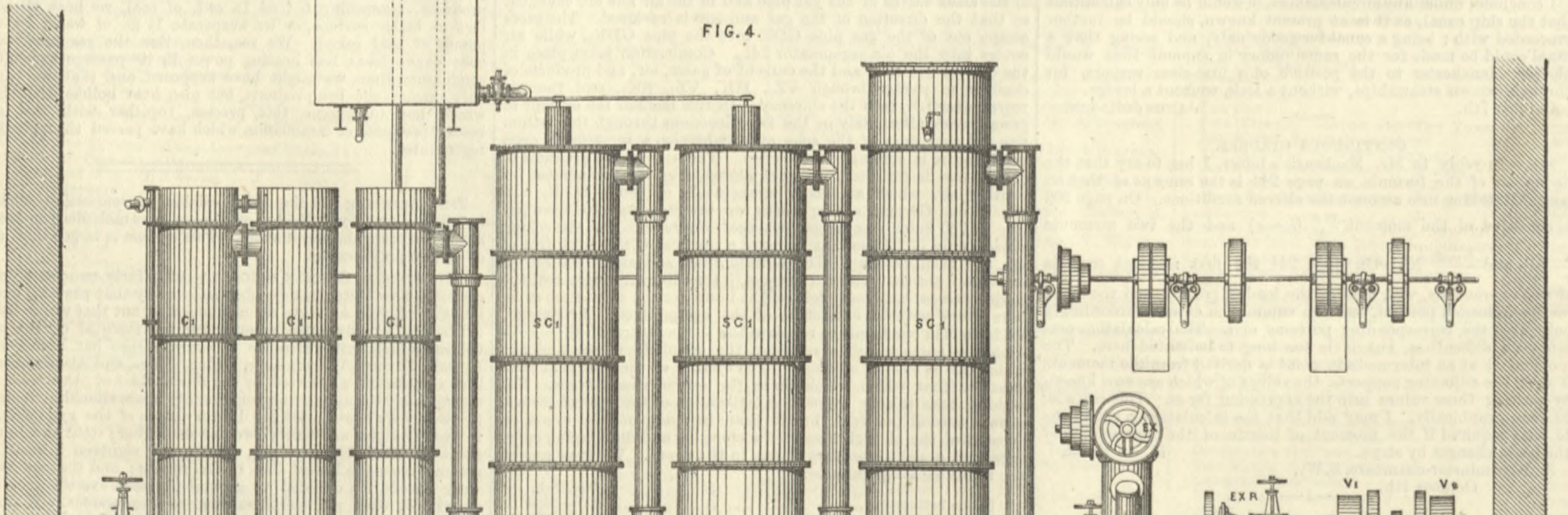


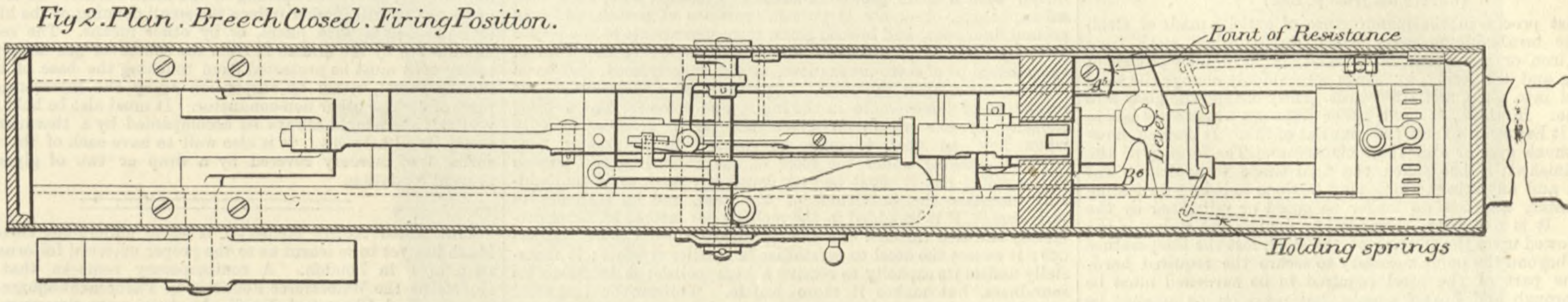
FIG. 4.



THE MAXIM AUTOMATIC MACHINE GUN.

(For description see page 281.)

Fig 2. Plan. Breech Closed. Firing Position.



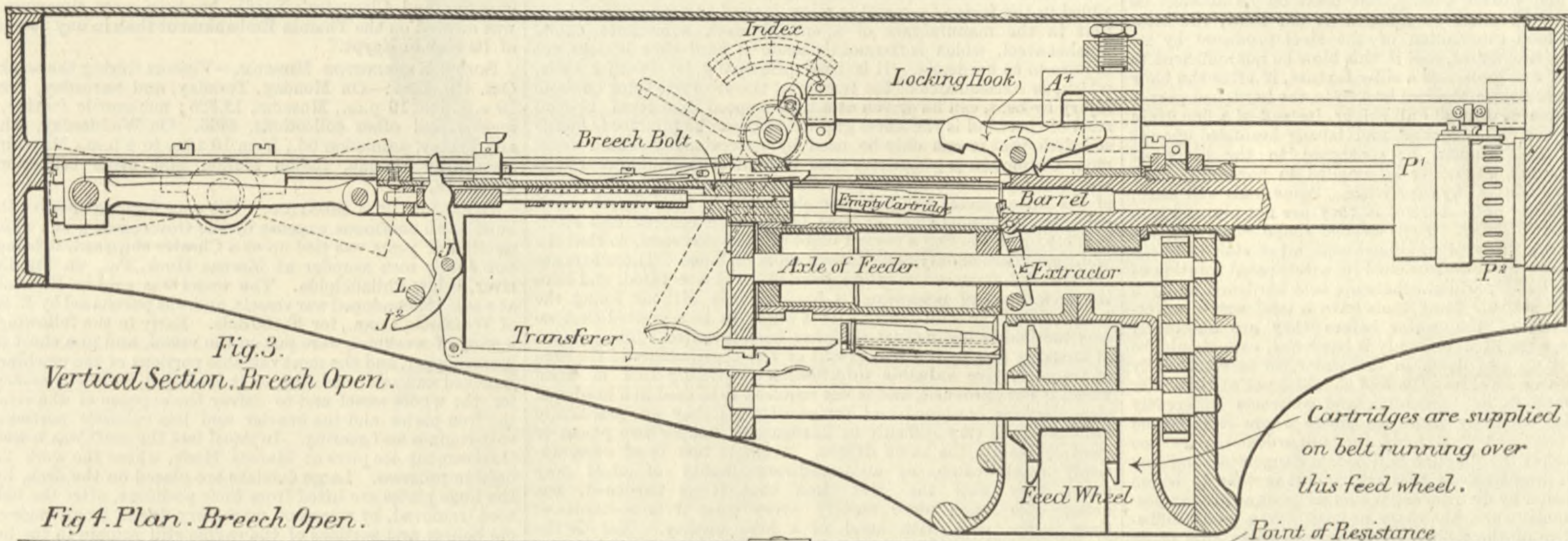
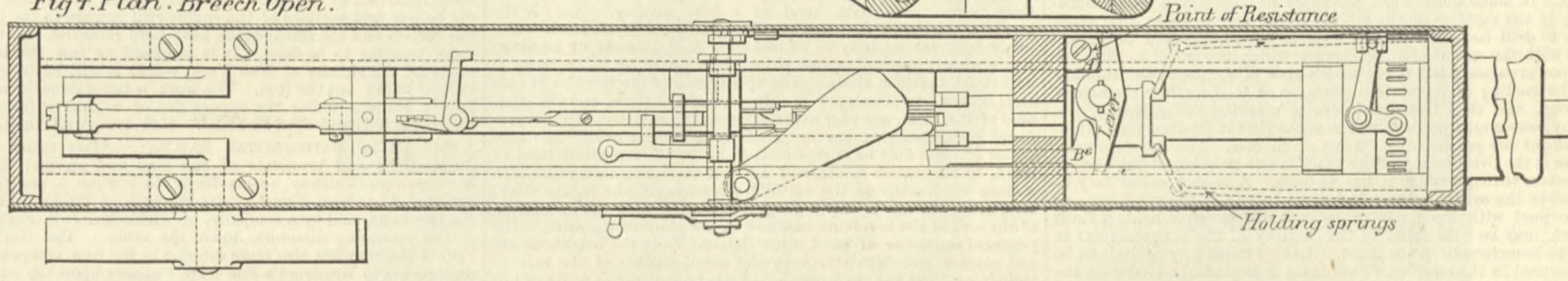
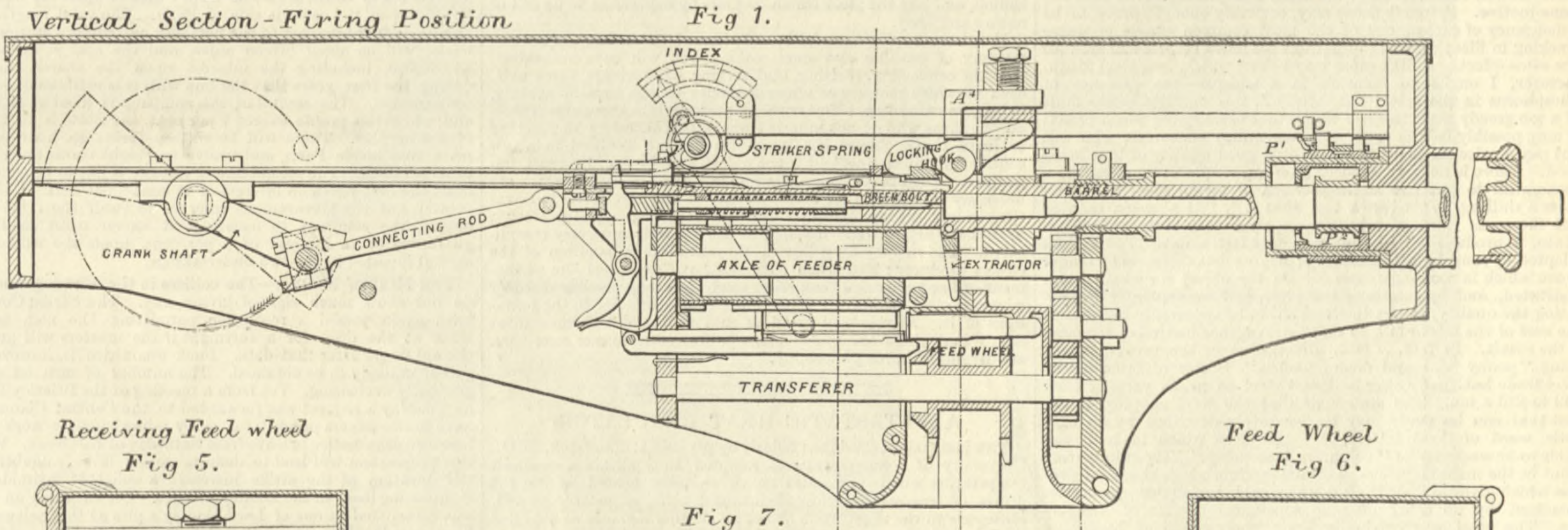


Fig.3.
Vertical Section. Breech Open.

Fig 4. Plan. Breech Open.



Vertical Section - Firing Position Fig 1



Receiving Feed wheel
Fig 5.

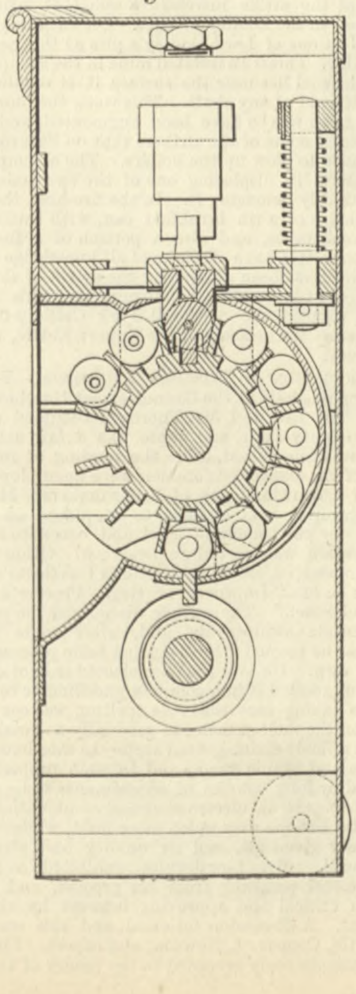
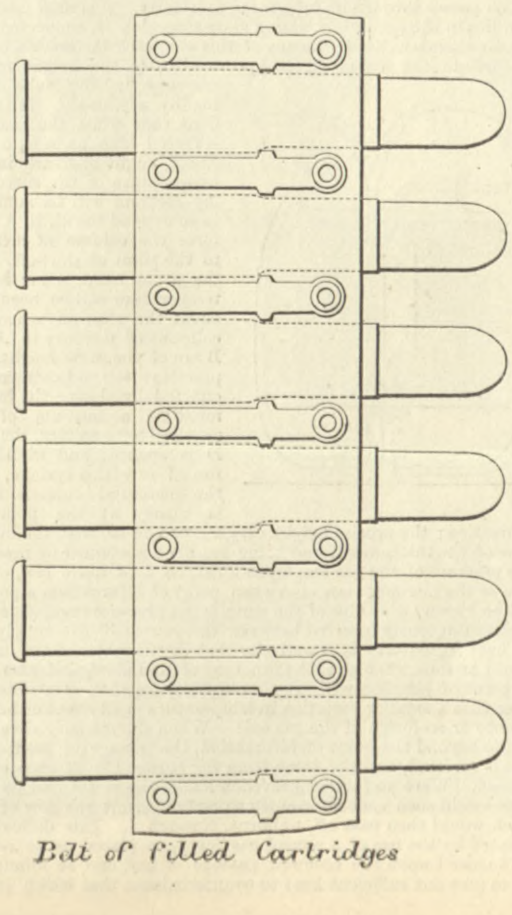
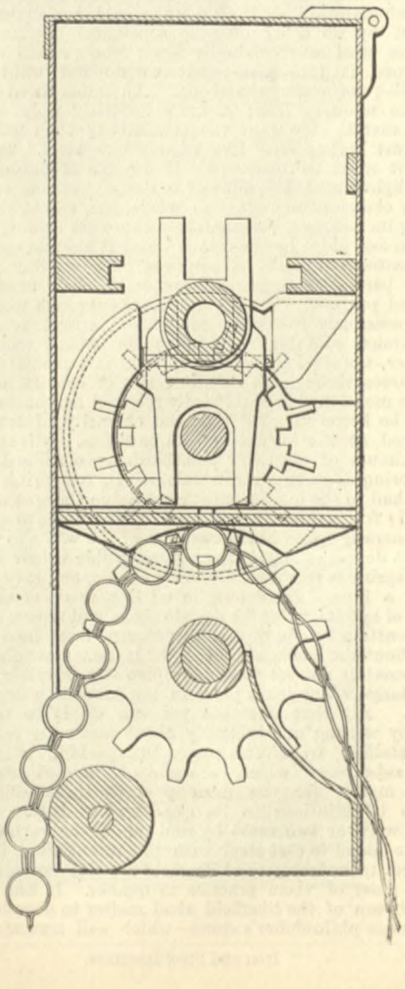


Fig 7.



Belt of Filled Cartridges

Feed Wheel
Fig 6.



ON THE MANUFACTURE OF CRUCIBLE CAST STEEL.*

By Mr. Henry Seebohm.

(*Concluded from p. 256.*)

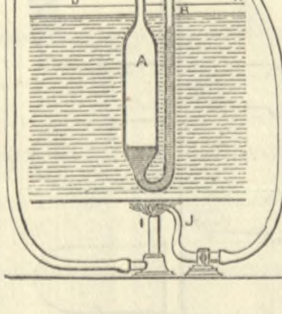
The last process in the manufacture of articles made of steel, where the invaluable property which distinguishes steel from wrought iron or cast metal is revealed, is the double process of hardening and tempering, by which we suddenly change the steel from lead into glass, and afterwards gently change the glass into whalebone. In these, as in all other processes which steel has to undergo, it has again to run the gauntlet of fire. It does so, however, at much greater risk than heretofore. The forging of the tool is finished; it has taken the final shape to which it was destined; and any injury which may be done to it by overheating is irrevocable, and can no longer be cured or mitigated by the hammer. It is necessary, therefore, to double and redouble the care bestowed upon the heating of the steel, lest the temperature be raised beyond the point necessary to secure the required hardness. The part of the steel required to be hardened must be heated through and heated evenly, but must on no account be overheated. The tool must be finished at one blow, the blow caused by the sudden contraction of the steel produced by its sudden cooling in the water, and if this blow be not sufficient to give to the steel a fine grain and a silky texture, if after the blow is given the fracture—were the tool broken in the hardened part—would show a coarse grain and dull colour, instead of a fine grain and glossy lustre, the tool is spoiled, and labour bestowed upon it is thrown away, and it must be consigned to the limbo of wasters. The special dangers to be avoided in hardening each kind of tool must be learnt by experience. Some tools will warp, or "skeller," as we say in Yorkshire, if they are not plunged into the water in a certain way. Tools of one shape must cut the water like a knife; those of another shape must stab it like a dagger. Some tools must be hardened in a saturated solution of salt, the older the better; whilst others are best hardened under a stream of running water. Most tools have a tendency to water-crack if taken out of the water before they are absolutely cold. When the edge of a tool only is hardened, care should be taken to move it up and down in the water, so as continually to change the water level lest the tool should crack at the water level. Steel contracts in hardening, and contracts differently where it is cooled suddenly from the places where it is cooled slowly. If the hardened part joins the unhardened part too suddenly, the steel at the junction will be in a dangerous condition of tension, which predisposes it to crack, and it is wise to lessen the amount of tension by distributing it over as great an area as possible. In some tools, where the shape necessitates a great difference in the rapidity of the cooling of the various parts, it is often wise to drill holes in the thicker parts, where they will not interfere with the use of the tool—holes which are made neither for use nor ornament, but solely with a view of equalising the rapidity of the cooling of the various parts, so as to distribute the area of tension, and thus lessen the risk of cracking in hardening. So many causes may produce water-cracks that it is often difficult to point out the precise cause in any given case. The most common cause is the overheating of the steel in one or other of the various processes through which it has to pass. A second cause may be found in the over-melting or too long boiling of the steel, causing it to part with too much of its occluded carbonic acid, a fault which may be attributed to the anxiety of the manufacturer to escape honeycombs in the ingot. A third cause may sometimes be discovered in the addition of too much manganese, added with the same motive. A fourth cause may, curiously enough, prove to be a deficiency of carbon, one of the most common causes of water cracking in files; whilst in some cases too much carbon will produce the same effect. A fifth cause may be one which, as a steel manufacturer, I ought to mention in a whisper—the presence of phosphorus in the steel; but, after all, this may not be the fault of a too greedy manufacturer who wants to make too much profit; it may possibly be the fault of a too stingy consumer, who will not pay a price sufficient to admit of a good quality of iron being used. There is nothing so dear as cheap steel. It must be more economical to put five shillings worth of labour upon steel that costs a shilling, to produce a tool that will last a week, than to put the same value of labour upon steel that costs only ninepence, to produce a tool that will only last a day. The system adopted by some large consumers of buying best tool steel by tender is one which in too many cases defeats the object for which it was instituted, and by lessening the price, and consequently deteriorating the quality, causes the steel bill to be apparently lessened at the cost of the labour bill, so that extravagance instead of economy is the result. In fact, it is an illustration of the proverb about being "penny wise and pound foolish." Scores of firms in the steel trade habitually offer best cast steel at prices varying from £40 to £45 a ton. The statement that the steel supplied is the best that can be made may be accurately described by an ugly little word of three letters, and the firms which make it are liable to be suspected of "voluntary inaccuracy." The culminating point in the manufacture of tools made from steel, the final process which gives to them their most valuable properties—properties possessed by no other metallic substance—is that of tempering. The steel was originally lead; the process of hardening has turned it into glass; but we do not want glass—it is too brittle; we want whalebone. An unhardened knife would bend like wrought iron; a knife hardened only would break like cast metal. We want the elasticity of the whalebone. Our knife must spring like—like what?—like steel. To attain this quality it must be tempered. If a piece of hardened steel be heated slightly and then allowed to cool, it becomes tempered. It suddenly changes from glass to whalebone, and in the process of changing its nature it fortunately changes its colour, so that the workman can judge by the colour which it has assumed the extent of the elasticity which it has acquired, and can then give to each tool the particular degree of temper which is most adapted to its special purpose. The various colours through which tempered steel successively passes are as follows: straw, gold, chocolate, purple, violet, and blue. Of course in passing from one colour to another, the steel passes through the intermediate colours. It really passes through an infinite series of colours, of which the six above mentioned are arbitrarily selected as convenient stages. It must be borne in mind that the elasticity of tempered steel is acquired at the expense of its hardness. It is supposed that the maximum of elasticity and hardness combined is obtained by tempering down to a straw colour. In tempering steel regard must be had to the quality most essential in the special tool to be tempered; for example, a turning tool is required to be very hard, and is generally taken hot enough out of the water to temper itself down to a degree so slight that no perceptible colour is apparent; whilst a spring is required to be very elastic, and may be tempered down to a blue. Hardening in oil is a mode of treating steel which is of special value for certain tools, and appears to a certain extent to attain by one process the change from lead into whalebone without the passage through the intermediate glass stage. It is unfortunately not yet possible to give any scientific explanation of the change which takes place in the hardening and tempering of steel. All that chemists yet can do is to mystify their readers by writing unintelligibly about molecular rearrangement and crystalline transformation. In speaking of the various foreign substances which are found in cast steel, I have confined myself for the most part to those which are supposed to be injurious to its quality; but before I close my paper, a word or two must be said upon the various materials which are added to cast steel with the intention of improving it. If the steel manufacturers of Sheffield are not doctors of chemistry, they most of them practice as quacks. It has ever been a darling dream of the Sheffield steel melter to discover some substance—some philosopher's stone—which will transmute common cast steel into best cast steel. The various substances used in the melting of cast steel, and supposed to have a chemical effect upon the material melted, are known by the technical name of "physic." The most universally used of these is peroxide of manganese, mixed with a little ground charcoal. Common salt, rock salt, sal-ammoniac, chromate of potash, prussiate of potash, and even ground fluor spar, and broken glass, form ingredients of the physic used by some steel melters. Manganese, either in the form of spiegeleisen or of ferro-manganese, is also largely used, and has a definite effect upon the steel. It prevents to a large extent the formation of honeycombs in the ingot, and increases the welding capacity of the steel; it gives the steel greater tenacity when hot, so that it may be heated to a greater heat without cracking under the blow of the hammer or the tension of the rolls; but it must be very cautiously used, as it undoubtedly increases the brittleness of the steel, and its tendency to water-crack, if it be added in the melting pot instead of being previously suffused through the iron. Silicon is even more dangerous; it causes the steel to crystallise in smaller crystals; it materially assists its capacity to receive a high polish; it increases its soundness, but makes it more brittle. Wolfram or tungsten, added in the form of a metallic alloy, is used to a considerable extent in the manufacture of a special steel, sometimes called Mushet steel, which is frequently made so hard that it does not require to be hardened. It is used principally for turning tools, which, in consequence of the temper of the steel not being liable to injury by heat, can be driven at a higher speed than usual. Special steel of this kind is the finest grained that can be produced, but is so brittle that it can only be used by exceptionally skilled workmen. Chromium is sometimes used instead of wolfram; and it is said that titanium is also employed, but I am not aware that any of the latter metal has yet been detected in steel by chemical analysis. A special steel for taps, called mild centred cast steel, is made by converting a cogged ingot of mild cast steel, so that the additional carbon only penetrates a short distance. These bars are afterwards hammered or rolled down to the size required, and have the advantage of possessing a hard surface without losing the toughness of the mild centre. It is much to be regretted that no easy method of testing cast steel has been invented. The amount of breaking strain, and the extent of the contractions of the area of fracture, give valuable information respecting iron or steel which is not hardened, and is not required to be used in a hardened state, but for hardened and tempered steel they are practically useless. It is very difficult to harden and temper two pieces of steel to exactly the same degree. A single test is of comparatively small value, as a second-rate quality of steel may stand very well the first time that it is hardened, but deteriorates much more rapidly every time it is re-hardened than is the case with steel of a high quality. Nor is the breaking strain a fair test of the quality of cast steel. For many tools the capacity to withstand a high amount of breaking strain, slowly applied, is not so much required as its capacity to withstand a sudden shock. The appearance of the fracture of cast steel is also very illusory. The fineness of the grain, and the silkiness of the gloss, are very captivating to the eye, but can be produced by hammering the bar until it is almost cold. The consumer of steel may be enraptured, if he be of a poetical turn of mind, by the superb fracture of a bar of steel, reminding him of a picture by Ruskin of the aiguille structure of the higher Alps. But, after all, this is only a dodge, depending upon the inclination of the axis of the revolving hammer to the plane of the anvil. The practical consumer of steel must descend from the heights of art and science, and take refuge in the commonplace of the rule of thumb, and buy the steel which he finds by experience to be full of nature and body.

If I have been successful in my attempt to explain the art and mystery of crucible cast steel making, you will have understood that the converting, melting, and forging of steel are three arts, each of which requires as much dexterity as the arts of skating, riding, or swimming. To arrive at perfection in these arts is difficult to those who do not inherit from skilled ancestors the facility to learn them; hence the trade has become localised in a few centres, of which Sheffield is the oldest and by far the most important. The arts of forging, hardening, and tempering, which are necessary for the further manipulation of the steel after it leaves the hands of the manufacturer in Sheffield, require equal dexterity, so that the art of steel making, if not mysterious, is very complicated. The real mystery lies in the chemical explanation of the effects produced; and when chemists have explained the phenomena of hardening and tempering steel, they may possibly discover why cast steel made from Dannemora iron is superior to the imitations of it. At present I presume that the candid chemist must admit that there are more things in best crucible cast steel than are dreamt of in his philosophy.

* Iron and Steel Institute.

A METASTATIC HEAT REGULATOR.

The instrument described below, by Mr. N. A. Randolph, M.D., University of Pennsylvania, is adapted to maintain a constant temperature within any water or air chamber heated by gas, the degree of temperature thus maintained being adjustable at will. Reference to the illustration shows an air thermometer so modified that the rise of mercury in the limb B will cut off the gas supply which passes through its bifurcated extremity. A second modification lies in the accurately fitting glass stop-cock D, connected with the air chamber A. By means of this stop-cock the tension of the air within the chamber, and consequently the height of the mercury in the tube B, is readily adjustable. It is evident that when the mercury is forced high up in B, a relatively slight increase in the temperature of the surrounding medium will be sufficient to so expand the air in A as to force the column of mercury to the point of shut-off. On the other hand, a far higher temperature will be needed to effect the shut-off when the columns of mercury in A and B are of the same height. In practice the adjustment is effected by placing the instrument in a medium of the required temperature, the cock D is opened, and air slowly forced in with a syringe, until the mercurial column in B is nearly at the point of bifurcation; the precise height varying, of course, with the dimensions of the instrument, and being readily ascertained by practice. The pressure of the gas employed must be kept quite low, otherwise as the mercury rises above the point of bifurcation, a portion will be blown out. One of the simpler gas pressure regulators may be advantageously inserted between the source of gas supply and the heat regulator. It is well also that the diameter of the limb C should be somewhat greater than that of its fellow, and also that its point of junction with B should be somewhat constricted, in order that a smaller variation in temperature shall effect either the patency or occlusion of the gas exit. When the mercury rises in B a trifle beyond the point of bifurcation, the passage of gas from G to E is arrested, and the flame from the burner I is at once extinguished. Were no further provision made, the vessel and its contents would soon cool sufficiently to again permit the flow of gas, which would then pass off, unburnt, through I. This difficulty is obviated by the use of a second gas jet J, so placed as to relight the burner I upon the renewed passage of gas, and so minute as not to give out sufficient heat to counterbalance that which is lost from the vessel by radiation, &c., during the temporary stoppage in the main jet. This secondary jet may be readily made from a common brass blow-pipe, bent in the form shown in J, and steadily supported in such manner that its little flame may constantly play immediately above the opening of the main burner. It is usually necessary to still further reduce the small opening of the blow-pipe by squeezing it with pliers, or by other means. The secondary flame is fed by the branch H from the source of gas supply. The instrument must be protected from touching the base of the containing vessel, either by suspension or by the intervention of a plate of cork or other non-conductor. It must also be held steadily vertical, and should always be accompanied by a thermometer to verify its adjustment. It is also well to have each of the exposed surfaces of mercury covered by a drop or two of glycerine to prevent oxidation.



The gilded Albert Memorial is again undergoing restoration. Much has yet to be learnt as to the proper material for ornamental structures in London. A contemporary remarks that "such objects as the Wilberforce Fountain in Parliament-square become eyesores, and Cleopatra's Needle has been more timeworn since it was erected on the Thames Embankment than in any two centuries of its stay in Egypt."

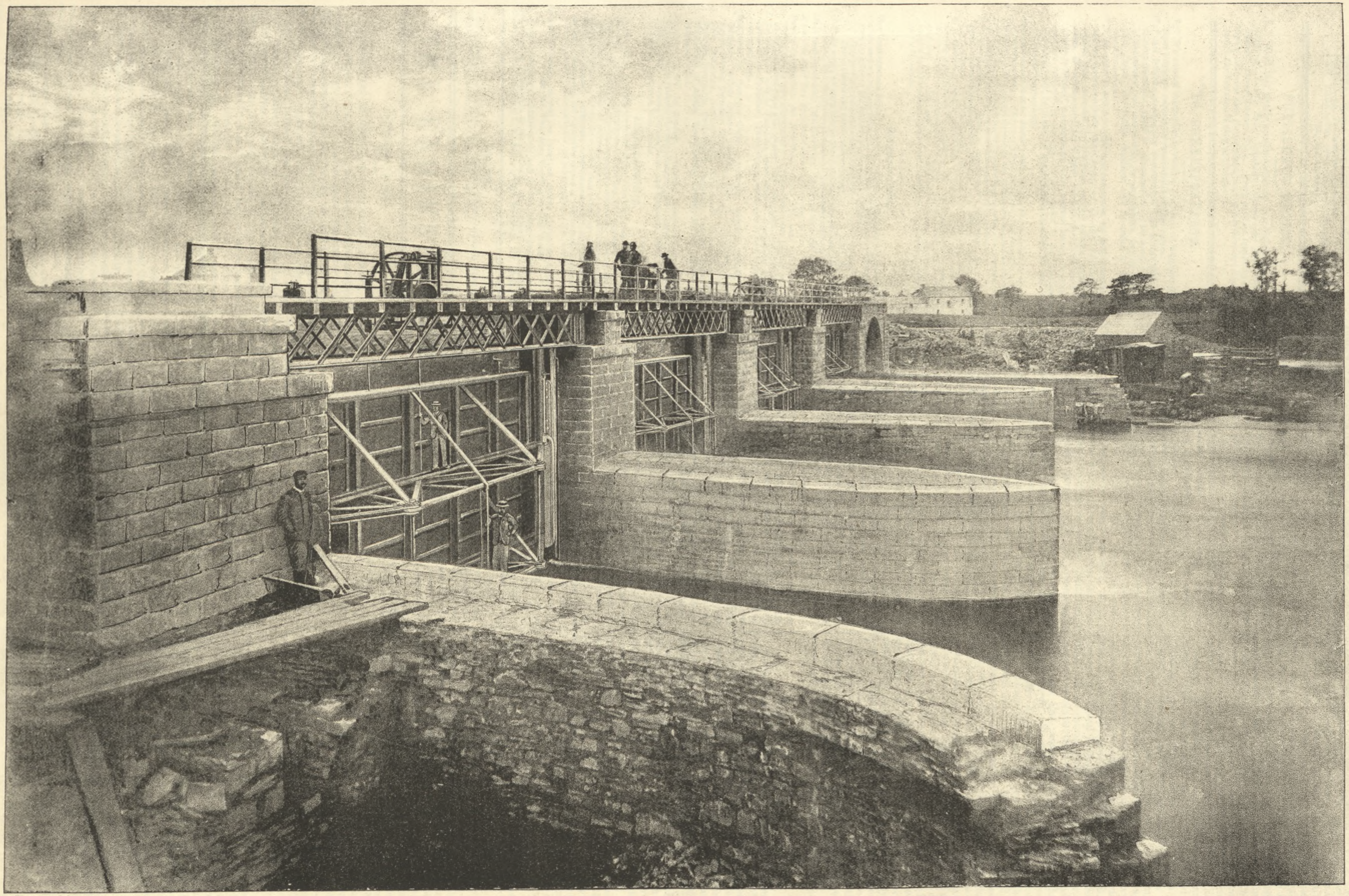
South Kensington Museum.—Visitors during the week ending Oct. 4th, 1884:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 12,325; mercantile marine, Indian section, and other collections, 4866. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 1508; mercantile marine, Indian section, and other collections, 249. Total, 18,948.

Breaking up a Monitor.—The once famous monitor Roanoke, built at an enormous expense by the Government, but which for a number of years was tied up at a Chester shipyard, is being slowly but surely torn asunder at Marcus Hook, Pa., on the Delaware river, below Philadelphia. The vessel was sold in November last at a sale of abandoned war vessels, and was purchased by E. Stanard, of Westbrok, Conn., for 40,000 dols. Early in the following month a gang of workmen were put on the vessel, and in a short time the brass, copper, and the most valuable portions of the machinery were removed and sold, realising, as it is alleged, sufficient money to pay for the whole vessel and to defray the expense of the removal of the iron plates and the heavier and less valuable portions of the vast engines and gearing. In April last the craft was towed to the Government ice piers at Marcus Hook, where the work has since been in progress. Large derricks are placed on the deck, by which the huge plates are lifted from their positions, after the bolts have been removed, by means of machinery driven by an engine. The old boilers and portions of the engine still remain in the hold, but the turrets and the smoke-stack have been removed, and but little more remains to be done. It is proposed to tow the hulk to a point in the vicinity of New York, where it will be beached and burned to get out the iron. The work is being done by a force of twelve Italians, under the supervision of a Yankee foreman, the men being fed and lodged on board.—*U.S. Army and Navy Journal.*

The Paris Metropolitan Railway.—After many years of negotiations and proposals of one kind and another, the Paris Metropolitan Railway seems likely to become a reality, as an agreement has been signed by the Minister of Public Works upon the one hand, and by a company, of which Mr. J. S. Forbes is one of the managing directors, upon the other. The Northern of France Railway has also some interest in the new company, which undertakes to construct a line from Puteaux upon the western, to Reuilly upon the eastern side of Paris. The total length of this line, including branches to the northern and eastern stations inside Paris, will be about fifteen miles, and the cost is estimated at £4,640,000, including the interest upon the shares and bonds during the four years that the line will, it is estimated, occupy in construction. The capital of the company is fixed at £2,000,000, and when the profits exceed 7 per cent. the State is to take half of the surplus. There will be sixteen trains an hour upon the main line inside Paris, and twelve and eight trains upon the two other sections. The second line of railway is not to be constructed until the first yields an interest of at least 6 per cent. on the share capital, but the Government reserves to itself the right of compelling the company to construct it sooner upon condition of guarantee of an interest of 4 per cent. upon the whole of the capital invested in the two undertakings.

The Miners' Strike.—The colliers in the Birmingham district do not show much sign of giving way. The Strike Committee have again passed a resolution permitting the men to go to work at the drop for a fortnight if the masters will guarantee the old wage after that date. Such guarantee is, however, altogether unlikely to be obtained. The number of men on strike is gradually decreasing. Yet from a meeting of the Brierley Hill men on Tuesday a request was forwarded to the Central Committee to have notice papers printed for every miner now at work to give fourteen days' notice to leave from Saturday of this week. Whether this proposition will lead to definite action is very doubtful. As the duration of the strike increases a spirit of intimidation is manifesting itself in the Dudley district. On Saturday an outrage was committed at one of Lord Dudley's pits at the Saltwells Colliery, near Dudley. This is an isolated mine in the group of the Saltwells, and as the coal lies near the surface it is obtained by open work without the aid of any shaft. This week the number of men at work at the mine was to have been augmented, and this seems to have so incensed some of the strikers that on Saturday night an attempt was made to blow up the boilers. The attempt, however, was only successful in displacing one of the two boilers from its setting, and seriously damaging it. In the fire-hole there was discovered the remains of a tin breakfast can, with traces upon it of some explosive substance, and also a portion of a fuse attached. The Strike Committee have disclaimed all knowledge of the outrage, and a reward has been offered for the arrest of the offenders. The coalmasters, at a meeting in Birmingham this week, have determined to support the Sandwell Park Colliery Company in their appeal against the decision of Sir Rupert Kettle, to which we referred last week.

London Association of Foremen Engineers.—The ordinary monthly meeting was held at the Cannon-street Hotel on Saturday, the 4th inst. Mr. Rea and Mr. Thorburn occupied respectively the chair and deputy-chair, and there was a fair attendance of members. It was announced, after the reading of minutes, &c., that only two of the associated foremen were unemployed, namely, one of pattern makers and one of boiler makers. Mr. Meredith Jones, late treasurer, next claimed to be placed on the superannuated fund for the benefit of aged and necessitous members, and the application was agreed to *nem. con.* Other matters of business were transacted, and then Mr. John Lewthwaite proceeded to read a paper on his "Improved or Regia Process of Manufacturing Iron and Steel." The author disclaimed the possession of any great scientific attainments, and, after some disparaging remarks on what he termed "the so-called basic process," went on to describe his own. He said that he selected iron of one, two, or more brands, and melted it in a common puddling or reverberatory furnace, always taking care that the melting was complete. He then threw upon the molten mass, as gradually as possible, certain mineral ores in a finely disintegrated state—as was done in the case of the New Zealand titanic sand—and in such proportions as he had determined by long courses of experiments to be most efficacious. The effect was an electro-chemical combination, by which the molten metal became very much more fluid, whilst its impurities were rapidly given off, and its quality and strength were greatly enhanced. Mr. Lewthwaite exhibited a number of specimens of metal resulting from his process, and these were examined with critical and approving interest by the practical audience present. A discussion followed, and this was shared in by Messrs. Bartle, Comrie, J. Newton, and others. Finally a vote of thanks was unanimously accorded to the reader of the paper.



"INK-PHOTO" SPRAGUE & Co. LONDON.

LOUGH ERNE DRAINAGE, SLUICES ON FREE ROLLERS AT BELLEEK, DOWN STREAM VIEW.

Mr. F. G. M. STONEY, M.I.C.E., WESTMINSTER, ENGINEER.

PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement, an Ink-photo of Lough Erne Drainage, Sluices on Free Rollers at Belleek, Down Stream View. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

TO CORRESPONDENTS.

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

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

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

STUDENT.—*At present we cannot advise you to take up electricity as a means of earning money. There are far too many electrical engineers now.*

MECHANIC.—*You cannot substitute the words you suggest in the way you propose, but you can leave out any words you please, and you can in your drawings and description show what you want to patent.*

C. D. Z.—(1) *Go to the School of Mines, South Kensington, for a couple of years, and afterwards become articled to a mining engineer.* (2) *Yes.* (3) *Five years.* (4) *Very difficult; practically impossible in this country.*

E. P. (Barnes).—(1) *The piston-rods of tandem engines are made tight by stuffing-boxes between the cylinders. In a small engine it is possible that the arrangement you propose will suffice.* (2) *You may make a galvanised roof with any slope you like; a flat roof will do.* (3) *The restrictions imposed by the law are so great that private steam carriages cannot be used on the highways.*

DEATH.

On Thursday, the 2nd Oct., at Carshalton, Surrey, suddenly, from heart disease, FRANCIS GILES, M.I.C.E., in his 79th year.

THE ENGINEER.

OCTOBER 10, 1884.

SHIPBUILDING BY CONTRACT FOR THE ROYAL NAVY.

IN discussions concerning the naval forces of England, prominence is always given to the fact that we possess unrivalled shipbuilding resources in the private yards of the country. The fact is undoubted, but it scarcely applies in the sense which is generally supposed. It is true that our shipyards can produce more rapidly than the shipyards of all other countries put together, ships of all classes, whether for war or for commerce. But modern wars are so hurried in their progress, that our great powers of ship construction would be practically of no avail if they were only called into operation immediately before or after the commencement of a struggle. Modern war ships require comparatively long periods for construction and equipment, even when the utmost is done. Hereafter some reference will be made to the periods actually necessary for the work on ships of different classes, but the general statement holds good. If, therefore, prevision is not exercised, and the private yards of the country made available during time of peace, as auxiliaries for Royal Dockyards, the possession of these magnificent establishments is practically of no avail to us in the national defence. It will be remembered that at the time of the Crimean War, when it was desired to strengthen the Navy by large numbers of gunboats, a call was made upon the private yards to undertake the work, with the result that there was enormous waste in hurried construction, bad workmanship, and unsuitable materials; and finally, we found ourselves, after the need for these vessels had passed away, saddled with a large number of them, whose condition was most unsatisfactory, and whose life was extraordinarily brief. Unless something like a definite policy is adopted, therefore, it may be anticipated that similarly unsatisfactory results, and possibly on a larger scale, would follow the attempt in time of war to bring the private shipyards of the country into full employment for warlike purposes. We are aware that quite recently a departmental committee, presided over by Lord Ravensworth, has been considering the question of contract shipbuilding for the Navy, and we have not the least desire to discuss a matter which might fairly be considered as still "before the Courts;" but there seems to be grave reasons for doubting whether the report of this Committee will ever be given to the public, and the urgency of the matter at the present time is sufficient excuse for drawing attention thereto.

We find ourselves in face of a generally acknowledged need for large and rapid extensions to the Navy, more particularly in the cruiser classes. The Royal Dockyards have on the stocks a considerable number of armoured ships, as well as protected cruisers, sloops, and smaller vessels. To press on with these vessels as they should be pressed, the resources of the dockyards will be taxed to the utmost, consequently the private shipyards of the country must be utilised if ships, yet to be laid down, are to be completed at the earliest possible date. For the reasons above stated, rapid progress is very desirable, in fact, essential, when once the policy of construction has been settled. This is true, whether we are to build more armourclads or to content ourselves for the present with advancing with the utmost speed the armourclads already on the stocks. The private shipyards of the country are probably better adapted for building cruisers than armourclads, if we leave out of account the few establishments which have been specially equipped for war ship work. But on the other hand, if more armourclads are to be built, they can be satisfactorily constructed in private shipyards—as satisfactorily, indeed, as in the Royal Dockyards, and probably in less time. Whenever a vessel of war is built there are certain conditions essential to rapid progress with work. The first of these is the complete study of the design, and the settlement of all its main features before the work of building is put in hand. This may seem very much like a truism, but in these times of rapid transition and improvement it is also a most important matter of practice. Everyone who knows anything about the Royal Navy knows that ships are ordered to be built, and actually appear in the Naval List as "ships building;" while, at the same time, their armament is yet unsettled. Now obviously both the nature and disposition of the armament affects so many parts of the structure, and the distribution of so large a part of the internal space, that to leave it open is to defer indefinitely the time of final completion. It is preferable to make this general statement rather than to particularise individual cases, but it would be easy to multiply illustrations of the statement, and to enforce its improvement by an appeal to the very long periods over which the construction of certain ships has extended. There have been cases, too, where the defensive features, as well as the offensive features, have been suspended for a long time on ships already far advanced; and, further, there have been cases where alterations in the equipment and outfit have practically kept vessels out of the list of those ready for service until long after they might have appeared there. It may be admitted that there are many temptations to endeavour to embody in any ship during her construction all the improvements which have become possible since she was first designed, but in the main all such temptations should be sternly resisted if rapid completion is to be secured; and instead of attempting to make any particular vessel ideally perfect in offence and defence, according to the lights of the times, it is surely far more sensible to be content in the main with what was contemplated originally in the design, even if there is some sacrifice of what might be done provided the time for completion were of no importance. Readiness to take her place in the fighting fleet is the matter which should always be kept in view in the construction of a war ship; until she is so ready the expenditure upon her may be treated as so much unproductive capital. Supposing all has been done that can be done in preliminary preparation, supposing alterations in the principal features of the design are studiously avoided, yet still it remains true that ships, especially armoured ships, must be a considerable time in construction; but it may be questioned whether, under these conditions, the time necessarily occupied would much exceed one-half of the time ordinarily occupied under present conditions. It ought to be, and is no doubt possible, to build a first-class ironclad in from three to three and a-half years under favourable conditions, and the fact that ironclads occupy from six to eight years in completion must be attributed either to the want of an early settlement of important features in the design, or to subsequent modifications, or to financial considerations, which prevent so many men from being engaged on the work as might usefully be employed.

Reverting to the question of work in private shipyards, there are other, although not equally important matters, in which changes might be made which would facilitate rapidity of production of ships for the Royal Navy. For example, the inspecting officers representing the Admiralty in private establishments should have ample powers for dealing on the spot with details of structure, fittings, &c., and should not find it necessary, as they now do, to submit the minutest details for approval at headquarters. All those who have had to do with the execution of a contract for the Admiralty know only too well the price which has to be paid for this excessive centralisation. Weeks may elapse before some questions so submitted by the inspectors and affecting greatly the progress of the work generally, the provision of the materials, and the employment of men, are decided. Again, it may be a matter worth consideration whether the Admiralty practice of placing contracts might not very properly be varied. It is understood that, as a rule, the lowest tender for a ship is accepted by the Admiralty, and it is a very open secret that the tenders so accepted are in not a few instances considerably below what is known to represent the nett cost price. Of course, it may be said that the Admiralty is in its right in accepting any offer received from one of the selected list of firms who have been called upon to tender, seeing that before any firm can appear upon that list, careful inquiry will have been made into the competency of the firm to execute the contract. On the other hand, it is scarcely creditable that the Navy of this country should acquire from private shipbuilders, ships at less than cost price, and there can be little doubt that when a contract has been taken on unfavourable terms, the builder has not any great inducement, as a rule, to push on the work rapidly. Not a few of the most eminent private shipowners find it to their interest to have ships constructed for them on the basis of agreed schedules of prices, the builder receiving as his profit a moderate percentage on his actual and ascertained expenditure. We would suggest, for the consideration of the parliamentary members of the Board of Admiralty more particularly, that it might be found advantageous to extend to shipbuilding for the Royal Navy a method which has been found to work so well in the mercantile marine. Finally, we would observe that motives, both of economy and of prudence, point to the desirability of the continuous employment of private yards in shipbuilding for the Navy. Shipbuilding is work peculiarly suited to private yards, but the maintenance and repair of the fleet are the special functions of the Royal Dockyards. It cannot be admitted that ships built in private yards need be, or are, inferior in any respect to ships built in the Royal Dockyards. It is undoubted that ships can be built more cheaply in private yards. Further, the high standard of work which is desirable in war ships can be more readily secured if larger orders than have hitherto been given to the private shipyards are given in the future. There will then be available a greater number of men accustomed to the work, and ready to submit to the special inspection which is unavoidable in war ship work. As matters stand in most yards, the shipbuilder finds one of his greatest difficulties in getting together workmen having the necessary qualifications, and willing also to submit to the discipline insisted upon by the Admiralty inspectors; but if a continuance of work were provided, this difficulty would to a great extent disappear. There are many other matters deserving consideration as affecting the employment of private shipbuilding establishments in the public service; but these cannot be even mentioned within the limits of this article. We have endeavoured to avoid anything controversial or personal, and to confine ourselves to matters of the first importance. We trust that some practical result may follow upon our having drawn attention to the subject.

MAIN DRAINAGE AND THE THAMES.

A PARLIAMENTARY Return which has just been issued, introduces us once more to the critical question of Thames pollution as connected with the main drainage outfalls of the metropolis. It is now some five years since the Thames Conservancy Board instigated an inquiry under the Thames Navigation Act as to certain mud banks said to be due to the presence of the metropolitan sewage, as discharged at Barking Creek and Crossness Point. What is termed an "exhaustive inquiry" followed, extending over five months. There were two arbitrators and an umpire, the latter appointed by the Board of Trade, Sir Charles Hartley being selected for the post. Forty scientific witnesses were examined, and at last the arbitrators and the umpire agreed upon a report which practically exonerated the Metropolitan Board from all responsibility with respect to the mud found in the river, injudicious dredging performed or sanctioned by the Conservators being made to bear the greater part of the blame. This report, so highly satisfactory to the Metropolitan Board, was made in April, 1880. But the question has not been allowed to rest, and now assumes a more portentous form than ever. In less than two years after the presentation of the report bearing such weighty signatures as those of Sir Charles Hartley, Sir F. Bramwell, and Captain Douglas Galton, a letter was addressed to the Home Secretary by Sir John B. Monckton, on behalf of the Port of London Sanitary Committee of the Corporation, declaring that in the opinion of the Committee, founded on careful chemical analysis and personal inspection, the river in the vicinity of the outfalls was so affected by the "great outpouring of sewage," as to be in a condition "always most unsanitary," and at times "very prejudicial to the public health." Hence, the Home Secretary was asked to exercise his powers, under the Metropolis Local Management Act of 1858, whereby he was authorised, on representation or complaint being made to him as to the metropolitan sewage works, "to cause inquiry to be made into the matter represented or complained of to him, and to direct such prosecutions, or to take such other proceedings" as he might deem proper, in order to ensure the prevention or abatement of the nuisance referred to.

At the time when this representation was made to the Home Secretary, the Metropolitan Board were taking steps to effect an enlargement of their sewage reservoirs at the outfalls so as to obviate any necessity for discharging sewage into the Thames when the tide was not on the ebb. The increase in the volume of the London sewage rendered such a provision necessary, and the sum of £160,000 was to be appropriated to the purpose. The full flow of sewage from the outfalls did not commence until 1875, when the western pumping station was completed. The effect of that completion was to raise the year's discharge at Barking from less than 23,000 million gallons to very nearly 27,000 million. In 1878 the discharge at that point exceeded 30,000 million gallons for the year. It was in October, 1877, that the Conservators made their first demand upon the Metropolitan Board to remove the mud banks by dredging, according to the terms of the Thames Navigation Act. At Crossness, in 1874, the year's sewage amounted to 20,544 million gallons, which, added to the outflow on the northern side, made a total of 43,155 million gallons. Four years later the total had risen to 57,496 million gallons. If we suppose the aggregate volume of the London sewage, as discharged at the two outfalls, to have gone on increasing in a uniform ratio since the opening of the western pumping station, the total yearly volume must now amount to something rather higher than is generally credited. Of course it is assumed that "sewage is sewage," of unaltered quality from year to year. Otherwise the increase of volume might be considered due, more or less, to increased dilution. If the rainfall were separated from the house drainage, the pollution of the river would remain much the same, although the volume of the sewage would be considerably diminished. But this continual augmentation of the London sewage is an element in the present question, and there can be no doubt that it has necessitated an occasional discharge from the reservoirs at unsuitable periods of the tide. It is, therefore, possible that the Thames has received greater damage from the London sewage as time has gone on. To what extent the damage now exists is a matter of dispute. Sir William Harcourt has been quite willing to listen to all complaints made to him as to the state of the Thames, and the Corporation have been, doubtless, quite prepared to point out any fault that could be detected in the main drainage system of the Metropolitan Board. On the receipt of the complaint from the Port Sanitary Committee, in January, 1882, the Home Secretary entered into an active correspondence with the Metropolitan Board, characterised by some degree of impatience on the part of Sir William. The latter also conferred with the Local Government Board on the subject, the result being that in May, 1882, he decided to take steps "for the appointment of a small Commission to conduct an inquiry into the outfall question." The Commission was accordingly appointed, having a twofold object—first, to ascertain whether the outfalls were doing any harm; and, secondly, if they were doing harm, to specify the remedy.

The Royal Commissioners reported on the first point early in the present year, the purport of their conclusions being that there was not very much the matter just then, but certain evils did exist in consequence of the outfalls, and the mischief would inevitably increase. It could not be said that the first report from the Royal Commissioners was startling. But a careful consideration of the document showed that something more momentous was likely to follow. The mere fact that the Commissioners were going to exercise their functions under the second head of their inquiry was sufficiently ominous. The fervid heat of the past summer has rendered the situation still more critical. Last July the Home Secretary wrote to the chairman of the Metropolitan Board, stating that he had received sundry complaints respecting the condition of the Thames, as affected by the main drainage. In this letter Sir William quoted an alarming statement from Lord Bramwell, with the terms of which the public have since been made sufficiently familiar. On a particular day the Royal Commissioners found the river to be "in such a state as to be a disgrace and a scandal to the metropolis and civilisation." Moved by this testimony, Sir W. Harcourt pointed out that, according to the original understanding when the main drainage works received Parliamentary sanction, the Board were bound to deodorise the sewage. If they failed to do this, the Home Secretary gave a hint that he should authorise a prosecution, or take some other decisive step in accordance with the Act, "in order to ensure the prevention or abatement" of the nuisance. It is worthy of note that the Board, in a letter to the Home-office on May 5th, 1882, said "to attempt to deodorise the sewage at the outfalls by any known process would involve a wasteful expenditure, and be accompanied by serious objections, without producing adequate advantages." Despite this adverse opinion, the Board hastened to deodorise the sewage when the alarm arose during the recent hot weather, but were sharply censured by the Home Secretary because they were unable to provide themselves with a sufficient quantity of disinfectants at the moment when their use was found to be necessary. Even when the Board got fairly to work, and threw perchloride of lime into the river at the rate of £2000 per week, the Home Secretary was not satisfied. He declared, on the authority of the reports which he received, that the river was none the better, but was rather growing worse. The Royal Commissioners, however, admitted ultimately that by "a special and vigorous effort," the Metropolitan Board had really conquered the sewage odour, using for this purpose "very large quantities of chloride of lime." Still the end was not reached, the Commissioners observing "that the process referred to is likely to be injurious to the river in other ways, and can only be regarded as a temporary expedient to palliate a state of things that ought to have a more suitable and permanent remedy." So far as the permanent character of the remedy is concerned, we find the Metropolitan Board preparing for the future by establishing chemical works of their own at Crossness, so that they may not fail to have the needful supply of deodorising materials on hand when wanted.

As for the actual evidence that the outfalls create a dangerous degree of pollution in the Thames, we have among other documents the report presented by Mr. J. Thornhill Harrison to the Local Government Board in August last. This gentleman finds sewage everywhere, all along the river, up as far as Teddington. His report reads very like a new edition of Captain Calver's original indictment, and in some respects it seems to present a still heavier accusation. Mr. Harrison compares the Thames to "a huge sewage tank," foul with putrescent mud. He thinks it no exaggeration to estimate that at the date of his report there was "a month's sewage from the metropolis oscillating backwards and forwards between Greenhithe and Teddington." "The evil," he says, "is very great, and demands a radical cure, which will no doubt be suggested by the Royal Commission appointed to consider the question." But what may we expect the Royal Commissioners to propose? It is difficult at present to ascertain what projects have been laid before these authorities. But as throwing some degree of light on the subject, we may refer to the last meeting of the Lower Thames Valley Main Sewerage Board, held a few days ago, when an important statement was made by the chairman, Sir Thomas Nelson. Through this medium we learn that Sir Joseph Bazalgette has laid before the Royal Commissioners a plan for taking the sewage of London, together with that of the Lower Thames Valley district, and other suburban quarters, down to Sea Reach. According to this plan, the southern sewage is to be taken across the Thames at Crossness, so as to join the northern system. The sewage is then to be conveyed in one combined stream to a point on the Essex shore lying very near Thames Haven pier. Districts north and east of the metropolis may be relieved by the same means, and this we presume would include the valley of the Lea. The sewage above London would be transmitted to Crossness without passing through the metropolitan area, and Sir J. Bazalgette calculates that the entire cost to the Lower Thames Valley district would not exceed 10d. in the pound per annum, of which 2d. would go to the Metropolitan Board. So, with regard to other districts, it appears to be intended that they should pay a rate of 2d. in the pound to the Metropolitan Board, the conveyance of sewage to the great united sewer being at the cost of the locality concerned. The scheme is a grand one; but, supposing it to be carried out, we may still expect to be told that the sewage travels up the Thames to some far-off point. Or perhaps we may hear that some disastrous consequences are accruing to the shrimps and oyster beds on the coasts of Essex and Kent.

In addition to this engineering project, there is another plan which cannot fail to have been laid before the Royal Commissioners, and with which Sir Joseph Bazalgette is also in some degree connected, though, we may presume, he has a preference for the Sea Reach project. It is a kind of open secret that, arising out of the experience gained in the recent deodorising experiments, the chemist to the Metropolitan Board, Mr. Dibdin, has devised a method for removing the suspended matters from the sewage at a very moderate cost. The clarified effluent thus obtained could be run into the river without any fear of creating mud banks. In summer this effluent could be further treated, so that it might be effectually deodorised. The disposal of the sludge is provided for in the scheme, and no revenue is reckoned upon as likely to accrue from it. The entire cost, including chemicals and working expenses, together with interest and redemption of capital, is put down at a figure which, although large, is yet moderate, considering the result that is promised. The details are so fairly worked out, and the calculations agree so well with existing facts, that the scheme undoubtedly calls for careful consideration. The plan differs essentially from that of casting a mixture of sewage and chemicals into the river, thereby making the Thames a species of precipitating tank. The objections to this rude and imperfect procedure, costing £30,000 during the past summer, have no application to the comprehensive plan to which we have thus referred, whatever else may possibly be said against it.

ELECTRICAL UNITS.

Mr. Preece's paper "On the Watt and Horse-power," read before the British Association at Montreal, and reproduced in our issue for Sept. 19th, contains a suggestion, or rather a demand, which it is difficult to consider seriously. It is nothing less than that engineers should alter the standard of horse-power in order that a so-called convenient unit may be employed by electricians. At first sight we were disposed to regard this demand as a joke, of inferior merit and feeble constitution, little calculated to bear the shocks of time; but nothing was further from Mr. Preece's mind than a jest. In sober earnest he asks engineers to raise the standard of horse-power from 33,000 foot-pounds per minute to 44,233 foot-pounds. The circumstance that there is not the most remote prospect that Mr. Preece's desires will be complied with in this respect is of little moment. We would not have noticed the subject at all but that we fear that electricians may, by adopting a new unit for their own use, widen the gap which now does so much to cut them off from engineers. If Mr. Preece and his disciples insist on having their way, and regarding a horse power as 44,233 foot-minute-pounds, while engineers adhere to James Watt's rule, confusion worse confounded will be introduced in the commercial matters, which are really all important, at least as far as electric lighting is concerned. If Mr. Preece could make out a good case we might sympathise with him, while expressing our conviction that he had not the smallest chance of gaining his point. But he has literally no case which will bear a moment's examination. The term indicated horse-power conveys a meaning of the most definite kind, which has been indissolubly connected, for more than half a century, with all manufacturing operations, such, for example, as cotton spinning, to say nothing of pumping water, winding coal, and the propulsion of ships. At the present moment there is not in the whole world 10,000 indicated horse-power used in the production of electricity—not as much power, in fact, as is developed within the hull of the Atlantic steamer Oregon. Probably not more than a few dozen electricians ever have had to use the term horse-power at all. The demand that for their convenience the rest of the world should alter a most important standard is saved from reprobation only by its extreme absurdity. In fact, as we have said, we should not notice the demand at all were it not that suggestions of the kind tend to injure the reputation of electricians, and if persisted in may add another obstacle in the way of electric lighting.

The theory of the suggestion is extremely simple and easily explained. Currents of electricity are measured just like currents of water in pipes, in terms of quantity and pressure, or tension. The unit of quantity is the ampère, the unit of pressure is the volt. Now, if we multiply ampères and volts, and divide by 746, we get the horse-power. Thus, suppose that an arc lamp requires a current of 10 ampères, with an electro-motive force, or potential, of 35 volts, we have $\frac{10 \times 35}{746}$ = ·469-horse power. This constant, 746, is called by electricians a "Watt." All this is quite straightforward and unobjectionable, to engineers at all events. But Mr. Preece finds that to divide by 746 is inconvenient and troublesome; therefore he proposes to substitute a new constant, viz., 1000, for it, which, of course, entails the necessity for raising the horse-power standard in the proportion 746 : 1000 : : 33,000 : 44,233. The only conceivable justifiable reason for making this change would be that very large numbers of calculations had to be made involving the use of such a constant. As, however, such calculations are seldom made, even by a few engineers and electricians, it is obvious that Mr. Preece coolly proposes to introduce a most important innovation for the sake of a minority altogether insignificant as far as either numbers or commercial transactions are concerned. If Mr. Preece wants the Watt changed, he has nothing to do but augment either the ampère or the volt, and the thing is done; the minimum of inconvenience being entailed by the alteration. Mr. Preece finds fault with the 33,000 foot-pound standard, as an "arbitrary" unit. It is really based on the results of experiments conducted by James Watt, who found that when he began to sell engines he must adopt some standard to sell them by. He caused powerful horses to draw weights up from a deep well, with the result that a strong horse raised 22,000 lb. one foot high in a minute. Determined that his customers should have no cause of complaint, he resolved that each of his horse-powers should exceed a real horse-power by 50 per cent., and took 33,000 foot-pounds per minute as his standard. So far it is, no doubt, arbitrary, but we have yet to learn that it is in any sense the worse for that. We may, however, retaliate, and state that the volt and the ampère are both, in the fullest sense of the word, arbitrary; and not only are they this, but it has hardly yet been settled what an ampère or a volt really is. The ampère, which until recently was called the weber, is the quantity of electricity that can be sent through a resistance of one ohm by a force of potential of one volt. Years have been spent by electricians in endeavouring to define what an ohm is. The ohm has been discussed at conference after conference, and even at the last moment Siemen's standard has been accepted with considerable reluctance. This standard is a column of pure mercury, one square millimetre in section and one metre long; but standard ohms actually constructed with every possible refinement do not give an ohm resistance, but an approximation only, varying between ·9545 and ·9554. In like manner the volt is based on nothing more substantial than the fact that a certain form of Daniel's cell has an electro-motive force of about ·98 of a volt. There is no reason whatever why a different cell should not be used giving a different standard. The worthlessness of the existing standards is shown by the fact that they cannot be used without a coefficient, the amount of which is indeterminate.

It may be urged that we are only dealing with practical units, while we ought to speak of the theoretical units on which they really rest; but it would be useless to deal with theoretical units if it could be shown that the practical volt and ohm were fixed in amount by practical standards, and could not be altered. Thus, for example, water is sold by the gallon, and it would be extremely inconvenient to alter the dimensions of the gallon. Electricity may, in a sense, be said to be sold by the ampère, and if the ampère were as rigidly fixed in amount as is the gallon, we should be the last to suggest a modification in it. But, as we have shown, neither the volt nor the ohm exist as rigid practical standards, and to alter them would be a matter of very small moment.

When we turn to the theoretical standard, we find ourselves at once face to face with a condition of affairs which has no parallel save in the Brazilian coinage, in which 1000 reis represents 2s. 3d., and a host entertaining a small party at dinner finds himself called upon to pay 80,000 or 100,000 reis. For some more or less inscrutable reasons, electricians have adopted what is known as the centimetre-gramme-second, commonly known as the C.G.S. unit of power; that is to say, instead of the foot-pound per minute, they use one twenty-eighth of an ounce moved about half an inch per second. Accurately, the gramme is 0·564 of a dram, which is the sixteenth part of an ounce, and the centimetre is ·394 of an inch. These quantities are far too small to be of any practical utility, and the result is that they are augmented in various ratios. Thus, for instance, the work done by a current of one ampère in overcoming a resistance of one ohm is ·9545 × 10^9 C.G.S. units. The erg referred to by Mr. Preece is $\frac{1}{13,825}$ of a foot-pound. Instead of saying that the arc lamp referred to above requires ·469-horse power to work it, the electrician tells the engineer that he wants 213,969,525 ergs per lamp. It is to facilitate the introduction of a convenient unit like this erg into workshops generally that Mr. Preece would have us abandon Watt's standard of horse-power. Let us be clearly understood. We have no fault to find with Mr. Preece or his brother electricians, if they find their C.G.S. unit answer their purpose better than the foot-pound; but we do object to attempts being made to force it on engineers. In the days when telegraphy represented the only practical work done by electricians, the quantities dealt with were extremely small.—a message may be sent across the Atlantic with a battery made of a copper percussion cap, a morsel of silver, and a drop of dilute acid. But all this has been changed by the introduction of the electric light and electric railways, and the dyne and the erg are in no way suitable to the commercial wants of the engineer who has to supply the electric light and electric railways. If, as we have said before, these units were based on any unmistakeable standard, there might be something to be said in their favour, but they are not. "By way of assisting the memory," writes Professor Everett in his excellent little book "Units and Physical Constants," "it is useful to remark that the numerical value of the ohm is the same as the numerical value of one earth quadrant per second, since the length of a quadrant of the meridian is 10^9 centimetres." Now this is just what it is not. It was believed to be so when the French metrical system was established. It is now known that the metrical system has no accurate physical basis on any terrestrial measurement of length. We do not assert that it is either the better or the worse for this, but we venture to think that it puts the words "arbitrary standard" out of court, as an argument to be used by Mr. Preece against received engineering units.

THE INDO-EUROPEAN RAILWAY.

SOME time ago we gave a brief notice of a proposed railway to India, along the shore of North Africa; since then it has made further progress in organisation. Of course, it is essentially a French undertaking in its inception, intended to obtain a through connection from Paris to French possessions in Algeria and Tunisia by completing the railway communication, leaving only a short sea passage across the Straits of Gibraltar. It is the sea passage which here, as elsewhere, tells in our favour. Whenever such a line becomes connected with India we shall have a direct interest in it. Meanwhile the French have for their own purposes to find the capital, and we shall have the benefit of subsidiary profits. Many journals have already devoted a great deal of attention to the enterprise, but the chief feature which has seized them has been the large reserve for engineering expenses. Our practical friends in the press, who often take in hand to set us right, appear to think that a railway can be bought yard by yard as loaf by loaf at a baker's shop. They are more puzzled than enlightened by the calculations for a railway costing so much per mile, and it does not enter into their calculation that before a yard of rails can be laid, and long before any work can be begun, a large amount of mental labour must be gone through. The public see the material results in a railway or other work, and have become so accustomed to them, that they have lost sight of all the necessary preparations in the due conduct of which success really depends. To engineers this is a matter of course; to the public it is not a matter at all, and great injustice is often done by them to professional men. If an undertaking is to cover many thousands of miles, then a mere percentage will make up a very large sum of money; and in the case of this railway, the estimates for engineering and other departments of the whole prospective undertaking have to be looked at in the beginning. The fact is, what is more material for our consideration is what we are to get out of it in this country. The French will have to find the capital, and therefore, in the usual course, would have in their hands the whole control and the whole benefits. As, however, the undertaking is considerable, it has to be made international; that is, instead of its securities being limited to the Paris Bourse, they must be made transferable in this the great market of the world. A Frenchman will prefer to subscribe for international securities, as in case of panic in Paris, or political alarm, he can buy and sell in London and receive his coupons here. Indeed, altogether, London has greater facilities for such an enterprise, and the essential preliminary has been effected of registering the undertaking in London. So from step to step our intervention will take place here, and as in the case of the Suez Canal, whenever it suits English interests a fuller participation will take place. Our control of the money market gives us the means of taking toll on foreign enterprise, and were these matters fully looked after in the common interest of English industry, we should seldom have to give way to a foreign competitor.

MANUFACTURED IRON TRADE PRICES.

WITH one exception the realised price of iron in the manufactured iron trade is now the lowest that has been known since the price was tabulated. In the year 1879 the price of iron thus ascertained was a few pence lower than it now is, but with that exception the present is the lowest price recorded. In the middle of the year 1874 a price of £10 18s. 11d. was reached—or more than double that which has been received during the period last officially reported on. It was in the period when prices as low as the present were known that the iron rail trade began its collapse, and there are some who believe that the low range of prices that is now known is the preliminary to a collapse of the iron plate trade. It is too soon to dogmatise on the question, but there are some indications that point to a substitution of steel plates for iron now, just as five years ago steel rails began to be substituted for iron rails. The price of iron plates, too, it is worth notice, keeps up the average of the realised price, for the price of the plates is usually higher than that of the other kinds of iron that are included in the return made. It is noticeable that over a period of some years there has not been that excessive fluctuation in the price that might have been looked for—the general tendency being to a fall in prices from 1874 to 1879, then to a rapid increase for a year or more, and since then to a fall almost as complete. It is the slowness of movement on the whole which makes a sliding scale most suitable in the manufactured iron trade, because such a scale has a tendency to preserve the equilibrium in wages—to allow the increase in average price one month to be in part balanced by any previous decrease for the preceding month, and thus to give something more of steadiness to the trade as a whole, and to the rate of the remuneration for the labour employed. Successive courts of arbitration, too, have defined within certain limits the rate of that remuneration; and thus, instead of what has been called the "haggling of the market" over the whole question of wages, the efforts of the Board of Arbitration or of the umpire are now devoted to the nicer but lesser task of deciding the exact rate, within the limits at which a scale shall be declared, or at which a period shall have a given wage. This is one of the results of the working of the Board of Arbitration in the trade, and it is one that is of very great value to the industry as a whole, and to the students of industrial statistics especially.

LITERATURE.

Practical Electric Lighting. By A. BURNLEY HOLMES, Assoc. M.I.C.E. Second edition. London: E. and F. N. Spon. Small 8vo. 172 pp.

IN this edition of the book which was noticed by us in August, 1883, the author has amended some of the letterpress, which we pointed out as requiring elucidation, and has made numerous small improvements by the eighteen pages of additional matter. Distribution by means of secondary generators forms the subject of most of this addition. The book is very useful, as providing those who wish to gain some practical information on electricity as applied to electric lighting with an introduction to the subjects concerned, and it will instruct the reader sufficiently to guide him in his selection of the books from which the higher branches of the subject can be obtained.

The Plumber and Sanitary Houses; a Practical Treatise on the Principles of Internal Plumbing Work, or the Best Means of Effectually Excluding Noxious Gases from our Houses. By S. STEVENS HELLYER. Third edition. London: T. B. Batsford. 1884. 373 pp.

THIS is a third and enlarged edition of a book, of the first edition of which we were able to speak in very high terms. The additions, both in text and illustrations, are considerable, and most of the book has been re-written. Its value is increased by further illustrations of how not to do plumbing and drain-ventilating work; and though we might deal with it at length, it will be sufficient to say that the very favourable commendation which we were able to bestow on the first edition is equally merited now that great advances have been made in the subjects treated, and it is a book with which every architect and builder, and we might almost say householder, should be conversant.

THE MANCHESTER SHIP CANAL.

THAT the rejection of the Manchester Ship Canal Bill last session was not at all likely to deter the promoters from making further efforts to secure the object they have in view, has never been a question of doubt, and the project is now again prominently before the public of Manchester and the district. As an evidence of the earnestness with which the project is being supported in Manchester, a town's meeting called for the purpose has by an overwhelming majority authorised the Corporation to levy a rate towards meeting the expenses of obtaining parliamentary sanction for an amended scheme in which it is intended to avoid the objections that proved fatal to the bill last session. It will be remembered that the opposition which proved successful before the House of Commons' Committee was based mainly, if not entirely, upon the evidence as to the injury which might result from the training walls proposed to be constructed in the estuary of the Mersey. After a careful investigation of several alternative schemes that have been put forward to overcome the objections to the original project, it has been decided so to alter the line of the proposed canal from a point near Runcorn that it will avoid the estuary of the Mersey altogether. The chief feature of the new scheme will consist in the abandonment of the training walls in the estuary and the construction of a locked channel on the Cheshire side from Astmoor Marsh. The channel will pass through the southernmost span of Runcorn Bridge, and proceeding outside the line of the quay wall of the existing docks at Runcorn and Weston Point, it will by a bold sweep be carried past the mouth of the Weaver; it will then traverse the marshes and at short distances the foreshore of the estuary, passing well inside Stanlow Point, and finally terminate in a set of locks above Eastham Ferry, from which point there is only a short distance to the existing Sloyne Deep, to which a channel will be formed by dredging. The carrying out of the new scheme, it is estimated, will involve an extra outlay of about a quarter of a million, and it will also slightly lengthen the course of the canal; but as a set off it is claimed that the deviation of the course will enable the canal to tap a larger trade than would have been possible with the original proposal. The locks originally proposed to be built at Runcorn will be removed to Eastham, and the water in the channel is to be maintained at a depth of 26ft. at low tides, whilst at high tides from 30ft. to 40ft. of water will be got. This is briefly what the promoters propose to bring before Parliament as their new scheme, but whether it will enable them to escape opposition on the old ground of possible injury to the navigation of the Mersey is a point that is open to some doubt. It would seem not improbable that the question may be raised whether the proposed new channel, although it avoids the estuary, may not have the effect of abstracting water which would otherwise flow through the estuary, and thus have a prejudicial influence.

That the promoters will not again have to encounter serious opposition is scarcely to be expected, and the action now being taken by the Bridgwater Navigation Company is a further complication which will not lessen the difficulties with which they have to contend. The proprietors of the Bridgwater Navigation are, in fact, putting forward a counter scheme for improving the water-way from Manchester to the sea, certainly not on so ambitious a scale as the proposed ship canal, but of a sufficiently important character to secure for it a considerable following of support from those who doubt the practicability of the larger scheme. This project contemplates the deepening and widening of the rivers Irwell and Mersey, the shortening of the course by making two channels to avoid the present devious warps and bends, and the entire removal of several of the existing locks and weirs, which would be reduced in number from eleven to six. The remaining locks would be doubled in length, breadth, and depth, and the navigation so improved as to admit craft drawing 10ft. of water or vessels up to 400 tons. The port of Runcorn is now the terminus of the Bridgwater Navigation, and at present it is only capable of carrying vessels of fifty tons, craft of greater tonnage having to unload at the above port. That the proposed improvement would immensely facilitate the water transit of goods between Manchester and the sea there is no doubt, and in addition to allowing coasting vessels to come direct to Manchester it would, in all probability, develope a special trade between Manchester and Liverpool in vessels constructed solely for this traffic, and which might be built up to 500 tons. This action of the Bridgwater Navigation Company is naturally regarded by the promoters of the ship canal as simply a scheme for increasing the value of their property, which will have to be purchased in the event of the ship canal being constructed. This no doubt is a result that the proprietors of the Bridgwater Navigation have in view in the event of their property being required, but it has not been the main object that has induced them to undertake the improvement. The work, which the company already possesses parliamentary power to carry out, has, in fact, been in contemplation for a considerable time past, and two years ago the plans were laid down, but held in abeyance in consequence of the ship canal scheme being brought forward. The proprietors of the Bridgwater Navigation have, however, now fully decided to proceed with these improvements, independent altogether of anything that may be done with regard to the ship canal, and schedules are now being prepared for the land that will be required.

MAXIM'S SELF-FIRING MACHINE GUN.

A GENERAL description of this gun was given in THE ENGINEER of Sept. 26th last. The engraving on page 275 shows the mechanism and action of the gun, which, as described in the article above referred to, when loaded and fired, continues the process of loading and firing and feeding itself as long as a supply of cartridges is presented to it. The form of supply recommended consists in bands or belts, each holding 333 rounds, which can be hooked on to each other so as to keep up a continuous supply. The gun can be set to fire at any rate up to 600 rounds per minute. The action is as follows:—On firing, the barrel and breech bolt—see Figs. 1 and 3—with attachments recoil firmly held together by the locking hook for about 0·44in., then the counter lever of the latter comes in contact with the block A_4—Figs. 1 and 3—causing the hook to rise and release the breech bolt, which at the same time receives a sudden impetus from the lever—see Figs. 2 and 4—whose counter lever is brought in contact with the point of resistance on the piece A_5, causing the lever to act against B_6, and so drive back the breech bolt and its attachments. It may be observed that this point of resistance moves along the curved face of A_5, changing each instant from a lever of greater power to one of greater speed; thus the momentum of the barrel is suddenly transferred to the breech bolt and its attachments, which fly back with sufficient force to complete a revolution of the crank and connecting rod, bringing the breech block back to the barrel and forcing both home into the firing position. In the meantime the extractor—Figs. 1 and 3—is made to eject the empty case of the fired cartridge—Fig. 3. The transferer at the same time draws a filled cartridge back from the feed wheel, which is carrying round the belt full of cartridges, and leaves it in the feeder—Figs. 1 and 3. The feeder is made to revolve, bringing a filled cartridge round in the place of the empty one, in time to be carried forward by the advance of the breech bolt. Also near the end of the withdrawal stroke the counter lever J_2 of the lever J_1 J J_2—Figs. 1 and 3—comes in contact with the stop L, which causes the lever end J_1 to carry back the striker and cock it.

Of course there are many pieces of mechanism not dealt with in this general explanation—for example, the arrangement for setting the gear for quick or slow firing—which depends on the opening or shutting off of the lever at the index and valves in a hydraulic cylinder—P_1 P_2 in Figs. 1 and 3—the gear for revolving the feed wheel, and many minor details. The general character of the action may, however, be seen from the above. The adjustment of the levers and counter levers for speed or power, and the transferring of momentum is, perhaps, the neatest part of the design. As stated in the descriptive article, September 26th, the work would be greatly simplified if a special cartridge could be employed rendering the movement of the barrels unnecessary. Mr. Maxim has made many modifications of his design; ten forms of it are briefly described and illustrated in his paten t specifications.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Ernest F. Ellis, engineer, to the Asia, for the Colossus; John H. Walton, engineer, to the Asia, for the Dreadnought; James R. Watson, assistant engineer, to the Asia, for the Dreadnought; Charles Edward Stewart, engineer, additional, to the President, for service at the Royal Naval College, Greenwich; Nathaniel Stearn and John Hall (b), chief engineers, additional, to the Excellent; John H. Slade, engineer, additional, to the President, for the Royal Naval College, Greenwich; and Edwin W. Cudlip, acting assistant engineer, to the Neptune.

H.M.S. RODNEY.—Shortly before two o'clock on Wednesday, the Duchess of Edinburgh launched H.M.S. Rodney from the Chatham Dockyard, the latest addition to the fleet of vessels of the Admiral class. The length of the Rodney between the perpendiculars is 325ft.; her extreme breadth, 68ft.; depth in hold, 26ft. 5in.; her draught as seated light on the river was 13ft.; but with her engines, stores, and armament on board she will have a draught of 26ft. 3in. forward and 27ft. 3in. aft. Her displacement is 9740 tons, and her steam power will be 7500 indicated horse. Her armament will consist of four 63-ton guns in two barbette towers, one in front and one in rear of the central citadel, which will contain six 6in. guns on the broadside. Besides these she will have twelve 6-pounder quick-firing shell guns and eight Nordenfeldt and two Gardner machine guns. There are four positions in her hull for discharging Whitehead torpedoes. The number of these weapons carried will be twelve. The hull is armoured along the water-line, both above and below it, with a belt of steel-faced plates. On the sides of the citadel the armour is 18in. in thickness, and on the ends beyond 16in. Over the barbette towers, the sides of which are steeply inclined inwards, the armour is 11½in. and 10in. The central portion of the hull is devoted to the engines, which have been entrusted to Messrs. Humphrey and Tennant. The horizontal divisions are a lower deck below the load line, plated with 2½in. to 3in. of iron, a main deck, and an upper deck. Over the citadel portion there is a very fine decked space, all round which the iron skin plating rises to above the height of a man. It will be thus seen that the belt system is carried out in the design, and that all the fighting, except in the barbette towers, is intended to be done under cover of the ship's constructive material. The estimated speed is set down at 16 knots, but there is little doubt of her being able to accomplish 17 knots; and it should also be noted that the power of her armament is not to be reckoned on the lines of the older guns. The shot of the 82-ton guns of former ships has, for example, a penetrative power of 30,000 foot-tons; but the penetrative force of the projectiles of the new 63-ton guns will be 36,000 foot-tons, so that both in speed and power of artillery the Rodney will be a very formidable vessel.

AMALGAMATED SOCIETY OF RAILWAY SERVANTS.—Several questions of interest not only to railway servants but to every one were discussed during Wednesday's sitting of the conference of the above society held in Bath. The Employers' Liability Act first received attention, and a spirited discussion followed with respect to the number of hours railway servants are employed, and a resolution on the subject was carried. The Congress then proceeded to discuss the most important subject to be introduced during the sitting, namely, the question of brakes. The matter was introduced by the delegate from Carlisle, who moved:—"That this congress of railway servants impresses upon the Board of Trade the necessity of the adoption of an automatic continuous brake upon passenger trains, and considers it essential to the efficacy of such brake that it should comply with the conditions laid down by the circular of the Board of Trade addressed to the companies on this subject in 1877." The resolution was seconded by the representative from Mirfield, and supported by a large number of engine-drivers, guards, and others. A remarkable unanimity prevailed among the speakers upon the question, and many of the accidents that now occur were attributed to the insufficiency of brake power. The speakers, with few exceptions, avoided showing a preference for any particular brake, being content with the condition laid down in the resolution—namely, that it should comply with the requirements specified in the Board of Trade circular. With such a brake, the drivers one and all expressed the opinion that they would travel with greater confidence, and that the risk of accident would be reduced to a minimum. It was predicted with some confidence that public opinion would soon make itself heard in this matter in such a fashion that the companies would be unable to resist the pressure brought to bear upon them. The resolution was carried by acclamation. The delegate for Leicester then moved, "That this meeting resolves to do all in its power to insure to the Board of Trade a true return of the failures of the different continuous brakes, and calls upon all railway servants to assist in this matter by reporting all failures of these brakes to act when required, as at present a true report of these failures is not made to the Board of Trade." Leeds (No. 2) seconded the motion, which was carried. The next resolution was as follows:—"With the view of providing greater safety, this congress considers it most desirable that additional brake power should be put on all goods engines, and that to this end all goods engines should be fitted with good steam or other brakes." This motion also provoked a long discussion, and opinions were very freely and earnestly expressed, though there was not quite so much unanimity among the delegates as prevailed with reference to the two preceding motions. The resolution was, however, carried with only two dissentients. The delegates subsequently considered the block system. Attention was also directed to the present system of coupling, and a resolution was proposed impressing upon railway companies the necessity of adopting a system of coupling which could be manipulated without the men going between the wagons,

THE NORTHWICH SALT WORKS.

A large number of mines, factories, and works was thrown open to the members of the Iron and Steel Institute during their recent visit to Chester, but the members did not avail themselves to any extent of the privileges thus courteously offered them; preferring, instead, to adhere to the excursion programme prepared for them. On Thursday afternoon, the 25th September, nearly all the members at the time in Chester left by special train for Northwich, a distance of fourteen or fifteen miles. Here the party broke up into two sections, one portion proceeding to the Anderton canal lift on the Weaver Navigation, while the others were conveyed by trains into Messrs. Verdin's Salt Works. The Anderton canal lift has often been illustrated and described in this and other journals, and it will suffice to say here that the canal boats are raised and lowered by a hydraulic lift, instead of a series of locks. The canal at Anderton is 50ft. 4in. above the river Weaver. The works consist of a basin opening into the canal, upon which a wrought iron aqueduct leads the water to a lift pit, which is connected with the river Weaver by a side channel. The lift is double, so that one barge or two canal boats can be passed each way at one operation. This not only saves time, but the weight of the descending load is nearly sufficient to elevate the ascending load. Each lift consists of a trough, constructed of wrought iron, the sides forming girders. At each end of the troughs and at the ends of the aqueduct are lifting gates or doors, which are all closed when the lift is in motion. The caissons or troughs are each 75ft. long by 15ft. wide, and capable of holding one barge or two canal boats. The depth of water in them when ascending is 4ft. 6in.; when descending, 5ft.; weight of caisson and load, 240 tons. Self-acting syphons abstract the 6in. of water as the caisson rises. It takes 3½ minutes to lift the caissons the total height of 50ft. 4in. The rams are 60ft. long by 3ft. diameter; pressure, 530lb. per square inch. The diameter of pipes between the main presses is 5in., thence to accumulator 4in.; waste pipes, 2in. The accumulator has a stroke of 13ft. 6in., and the diameter of ram is 1ft. 9in. The work was let and put in hand when iron was about at its highest price, and the cost, inclusive of basin, aqueduct, &c., was £48,428.

The party visiting Messrs. Verdin's works were first taken to the salt pans, which are simply wrought iron shallow tanks exposed to the air, in which brine is evaporated, leaving the salt behind. Each tank will produce about forty tons of salt per week; but this varies with the weather and the quality of salt made. The fuel used is slack, burned in furnaces under one end of the pan, with wheel flues conveying the hot products of combustion to the chimney. When the process of evaporation is hastened, small crystals, or table salt, is obtained. When the evaporation is slow, large crystals are obtained, such as are needed for chemical works, and this was the species of salt being manufactured at the time of our visit. It is stored as made in large barn-like wooden structures. The brine is obtained by pumping, the lift being about 100ft.

The visitors next proceeded to the Adelaide mine, when a novel experience awaited them. The whole of the mechanism at the pit head, as we may call it, is on a very small scale. Two shafts are used, each under 3ft. 4in. in diameter and 110 yards deep. Two buckets were used to lower the visitors, who went down three at a time. The shafts are about 20ft. apart, and for a considerable length they are lined with iron tubbing where they pass through the strata from which the brine is pumped, which lies right over the mine.

The mine itself presents a remarkable spectacle, to which it is quite impossible for words to do justice. The visitor, on getting out of the tub, finds himself in an underground world. In other words, he is in an enormous cave, no less than fourteen acres in extent. The roof is, in the highest place, about 25ft. above the floor. It is supported by a comparatively few pillars of great size, spans of considerably over a 100ft. being left entirely unsupported. The salt is of the well-known reddish kind, and is so hard and firm that it has to be blasted with gunpowder. It is worked in benches from the top down. The salt is undercut by a horizontal circular saw driven by compressed air led down from the surface, and blasts are subsequently put in and the salt thrown down. The two shafts are close to one end of the mine. Messrs. Verdin liberally entertained their guests. No fewer than 11,000 candles were used to light up the mines, the candles being arranged on the pillars in ornamental devices. As the visitors proceeded through the mine blasts were discharged in various places, and the echoes rolling and reverberating like thunder under the mighty roof, produced an effect seldom experienced. Indeed, it falls to the lot of comparatively few to hear several pounds of gunpowder discharged in a cavern fourteen acres in extent. Coloured fires were burnt in various places with remarkable effect. There is none of the glitter in the Adelaide mine which we are prone to associate with salt working; on the contrary, the general aspect of the cavern is very sombre.

The most striking fact, or at all events that which seemed such, to those in the mine, is that the whole contents of this enormous excavation had been taken to the surface through the two little shafts of which we have spoken. Standing beneath their lower orifices, they looked more like two of the holes through which house coals are shot into cellars than respectable mine shafts. An ascent up them was like an ascent through a chimney, and as only three persons could go up at a time, both shafts were kept busy for a long time before the last of the visitors was got out. The whole ventilation is effected through these shafts, and no means of artificial ventilation of any kind are used or needed. A certain quantity of fresh air is, however, led into the mine, compressed for working the excavating machine. The temperature is moderate and extremely equable, as may be imagined. The whole cavern is pervaded by a faint, but perfectly distinct odour, resembling more than anything else the smell of onions. Whether this results in some way from a combination of the smell of gunpowder gases with the hardly perceptible smell of rock salt, we are unable to say.

We believe we are right in saying that Adelaide Mine is unique, nothing like it existing elsewhere. The salt mines at Salzburg are quite different in character, the working taking the form of long galleries. As the mine is still supplying about 250,000 tons of salt per annum, it is difficult to say what dimensions it may ultimately attain to.

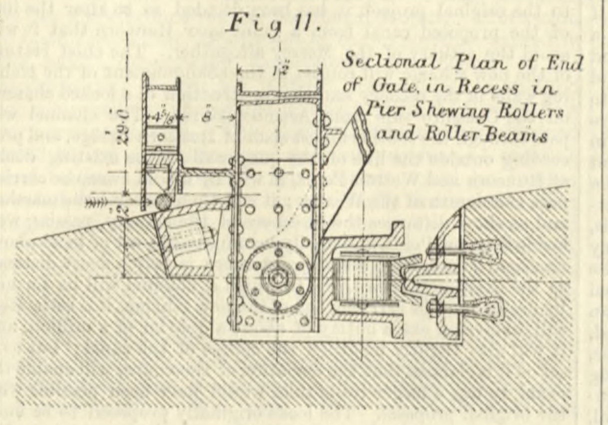
Northwich is one of the most important centres of the salt trade of Cheshire, there having been 465 pans there at the end of 1883, against 293 in 1867, and 388 in 1872. The quantity of salt raised in Cheshire is now close on two million tons per annum. The rock salt is twenty-three yards in thickness; and the total number of pans in existence in the county in 1883 was 1312, against 1170 in 1882, and 752 in 1867.

LOUGH ERNE DRAINAGE—LARGE CONTROLLING SLUICES AT BELLEEK.

On page 218 of our impression of 19th September we gave the first of several engravings representing the large sluices erected at Belleek, from the designs and under the free roller patents of Mr. F. G. M. Stoney, M.I.C.E., of Westminster-chambers.

As promised, we now complete the illustrations with a description of these remarkable sluices, and give also a photographic supplement showing the sluices as completed and their surroundings.

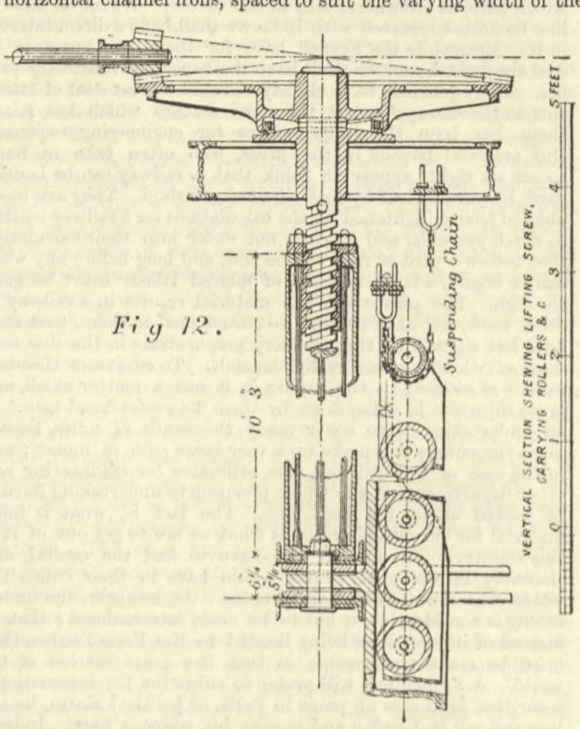
The upper and lower Erne lakes, in the county Fermanagh,



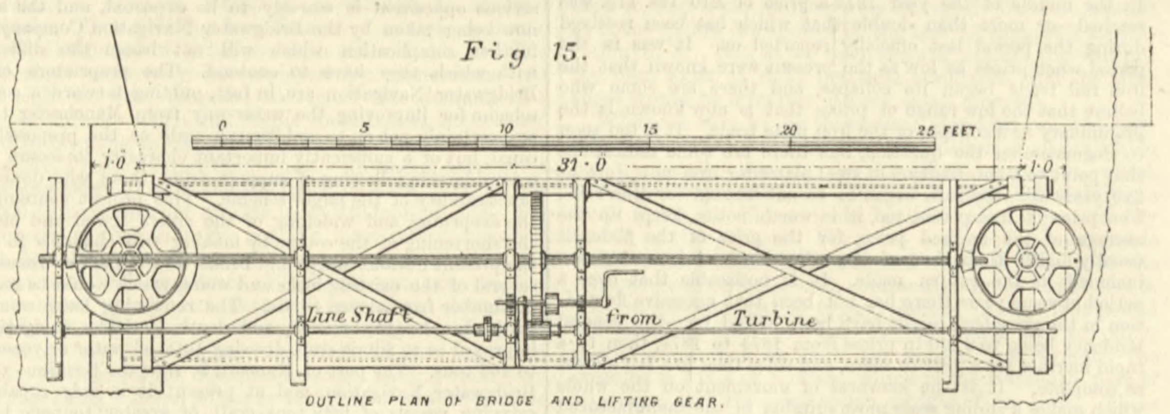
Ireland, extend from near Belterbet to near Belleek, a distance of about fifty-two miles of unbroken water, studded with numerous picturesque islands. These lakes are the natural river basin of an extensive catchment area in a very wet district, and some 18,000 acres of land bordering the lakes were flooded injuriously by the winter and autumn floods, at which times the lakes rose to as much as 7ft. above normal summer level. The great loss to the riparian proprietors and farmers by damage to and loss of crops has caused a long felt want of some efficient means of controlling the water level in the lakes, and the "Lough Erne drainage" scheme has been proposed and dropped time after time during the

posed of two heavy channel irons, 12in. by 3in., back to back, but separated some 5in., the depth of the rolled H-iron struts, which are rivetted to both channel irons, and at their other extremities are united in double wrought iron plates, which form bearings for the 3½in. coupling pins of the forged link bars forming the tension member of the trusses. The extreme ends of these link bars are united to the ends of the channel irons by like 3½in. turned pins.

The main beams are situated at equal distances above and below the centre of pressure, when there is 14ft. of water at one side and no water at the other. On these beams are seven vertical rolled iron H beams, 8in. by 5in., and on these again are horizontal channel irons, spaced to suit the varying width of the



wrought iron plated front, the plates of which vary from ½in. thick at the bottom to ¼in. at the top. This arrangement makes a very strong structure, and brings the position of centre of gravity of the moving mass into the planed centre of the compression member of the main beams. On the back of the gate at each end is a trough-shaped cast iron girder to form a roller beam or path for the bearing rollers. These beams have heavy lugs at their backs, which are bored out to fit the 3½in. turned pins. They fit in between the double link bars—Figs. 8, 11, and 12—of the truss, and are incorporated with it by the 3½in. pins, so that they can, if required, oscillate a few degrees to right or left to compensate for discrepancies between the span of the truss and the span of the masonry expansion, or maladjustment. It also prevents the possibility of twist or crack in the casting. Experience in erecting and working has proved the great utility and convenience of these provisions.



OUTLINE PLAN OF BRIDGE AND LIFTING GEAR.

past twenty years, kept alive and pushed into substantial existence by Mr. J. G. V. Porter, of Belleisle, under the engineering management of Mr. James Price, M.I.C.E., Dublin, chief engineer to the Lough Erne Drainage Board. So far back as 1879, after having inspected the French systems of barrages, Mr. Price conferred with Mr. Stoney as to his system of free roller sluices which he finally adopted. The plans were prepared in 1880, and the work ordered early in 1881.

The natural outlet of the Erne lakes is the Erne river, which leaves the lower lake at Roscor, a few miles above Belleek. There is very little fall in the river between these points, and there are numerous shoals and obstructions which prevent the efficient discharge of flood waters. At Belleek are the first falls and rapids, and from that to the sea at Bally Shannon, some five miles, there is a fall of about 150ft. If the river Erne were simply enlarged and deepened from the lake at Roscor, and through the Belleek falls, no doubt the lakes could be drained, but the summer level would be reduced and the navigation destroyed. Not only to maintain, but to raise this summer level, and at the same time provide a means of complete control for the retention or release of water, and the maintenance of a fairly uniform water level in the lakes without flooding the borders, these large sluices were designed. A new cutting, some few hundred yards long, about 140ft. wide, and 16ft. deep, has been made through the limestone rock at the Belleek falls, and in this new cutting the four large sluices are erected in massive piers of ashlar masonry, set in cement mortar. The sluices have a span of 31ft. from centre to centre of the bearing rollers which carry the entire water pressure, without any sliding friction whatever. The clear span at front of the gate is 29ft. 2in., and the height of the gate itself is 14ft. 6in. above the sill, the static pressure being between 85 tons and 86 tons. The weight of each gate is between 12 tons and 13 tons, no portion of which is in anywise counterbalanced. As a matter of working experience, the resistance in traction on the bearing rollers due to the 85 tons water pressure is inappreciable, and the work to be done in opening a sluice is practically that of lifting the weight of the gate, for which reason great care and attention has been bestowed on the means of carrying this weight with as little friction as possible consistent with suitable gear. To this end the dead weight of the gate is carried on coned free rollers.

Each gate is built up on two powerful truss beams, seen in plan in Fig 7. The compression member of each beam is com-

The water-pressure is transmitted from these beams through groups of free rollers to heavy cast iron beams bolted to the masonry piers, Fig. 11. These beams are compound, being composed of a fixed casting having a vertical flat V groove, in which rocks a face casting, planed on one side to form a roller path, and on the other to a V bearing of 90 deg. This face casting is attached at both ends to the fixed casting in such manner that while it is securely held in position it is free to rock a few degrees as may be required. This provision, together with that

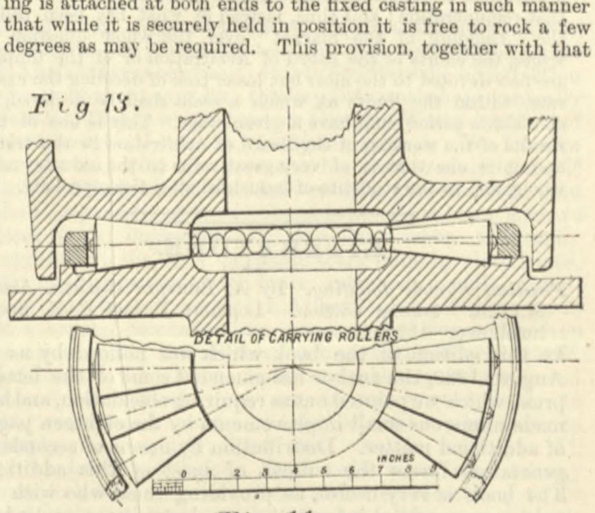


Fig 14.

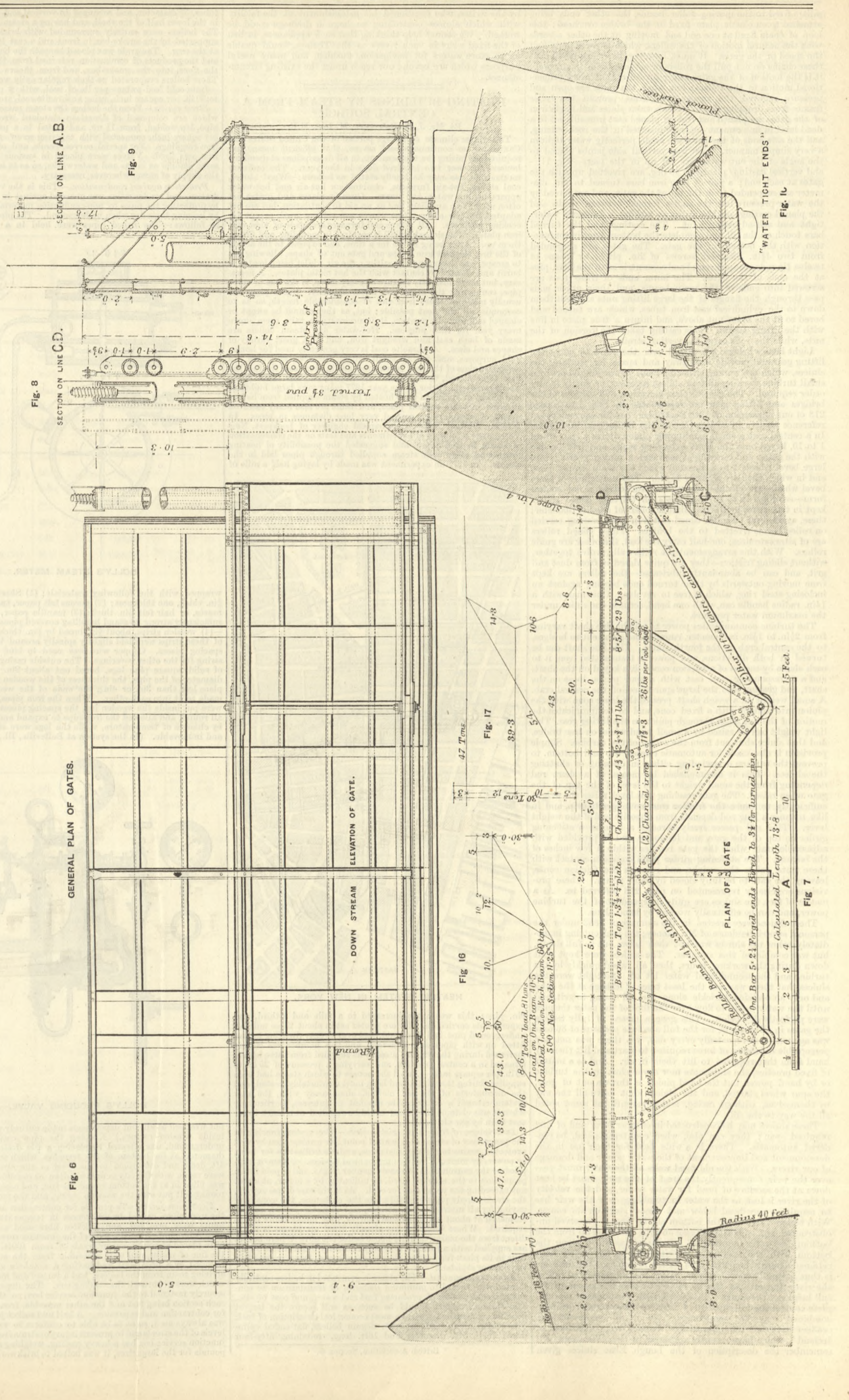
in the beams attached to the gates, insures absolute parallelism between the working faces of both beams, a thorough even bearing on the large rollers, without drag or twist, and realises the benefit of free rolling motion.

The bearing rollers consist of groups of twelve rollers, 8½in. diameter, 6in. face, turned to a ring gauge symmetrically disposed against the centre of pressure, also two guide rollers and a suspending chain pulley. Each group is enclosed between a pair of stout wrought iron cheek plates, and is suspended by a pair of light chains passing under the turned pulley on top of the frame— Fig. 12; one end of these chains is carried on small

LOUGH ERNE DRAINAGE—LARGE CONTROLLING SLUICES AT BELLEEK.

MR. F. M. G. STONEY, M.I.C.E., WESTMINSTER, ENGINEER.

(For description see page 282.)



pillars fixed to the moving roller beams, the other ends being attached to an elastic plate fixed in the bridge overhead; this loop of chain fixed at one end and moving at the other accords with the natural motion of the rollers, which move at only half the speed of the gates. It must, however, be remembered that these chains do not pull the rollers or actuate them in any way; it is the motion of the gates under pressure that gives proportional motion to the rollers; but when the gates are open and pressure relieved, the suspending chains prevent the roller frames from dropping down. The bottom plates and angle iron of the gates are planed and rest on planed cast iron sills set to a dead level in fine cement concrete inserted in the rock-cutting, and the side ends of the gates are made perfectly water-tight in a very simple manner. Cast iron vertical side jambs planed to the angle of the cut-waters are set up in the piers—Fig. 11—and vertical castings planed to 45 deg. are rivetted up with the gates at each end; a pair of long iron bars turned to 2in. diameter are suspended from the top of the gates, and are forced by the water pressure into the angles formed between jambs and the planed castings on the gates, so making a perfectly water-tight and self-adjusting joint. The castings and the turned bars touch on the sill, and complete the bottom joint in conjunction with the bottom of the gate. The gates are suspended from two 4½in. diameter screws of 2in. pitch, by means of twelve tie rods grouped round and concentric with the 3½in. pins at the ends of the gates. The lower ends of these rods are screwed into ends of the main beams, and their upper ends pass through the flanges of the large lifting nuts and bolt them down to the cylindrical cast iron tubes, which are turned and bored to fit the brass nut above, and insure a true place in line with the lifting screws. This casting takes the torsion of the nuts, while the rods carry the vertical strain.

Light lattice bridges are placed over the piers to carry the lifting gear and provide a footway and space for working the sluices, which are worked either by hand power singly, or by a small turbine working all four sluices together, or singly in any order required. The general plan, elevation, and sections of the bridges and lifting gear are represented in Figs. 1 to 5, page 218 of our impression of 19th September, but for convenience of reference we give an outline plan of the lifting gear in Fig. 15. In a central crab a small hand-power pinion drives a spur wheel 1 to 10, keyed on a 2in. shaft extending right and left in line with the gates, and carrying at each end a pinion gearing into large bevel wheels 1 to 8, through which the main screws pass, and in which they are securely keyed. The under side of these bevel wheels are chambered out and turned to a flat conical form—see Figs. 12 to 13—and rests on thirteen coned rollers kept in true space by thirteen similar rollers of smaller diameter; these, again, bear on a like coned cast iron bush bearing carried on rolled beams rivetted to the bridges. These coned rollers are of alternate sizes; one-half carry the load, the other are guide rollers. With this arrangement the rollers all revolve together, without sliding friction—they are quite closed in from dust and grit, and can be abundantly lubricated—the rollers are kept from moving outwards by their turned ends bearing against an inclosing steel ring, which is free to revolve. One man with a 14in. radius handle can, with one hand, actuate one sluice under the maximum water pressure.

The turbine communicates power to a light line shaft varying from 2¼in. to 1½in. in diameter, running along the entire bridges, to the central crab on the fourth sluice. This line shaft can be turned in both directions, and power is transmitted from it to each sluice by means of a friction coned disc keyed on the shaft, and a corresponding cone cast with a spur pinion loose on the shaft, and gearing into the large spur wheel of the central crab. A small weight on a weigh shaft presses the loose cone with the pinion into contact with a fixed cone, and so communicates the motion of the line shaft through pinion to the lifting gear. This light weight can be raised by a small hand wheel on the bridge, and that sluice shut out from the action of the turbine. Simple provision is also made for automatic release, top and bottom, to prevent the turbine overwinding either in opening or shutting the sluices. This is accomplished by means of a short rod depending from the small weight to the level of the top of the gate when raised. The gate reaching this level, raises the weight sufficiently to cause the friction cone no longer to grip, and in like manner a long rod depends from opposite end of the weight lever. This rod passes freely through a hole in a stiffening girder on top of the gate, and its lower end is provided with adjustable nuts when the gate reaches within a few inches of the bottom. The stiffening girder plate comes in contact with these nuts, raises the weight, and releases the friction cones, leaving the gate to be fully closed by hand power. These provisions are clearly represented on page 218 referred to. As a matter of fact, the sluices are quite independent of the turbine power, and can be effectually worked by hand alone.

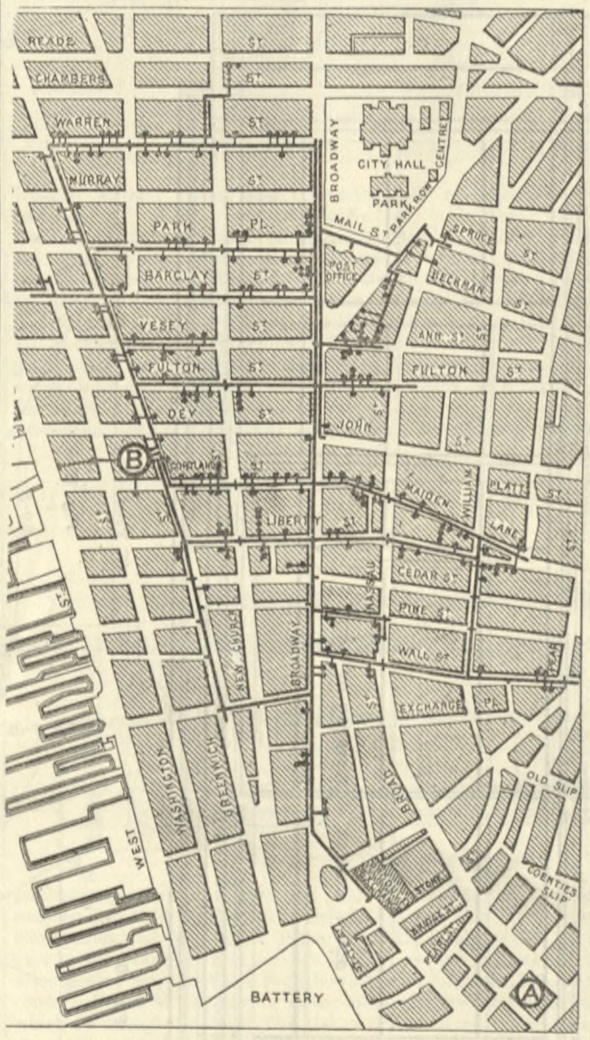
These sluices were erected in the summer of 1883 under the personal superintendence of Mr. Stoney; the rock cutting immediately below the sluices was not then taken out to full depth, but was completed this summer. The sluices were kept shut down during the working hours, then all raised quickly by the turbine and the accumulated water let off. So tight were the sluices that there was not the least trace of leakage at the sides and only an occasional trickle along the sill owing to grit, and until the water began to flow over the tops of the gates the men were perfectly dry below. This gave a means of fully testing the gates in all respects, for the full absolute pressure of 86 tons was against them repeatedly every day, yet there was not any perceptible difference of force required to start and lift them by hand from that required to lift them in air. And as a matter of fixed practice, the sluices are now never shut by the turbine or by hand power, but the hand pinion is thrown out of gear, the spur wheel started, and the sluices shut down all the way by themselves, without racing, and apparently at same speed all the way to the sill.

These sluices may be constructed in cheaper form and of any required span; they can also, when counterbalanced, be rendered automatic. There is a wide field for their use in the development and improvement of the water power and drainage of our rivers. With the old fixed weirs all the water must pass over the weir, consequently the crest of the weir must be kept down at the sacrifice of head for water power, and the velocity of the river is lost, as the water in tumbling over the weir has to acquire a new head below and a new start on its course. With the movable weir the bottom of the river is preserved unobstructed, and as floods increase and the gates rise up from the bottom, the water requiring to be released passes off along the bottom with the maximum velocity due to the entire head retained against the gates; and for the reason that the drainage is thus naturally provided from along the unobstructed bed of the river, the gates of the movable weir may be carried to the full height of the banks. In a word, with such means of complete control the full capacity of the river for power and drainage combined may be commanded. No doubt many of our readers have seen the interesting "Letters from the West of Ireland" which have recently appeared in the *Times*, and will remember the description of the Lough Erne sluices given by the writer, who mentioned his astonishment at the facility with which sluices controlling so large a drainage could be worked. We cannot help thinking that such appliances, in lieu of the fixed weirs in such rivers as the Thames, would enable us to store waters for navigation, flushing, and many useful purposes which are beyond our reach under the existing circumstances.

HEATING BUILDINGS BY STEAM FROM A CENTRAL SOURCE.*

By Mr. J. H. Bartlett, M. Inst. M.E.

The winter climate on a large portion of the United States and Canada is so continuous and severe, that efficient means are required for raising the temperature, in all descriptions of dwelling-houses, for over two hundred days in the year. The ordinary methods in use may be briefly stated as follows:—Wood stoves, coal stoves, hot-air furnaces, combination hot-air and hot-water apparatus, hot water, and steam. Open fireplaces and grates are often used as an auxiliary and as an aid to ventilation, but are not adapted for use alone. Gas stoves are seldom used, except for cooking purposes. All stoves and furnaces are made of thin cast iron plates. Considerable skill is required in moulding and fitting them up. After being in use for a time, and exposed to the action of the fire, the cast iron warps and gets out of shape, allowing gas to escape, and becoming unhealthy; the air whilst being heated is burnt and vitiated by contact with the hot metal plates. A necessary, but most unsightly feature of every stove, is the flue or stove pipe, connecting the stove and house chimney. Stove pipes are usually made of sheet iron and of considerable length, so as to economise all the heat possible; but, as they cannot be swept or cleaned out when in position, it is necessary to take them down every year for that purpose. Hot-water and steam boilers are made of both cast and wrought iron, and of a great variety of shapes and sizes. Anthracite coal is very generally used for household purposes, and for all small boilers, furnaces, or stoves, an expensive class of this coal is required, and in every case the fuel has first to be stored, then handled and burnt, and the ashes afterwards removed. Prior to the year 1877 many very large buildings and blocks of buildings were heated by steam supplied from boilers situated in some central place, and there are also many cases on record of steam being carried very long distances in pipes. In 1876 Mr. Birdsill Holly, a mechanical engineer of Lockport, New York, made a number of experiments and tests on the condensation of steam in iron pipes, and suggested the possibility of heating towns and cities with steam supplied through pipes laid in the streets. In 1877 an experiment was made by laying half a mile of



HEATING SYSTEM IN NEW YORK.

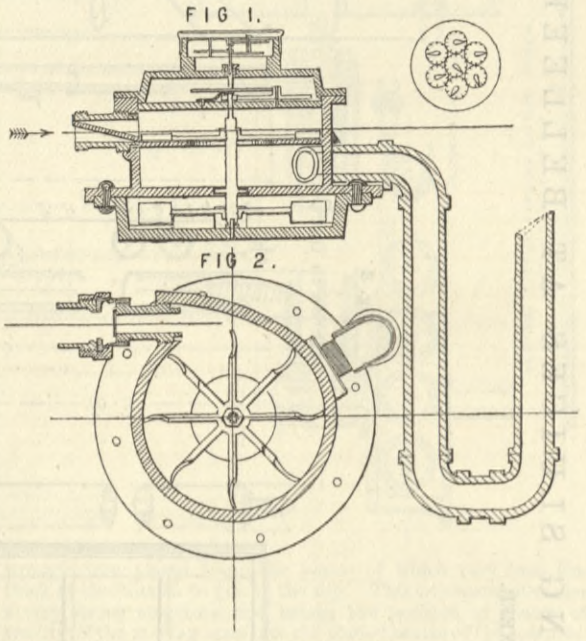
3in. pipe; this was again increased to a mile and a-third, and experiments carried on. Before winter set in about three miles of underground pipe had been laid, and over twenty dwelling houses fitted up with pipes and radiators, and this number was largely increased during the winter; steam was supplied from three boilers situated in a central position, and carrying a pressure of 25 lb. to 30 lb. per square inch. As all the houses to which steam had been supplied during the winter had been most comfortably heated, and the discomforts of the old methods done away with, the new system created a considerable amount of interest, particularly when it was claimed that heat could be supplied at a much lower cost than by the old methods.

Description of Holly's district system.—The system consists in the generation of steam at a central point, its transmission by well protected mains to suitable distances, and its utilisation for heat, or power, by means of various mechanical devices. Steam is supplied to the consumer in the same manner as gas, and is paid for in proportion to the amount used, as indicated by a meter, at a cost not exceeding the usual cost for coal. As in the case of gas supply, the steam supply pipes are laid up to the curbstone, the consumer paying for all internal pipes, fittings, and radiators, which can be furnished at about half the usual charges, as a house boiler is not required. Where buildings are already fitted up, steam is taken direct from the mains, and the house boiler cut off. Where houses are supplied with a furnace, it is only necessary to substitute steam coils in its place for heating the air, no changes being required in the flues or registers.

Apparatus required.—The steam is generated in boilers centrally located with regard to minimum distance of transmission to consumers, convenience of procuring fuel and water, and cost of site. The form of boilers should be such as will secure the largest possible evaporation, with the most economical description of fuel. Those adopted at Lockport were Seguin boilers, flat-ended cylindrical shell, 5ft. diameter and 16ft. long, containing fifty-four tubes, 3¾ diameter, and arranged in vertical and horizontal rows, in the lower half of the shell, and having a steam dome on the top. The boilers were entirely surrounded with brickwork, and were supported by the smoke-box in front and a cast iron belly bracket at the rear. The grate was placed beneath the boilers at the front, and the products of combustion returned from the back, through the flues, into the smoke-box, and from thence to the chimney. These boilers evaporated as their regular daily work 9 lb. of water—from cold feed-water—per lb. of coal, with a pressure of 25 lb. to 30 lb. per square inch, using anthracite coal, stove and grate size.

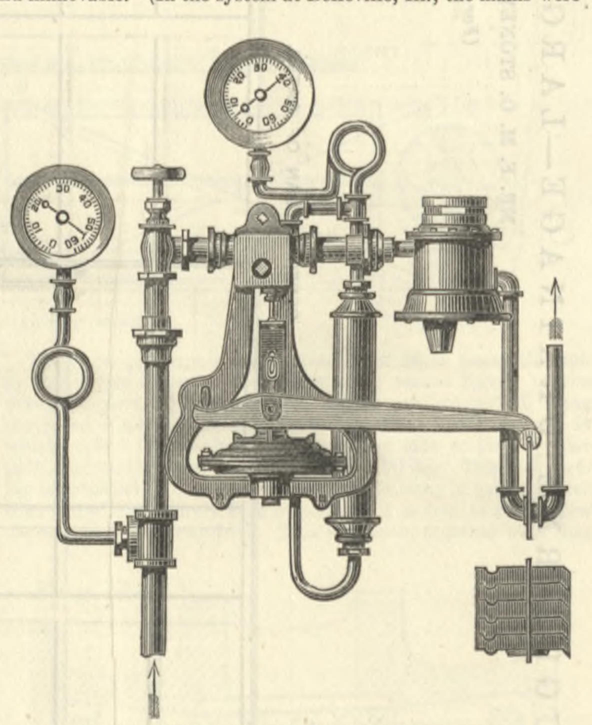
Street mains.—From the boilers the steam passed into the mains, which are composed of American standard wrought iron steam pipe, lap welded, from 1¼ up, and tested to a pressure of 500 lb. per square inch, connected with tapering screw ends, and wrought iron couplings. For special curves, bends, and other details, cast iron was used. Valves were placed in various positions, in the same manner as in gas and waterworks, so as to be able to turn off the supply of steam wherever necessary.

Protection against condensation.—This is the vital point of the system, and condensation was guarded against in two ways—first, by protecting the pipes by non-conducting materials; and secondly, by keeping them dry when underground. The pipes were prepared as follows:—The naked pipes were held in a lathe, and were



HOLLY'S STEAM METER.

wrapped with the following materials: (1) Sheet asbestos about ⅛in. thick, one thickness; (2) porous felt paper, two or three thicknesses, or hair felt ½in. thick; (3) manilla paper, one thickness—sufficiently strong to stand handling covered pipes, and not to tear—(4) wooden strips, about ¾in. broad by ⅜in. thick. Three or four of these strips were laid slightly spirally around the pipe, forming spacing pieces. Copper wire was used to bind the strips, and string for the other coverings. The outside casing of all was made of solid square pine logs, bored out about 2in. larger than the diameter of the pipe, the thickness of the wooden shell being in no place less than 3in. or 4in.; the ends of the wooden pipes were made to fit into each other. When the iron pipes, duly protected, were put inside the wooden log, the spacing pieces left an air space all round, and allowed the iron pipe to expand and contract freely, by changes of temperature, while the logs were securely anchored and immovable. (In the system at Belleville, Ill., the mains were



HOLLY'S REDUCING VALVE.

not wrapped at all, but dependence made entirely upon air spaces inside wooden casings.) Keeping the pipe casings dry, when underground, was effected by placing a tile drain, 3in. or 4in. in diameter, at the bottom of the trenches, which were from 3ft. to 4ft. deep, and conformed to the level of the street; connections were made with the city sewers as often as possible; broken stone was filled in at the bottom round the tile, and a covering of tarred roofing felt put over the wooden casing, and the trench filled in.

Expansion joints.—To provide for contraction and expansion in the iron pipes, caused by differences in temperature, stuffing-box joints were provided, and asbestos fibre used as packing. The expansion joints formed a part of the junction service boxes, which were placed at convenient intervals of from 100ft. to 200ft. along the line of mains, and were accessible from the street, being surrounded by a brick wall, and having a manhole and cover. The arriving main from the boilers, had a turned and nickel-plated end, which worked through the stuffing-box. The departing main was securely fastened to the junction service box, so that, one end of each section being fast and the other movable, free play was given for contraction and expansion. A ball and socket joint attachment was always used, so as to be able to conform to variations in the levels of the streets and to prevent injury or strain from settling. The junction service box has a heavy casting, weighing several hundred pounds for the large sizes, it was bolted to brickwork, and anchored

* British Association, Section G.

to the wooden pipe casing. The mains were never tapped for the attachment of service pipes, these connections being only made at the junction boxes, which also served to take up the water of condensation, the bottom of the box, being placed lower than the level of the pipes. A very important improvement has recently been made by using elastic copper ends to the sections of iron mains, this allows sufficient play, and does away with all packed joints, which are now entirely discarded.

Service pipes.—The service pipe connections on the junction service box were taken off at right angles to the main, and were provided with stop cocks. The service pipes were protected from condensation, in the same manner as the mains.

Reducing valve and regulator.—The steam on entering any building through the service pipe, at high pressure, had at once to pass through a regulator-reducing valve, by means of which the pressure was reduced to any desired amount, and the supply of steam automatically regulated. This was done by means of an elastic diaphragm, and a weighted lever, a small slide valve being moved, by a valve rod connected with the diaphragm. Valves made on the same principle have often been used for supplying low-pressure steam engines, from high-pressure boilers.

Meter.—From the reducing valve and regulator, the steam, at a low and uniform pressure—generally from 2 lb. to 5 lb.—passed through the meter and into the supply pipes of the house. A method of accurately measuring and recording the amount of steam supplied, has been a most difficult problem to solve, the commercial success of the system being really dependent upon it. The method at present employed is pronounced reliable and satisfactory by several independent parties, after being in practical use for the past two years. The meter is made of cast iron, and in plan is circular in shape; its height and diameter are about equal; it is divided horizontally into four chambers or compartments. On the outside upturned face are a series of horizontal dials, which register revolutions, actuated from gear wheels inside the top chamber, they derive their motion from a central vertical shaft, passing through the other compartments, and having a bearing on the bottom of the meter. To this shaft are fastened two miniature brass paddle-wheels, or spider frames, of eight arms each, with vane-shaped ends, curved slightly forward. The second, or steam entry compartment, contains one paddle-wheel, which revolves almost touching the bottom. A circular opening in the bottom connects the third or steam exit compartment. The bottom compartment, which is closed all but a small hole round the shaft contains the other paddle-wheel, and is always full of condensed water, in which the paddle-wheel revolves, stationary vanes preventing the water from being bodily whirled in the direction of rotation. Steam is admitted through a square pipe, the centre line of the opening being on the line of the inside circumference of the chamber, giving the steam a circular motion as it enters; within, and from the top of the square pipe is hung a long copper tongue, the same width as the pipe. The tongue rises and falls, as the quantity of passing steam varies, but always directs it upon the vane-shaped ends of the spider, which revolves in the steam at a speed proportional to the amount and pressure of the steam admitted. The bottom spider, revolving in water, acts as a governor and prevents the too rapid revolution of the shaft, the revolutions of which are recorded by the counters on the top. The steam passes out of the third compartment, the exit being nearly at right angles to the entrance. The quantity of steam passing through the meter is not measured or recorded in any ordinary terms of measurement, such as pounds, or cubic feet, but in "units," the value of which have been determined by experiments, the amount of condensed water resulting from steam passed through having been accurately weighed. Charges for steam supplied through meters are made per 1000 units. The value of the unit varies with the size of the meter, the pressure of steam, and the cost of fuel and water, and the evaporative performance.

Direct heating—Radiators.—From the meter the steam intended for heating purposes passed through the supply pipes into the radiators. Any of the ordinary forms may be used, and all the ordinary steam fixtures. The usual American pattern of radiators are made of vertical lengths of 1in. iron pipe, secured into a base and cap, the steam exit and entrance both being in the base. In common with most descriptions of steam radiators, they have to be either full of steam or empty, there being no means of regulating the steam supply. Mr. Holly overcame this by making the steam entrance at the top of the tubes, in the cap, and having an air valve at the base to permit the air to escape. Steam, being lighter than air, displaced it to any extent that might be required, entirely or only partially filling the tubes. In practice it was found difficult to keep the joints tight in the base and cap owing to unequal expansion and contraction.

Indirect heating—by coils in the basement.—The steam and water of condensation from all the radiators passed through coils of steam pipe in a chamber in the basement, to which fresh air from the outside was carried through a flue; the air thus heated rises through flues and registers, in the ordinary way, and supplies fresh air, while assisting to heat the house.

Traps.—The water of condensation escaped through a steam trap and wasted into the sewers, unless required for domestic purposes.

Other uses of steam.—Live steam can be used for heating water, and when this is done, by direct contact, the noise can be almost entirely stopped by first passing the steam through a small box filled with gravel or fragments of stone. For cooking purposes, steam does well for a variety of articles, and a stove has been perfected that, with superheated steam, all sorts of cooking can be done, the superheating being done with a gas flame. The following report of Mr. Birdsill Holly was published at Lockport on May 18th, 1878:—"During the past winter an equivalent of sixty-five houses,* on nearly three miles of underground pipe, have been heated, and an accurate record has been kept from day to day of the amount of coal consumed. From well-understood facts, and from tests actually made to ascertain the amount of condensation in the houses, also twelve hour tests upon the main line with all the houses shut off, it is demonstrated what amount of condensation is due to the buildings, and how much to the pipe underground. The details for cost of constructing works and the cost of fuel are applicable to this city, and will be varied somewhat, according to location and circumstances. The tables in the next page show the cost of heating by this system, and the comparisons made with other systems of heating will, upon perusal, speak for themselves.

This result has not as yet been realised in actual practice, but none of the systems have had so large a number of consumers on so short a main.

The winter's experiment at Lockport in 1877-8 having proved the practicability of the system, and the consumers being so well satisfied, several other towns at once took the matter up and had systems in operation for the following winter. The first meters did not work well, and the only way of charging for heat was by bargain, based upon the previous coal bills of the consumer. The companies suffered severely in these bargains, but the greatest loss was caused by having long lines of main, with only a few consumers drawing steam, the loss by condensation being then very great. In many cases the trenches were not properly drained, and the system was adopted before sufficient time had been given to perfect all details. The result of all this being the failure of several of the companies.

Duplex system at Lynn, Mass.—At Lynn, Mass., a duplex

Number.	City.	State or Province.	Year of commencement.	Amount of capital or capital stock.	Boilers. Number.	Diameter.	Length.	Number of tubes.	Diameter of tubes.	Total horse-power.	Pressure carried.	Underground Steam Mains.											American Standard. Wrought iron welded tubes.
												1·80	2·88	4·98	7·20	11·31	19·49	30·11	42·36	70·65	96·25	166·9	Length to contain 1 cubic foot.
												78·838	50·039	28·889	19·990	12·73	7·388	4·783	3·355	2·038	1·496	0·8627	Internal area, in square inches.
												0·355	0·444	0·577	0·629	0·849	1·091	1·328	1·611	2·010	2·301	2·903	Length per sq. ft. out. sur. in ft.
												10·750	8·625	6·625	5·563	4·5	3·5	2·875	2·375	1·90	1·660	1·315	Actual outside diam. in ins.
												10·019	7·982	6·065	5·045	4·026	3·067	2·468	2·067	1·611	1·380	1·048	,, inside ,, ,,
												10in.	8in.	6in.	5in.	4in.	3in.	2½in.	2in.	1¼in.	1½in.	1in.	Nominal diameter.
1	Lockport	N.Y. ..	1877	dols. 50,000	6	5	16	54	3½	480	25-30	—	Four m	iles 8in.	and und	er	—	—	—	—	—	—	21,120 total lineal feet.
2	Detroit	Mich. ..	1878	81,750	—	5	16	—	—	1500	,,	—	About 3	miles of	all sizes,	8in. and	under	—	—	—	—	—	15,840 ,, ,, ,,
3	Springfield	Mass. ..	,,	50,000	9	5	16	—	4	685	,,	—	300	and 18,4	80 lineal	feet of s	maller s	izes.	—	—	—	—	18,780
4	Auburn	N.Y. ..	,,	31,300	4	5	15	79	2½	240	,,	—	—	900,	1200,	—	1500,	2000,	Not cou	nting la	terals	—	5,600
5	Milwaukie	Wis. ..	1879	75,000	17	5	15	—	—	—	—	585,	2540	5156,	1375,	5195,	1300,	and	6900	feet of	smaller	sizes	23,051
6	Troy	N.Y. ..	,,	75,000	6	—	—	—	—	700	25-30	—	Five m	iles fro	m 8 to	3in.	—	—	—	—	—	—	26,400
7	London	Ont. ..	,,	65,000	6	—	—	—	—	—	—	—	—	1900,	2000,	3000,	3000,	1500,	2100,	10,000	—	—	23,500
8	Belleville	Ill... ..	,,	45,000	10	—	—	—	—	—	—	—	Two m	iles 8in.	and und	er	—	—	—	—	—	—	10,560
9	Dubuque	Iowa ..	,,	40,000	—	—	—	—	—	—	—	—	—	860,	1960,	3818,	4441,	—	205,	2073,	2508,	643	16,508
10	New Haven ..	Ct... ..	,,	50,000	6	—	—	—	—	450	25-30	—	—	—	—	—	—	—	—	—	—	—	—
11	Lynn	Mass. ..	1880	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12	Denver	Col. ..	,,	160,000	15	5	17	48	4	1100	25-30	—	1540,	4968,	—	4094,	3400,	500,	3400,	1500,	1000,	500	20,902
13	New York City ..	N.Y. ..	,,	3,000,000	Ba	bco 250-	ck H.P	& eac	Wil h.	cox,	80	Five m	iles mos	tly 11,	13, 15, a	nd 16in.	diamete	r	—	—	—	—	26,400
14	Garden City ..	N.Y. ..	,,	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15	Hartford	Ct... ..	,,	75,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	Burlington ..	Iowa ..	,,	60,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	Clearfield	Pa. ..	1883	15,000	2	6½	17	72	4	—	25-30	—	—	—	400,	2200,	2600,	—	—	not cou	nting la	terals	5,200
18	Phillipsburg ..	Pa. ..	,,	20,000	2	—	—	—	—	160	—	—	—	—	350,	4000,	3000,	—	250	not cou	nting la	terals	7,600

Number.	City.	Consumers. Number.	Cubic feet of space heated.	No. of engines.	Charges for steam. Holly meters per 1000 units. 1in.	1½in.	2in.	Per 1000 cubic feet per season.	Fuel. Description.	Amount.	Reported trouble from leakages, bad joints, accidents.	Reported or estimated loss by condensation.	Public opinion. Are consumers satisfied?	Remarks.
1	Lockport	300	—	—	c. 65	dols. 2.00	dols. 5.00	dols. —	Soft slack	—	None	5 per cent.	Thoroughly	—
2	Detroit	—	—	—	U	suall	y	4.00	,,	—	More or less	Very much loss	Yes	Not likely to prove a good investment.
3	Springfield	194	—	—	70	—	—	—	Pea, dust, coke, buckwheat	4000 tons gross	None	10 per cent.	Very much pleased	Their bills are reasonable compared with furnace heat. The company made 12 p. c. last season.
4	Auburn	140	3,000,000	—	No	regu	lar ra	te.	Clearfield bit.	2300 ,,	Not more than could be expec'd	Big	Very much pleased	Prospects good for the future.
5	Milwaukie	100	5,000,000	10	U	suall	y	4.00	Soft slack	The company	failed during the	second season	and the works	were sold.
6	Troy	—	4,000,000	21	—	—	—	—	—	,, ,,	,, ,,	,, ,,	,, ,,	,,
7	London	150	—	—	—	—	—	—	Oil and tar	,, ,,	,, ,,	,, ,,	,, ,,	,,
8	Belleville	90	—	—	—	—	—	—	Soft coal	1000 bushels per day	None	—	Yes	No dividends paid so far.
9	Dubuque	100	3,500,000	—	—	—	—	—	—	—	—	50 per cent.	,,	—
10	New Haven ..	75	—	—	—	—	—	—	Pea coal	—	Yes	50 per cent.	—	"Sunk all their capital and shut down for good; in other words, busted."
11	Lynn	—	—	—	—	—	—	—	—	—	—	—	—	—
12	Denver	140	9,000,000	—	—	—	—	—	Slack coal	90 tons per day	None	15 per cent.	Yes	Prospects for the future good.
13	New York	250	—	160	—	—	—	—	Hard coal	—	,,	Same as gas	,,	,, ,, ,, ,,
14	Garden City ..	—	—	—	—	—	—	—	—	—	—	—	—	No information obtainable.
15	Hartford	—	—	—	—	—	—	—	—	—	—	—	—	Reported to have lost money last season.
16	Burlington	—	—	—	—	—	—	—	—	—	—	—	—	Prospects improving.
17	Clearfield	62	1,500,000	—	50	1.50	4.00	—	Soft coal	4 tons per day	None	5 per cent.	Perfectly	Made 6 p. c. last season, and expects 10 to 12 p. c. in future.
18	Phillipsburg ..	24	1,500,000	—	70	—	—	—	,,	2½ ,, ,,	,,	5 per cent.	,,	Company doing well.

* 12,000 cubic feet of space being taken as an average for dwelling-houses in Lockport.

system was put in for first supplying high-pressure steam through one main to drive large mill engines, these engines exhausting into a low-pressure main, from which steam was supplied for heating, &c. The idea was to utilise the power first and leave sufficient pressure for heating and cooking purposes. The boiler-house here was situated on very low land, which was subject to inundation during extreme high tides, the consequence being that near the boiler-house the steam mains were sometimes under water, and as few of the streets in Lynn are sewered, the ground was constantly damp in many of them, and a very large amount of condensation took place. The steam supply was discontinued, and the works sold and utilised for other purposes, although the steam works were fully paying expenses at the time of selling out.

The system in New York.—In New York, the system is being operated on a very large scale by a company who have selected and purchased ten sites for steam stations. The first station—station B—at Nos. 172 and 176, Greenwich-street, has been built, and consists of a building 75ft. front by 120ft. in depth and 120ft. high, in which are to be placed sixty-four Babcock and Wilcox sectional boilers of 250-horse power each, or, in all, 16,000-horse power distributed upon four floors—sixteen boilers on each floor. The draught for the furnaces of the boilers will be obtained by two large chimney stacks, each about 225ft. high, supplemented by a fan blower on each floor. The walls of the building are 36in. thick at their base and those of the chimneys are 4ft. thick. The dimensions of the chimney are as follows:—Exterior dimension at the base, 32½ft. by 20ft.; at bottom of flue, 32½ft. by 13ft.; interior area, 27ft. 10in. by 8ft. 4in. The coal supply will be elevated to the upper stories of the building and delivered through shutes alongside each boiler, while the ashes will be taken by shutes from each boiler through the basement of the building. On the 1st of January, 1884, the company had five miles of its street steam system in active use, having increased from one mile in use on the 1st June, 1882. The mains, which are from 6ft. to 10ft. underground, have been all the time under a full pressure of 80 lb. per square inch, and no one has been injured. The mains are made of lap welded tubes, and are most of them 11in., 13in., 15in. and 16in. in diameter, some are shortly to be put in 20in. and 24in. in diameter. In place of being screw coupled they are flanged and bolted together, the end of the wrought iron pipe being expanded into the flange by an enormous tube expanding machine. The condensed water is returned to the boilers by a pipe about half the size of the mains. The mains and return pipe are laid in a well-drained brick chamber and packed all round with mineral or slag wool as a non-conductor. Expansion and contraction is provided for by using elastic copper ends to the pipes, and the details of the system have been very carefully worked out.

Estimated Cost of Construction and Operation for a District of 400 *Dwellings on Two Miles of Street Mains, heating the same for* 240 *days, from September* 15*th to May* 15*th.*

CONSTRUCTION OF WORKS.

	£	s.	d.
Boiler-house and chimney stack	1232	17	6½
Six boilers, 5ft. by 16ft., set, with feed-water heaters	2465	15	1
Two miles mains, average 3in., at 5s. 9d. per foot ..	3037	16	2
Superintendence and incidentals	249	17	3
Total	6986	6	0½

OPERATING EXPENSES FOR 240 DAYS.

	£	s.	d.
2000 tons of coal, at 16s. 5¼d.	1643	16	8½
Two firemen and extra labour..	164	7	8
Repairs and depreciation	164	7	8
Office expenses	308	4	4½
Taxes..	82	3	10
Water Bill	20	10	11½
Dividend of 20 per cent. on 34,000 dols...	1397	5	2¼
Total	3780	16	5
400 consumers at £9 9s. 0½d.	3780	16	5

Cost of a District equivalent to 1000 *Dwellings, partly composed of Business Blocks and Public Buildings.*

CONSTRUCTION OF WORKS.

	£	s.	d.
Boiler house and chimney stack	1643	16	8½
Twelve boilers, 5ft. by 16ft., set, with feed water heaters	4931	10	5
Four miles of mains, average 3in., at 5s. 9d. per foot	6075	12	7½
Superintendence and incidentals	499	14	6
Total	13,150	14	2

YEARLY EXPENSES, HEATING, 240 DAYS.

	£	s.	d.
5000 tons of coal at 16s. 5¼d. per ton	4109	11	9½
Fireman and extra labour..	410	19	2¼
Repairs and depreciation, and sinking fund	410	19	2¼
Office expenses	308	4	4½
Taxes..	246	11	6
Water bill..	61	12	10½
Dividend of 20 per cent. on 64,000 dols...	2630	2	9
Total	8178	1	8½
1000 consumers at £8 3s. 6½d.	8178	1	8½

Statement of Cost.

INDIVIDUAL FURNACE SYSTEM.

One furnace will cost £56 10s. 1d.

	£	s.	d.
One consumer will use 10 tons, at 5·00 dols.	10	5	5¾
Depreciation and repairs 10 per cent. on 275 dols. ..	5	13	0¼
Five cents = 2½d. per day for attendance	2	9	3¾
Interest, 7 per cent., on investment, 275 dols.	3	19	1¼
Unreduced insurance	1	0	6½
Total..	23	7	5½

INDIVIDUAL STEAM SYSTEM.

One boiler and fixtures will cost £164 7s. 8d.—Running Expenses.

	£	s.	d.
Twelve tons of coal, at 5·00 dols...	12	6	7
Depreciation and repairs 5 per cent. on 800 dols.	8	4	4½
Fifteen cents = 7½d. per day for attendance	7	7	11¼
Seven per cent. interest on investment	11	10	1¾
Unreduced insurance	1	0	6½
Total..	40	9	7

DISTRICT SYSTEM WITH 400 CONSUMERS.

	£	s.	d.
Seven per cent. interest on cost of fixtures = £41 1s. 11d.	2	17	6½
Two per cent. depreciation and repairs	0	16	5¼
Heat bills, for steam supplied	9	9	0½
Total..	13	3	0¼

DISTRICT SYSTEM WITH 1000 CONSUMERS.

	£	s.	d.
Seven per cent. interest on cost of fixtures = 200 dols.	2	17	6½
Two per cent. depreciation and repairs	0	16	5¼
Heat bills, for steam supplied	8	3	6½
Total..	11	17	6¼

COMPARISON OF COST.

	£	s.	d.
Individual furnace system	23	7	5½
Individual steam system	40	9	7
District system with 400 consumers	13	3	0¼
District system with 1000 consumers	11	17	6¼

In a recent report the company state that they have over 200 buildings on their line, including 160 engines for power, and that they supply the steam for running the engines of the *Times*, the *World*, *Commercial Advertiser*, the *Tribune*, and five other newspapers, and a large number of printing offices, the new Produce Exchange, with nine elevators and electric lights, &c. &c., and that none of these buildings have boilers on the premises. They go on to say:—"To mention one thing in detail, cooking may sound small—it is and will be, in fact, one of the very largest in its consumption of steam. . . . There is one restaurant which has used our steam for eighteen months—Messrs. Smith and McNeil, Greenwich-street—and which buys from this company 15,000 dols. worth of steam per anuum. This is probably the largest restaurant in the world, serving about ten thousand meals per day. Messrs. Nash and Crook, in the *New York Times* building, is the next in size in the city, and one of the best known. The proprietors of both these immense establishments say they would not go back to their former mode of cooking if the coal were furnished to them for nothing." Steam will be supplied to heat buildings, supply power for cooking, and laundry work, for baths, and many other purposes requiring water as well as steam, for melting snow in the streets, and for extinguishing fires. Steam will be supplied by meter. The system is expected to spread all over the city, and the company say that, although having been so short a time in operation, they have reached a paying basis. The most recent development in connection with the New York system is that of supplying steam for electric lighting purposes. It was found that there was comparatively very little demand for steam from six o'clock at night till six o'clock in the morning, and there was consequently a waste in blowing it off every evening. To prevent this waste, the company propose to supply steam for running electric light engines during the night, and the cost of lighting should be much reduced in consequence. To prevent misunderstanding, it might be well to mention that there was another company in New York, who laid pipes in the streets, on some other system, for the supply of steam, but this company failed after having repeated accidents and explosions in the streets. The annexed list gives particulars of very nearly all the systems put in, the data in most cases having been kindly furnished by the companies themselves or from published reports. At Springfield, Mass., the gas company there took the matter up in 1878, and have been successful from the start, having utilised waste heat from their retorts, and also coke made on the premises. They put in a very short line to commence with, gradually extending it as consumers increased. Most of the systems are in operation for seven months, and at Denver eight months, out of the twelve. At first the street mains were only laid from 3ft. to 3ft. 6in. under the ground, but it is now thought that this is not deep enough, and double this distance is recommended, so that the frost and snow will not increase the condensation. In conclusion, it appears as if with the past experience, gained at the expense of several failures, this system of heating will in the future be adopted in many places; the two last systems reporting commercial success after being in operation only one winter.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, Sept. 23rd.

THERE has been a slight relapse in the volume of business, not only in iron and steel, but in lumber, coal, wool, cotton, and textile goods. If there is any reason for this, it is the fact that the States are entering upon the most exciting presidential compaign of twenty-four years. The greatest interest is being developed. It is only within the last few days that the men who contribute the money to run a presidential campaign have opened their purses; but the opening has been made, the political machinery has been started, and will be run to its highest speed up to the day of election.

During the past ninety days, eighteen anthracite blast furnaces have gone out of blast, reducing the productive capacity from 27,972 tons per week to 22,864 tons per week. The idle capacity has been increased during the same time from 27,305 tons per week, to 32,595 tons per week. During the same period fifteen bituminous furnaces have gone out of blast, reducing capacity from 48,000 to 43,000 tons per week. The idle furnaces have been increased during that time from 127 to 142, and the idle capacity from 43,000 to 49,000 tons per week. The American iron trade is therefore not in a very healthy condition. More than half of these furnaces will never make another ton of iron. In manufactured iron there is very little improvement. In fact, there is a general sagging of prices, and here and there mills are changing from double to single turn. Some furnaces are thrown off. The productive capacity of the blast furnaces has been reduced about 15 per cent. within three months.

From 20,000 to 30,000 tons of steel rails are selling every week, at from 27 dols. to 28 dols. per ton, according to size of order, and the inquiries coming to hand show that there is still a large amount of business to be done, but unfortunately a great deal can be done only in case rail makers or their friends will accept bonds, which just now it is impossible to negotiate.

In structural iron the heavy requirements for the next few months have been filled, but for next spring and summer a number of very important enterprises are talked of, and will no doubt be undertaken. In our large cities, there is need of, and demand for, elevated roads. The railroad companies are putting a great deal more iron into their buildings, and this helps to swell the demand. In Western Pennsylvania, the demand for natural gas fittings is stimulating demand for wrought iron pipe, and the manufacturers are doing very well. During the past week there were 206 failures, of which 82 per cent. were those of small traders, with capital less than 5000 dols. The striking spirit is waning. The Cambria Iron Company has just reduced wages 10 to 20 per cent., to date from October 1st. Their capacity is 150,000 tons of steel rails per annum.

The anthracite coal combination is mining 850,000 to 900,000 tons of coal per week, but finds it necessary to restrict production about 25 per cent. in order to preserve prices. The production this year will be about 30,000,000 tons. There will be a week's suspension from September 29th.

Several important engineering enterprises are projected. Capital is abundant, and is anxious for investment. The condition of the country generally is prosperous, and wage workers are content. Several companies have been formed recently to invest money in the South, and there will be a large number of capitalists and manufacturers who will visit the New Orleans Exposition from Boston, New York, and Philadelphia, for the purpose of making a preliminary investigation as to how and where they can most profitably invest some of their idle millions.

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

(*From our own Correspondent.*)

THE quarterly meetings this week have been an improvement upon those of July; yet the business done has not been conspicuous in other than sheets. In Wolverhampton yesterday—Wednesday—marked bars were reannounced as £8 2s. 6d. for Earl Dudley's make, and £7 10s. nominal for those of the other list houses. It is, however, well known that several firms who quote this price are accepting £7 and £6 10s. for good shipping orders. Earl Dudley's rivet and tee iron was quoted £10 10s. for single best, £12 for double best, and £14 for treble best. His lordship's ordinary tee iron was nominally £9 2s. 6d.; and strips and hoops of 14 to 19 b.g., £8 12s. 6d. for lowest quality, £10 for single best, £11 10s. for double best, and £13 10s. for treble best. William Barrows and Son's plating bars were quoted £8; their best Crown bars, best scrap bars, and best chain bars, £9; double best scrap and chain bars, £10; and their hoops, from 14 b.g. to 18 b.g., £8 per ton.

The demand for marked bars was reported by the chairman of the iron trade, Mr. B. Hingley, as only moderate, while he complained loudly of the competition with the Staffordshire district of the North of England ironmasters, not only in plates and angles and other constructive sections, but likewise in bars for export. The northerners are taking large numbers of shipping orders for bars that, in the ordinary condition of things, would fall to Staffordshire mills. The demand for cable and chain bars was reported worse than for a long time past, consequent upon the decline in the shipbuilding trade.

Ordinary bars were £6 2s. 6d. to £6, and common £5 17s. 6d. to £5 15s. Hoops were in fair call at £6 to £6 10s. at works, and the orders for gas tube and nail strip were increased at prices varying from £5 12s. 6d. to £5 15s. upwards. Common plating bars were £6 10s., and bedstead angles, in which the trade is improving, £6 5s. to £6 7s. 6d. and £6 10s.

An enquiry was on the market for the supply, for a period of three years, of the Admiralty with angle T, and Z bars, under a standing agreement. No manufacturer hereabouts, however, with trade in its present state, would think of looking at a contract which bound him to the end of 1887 unless he could secure a price which it is pretty certain the Director of Navy Contracts would not give.

Sheet makers brought better accounts on to 'Change than any other ironmasters. Certain of the stamping sheet makers continue as busy as they can be, largely on export account, at from £11 to £13 for high qualities. The makers of merchant and galvanising sheets are, in numbers of instances, booked forward considerably. These manufacturers are refusing offers made at 2s. 6d. rise upon the late minimum, and demand 5s. to 7s. 6d. per ton rise. Doubles were quoted £7 7s. 6d. to £7 10s., and occasionally £7 12s. 6d. Latens were £8 7s. 6d. to £8 12s. 6d. at works.

Shropshire sheet makers were particularly strong. Some of these quoted as much as £7 17s. 6d. for singles and £8 7s. 6d. for doubles, delivered at Liverpool. They stated that they had this week firmly refused £7 12s. 6d. for singles delivered Liverpool.

Wire rods were in improved demand, and Shropshire makers made the most of the circumstance. Rods for common fencing purposes they quoted £6 7s. 6d. to £6 10s., and £6 12s. 6d. delivered Liverpool; screw rods for United States consumption, £7 5s.; and charcoal rods for best screw and fine wire purposes, £11 Liverpool.

Pig iron sales were quiet in Wolverhampton market, consequent, in part, upon the recent considerable business having satisfied necessities. Again, consumers who have not bought are unprepared to give the advanced rates asked by vendors of brands made outside this district. Staffordshire all-mine pigs were redeclared yesterday at 80s. for cold blast, and 60s. nominal for hot blast. Sales could not, however, be generally made at more than 57s. 6d. for hot blast, and sometimes 56s. 3d. was accepted. I even heard of 55s., but these pigs could not have been made of Staffordshire ores. At 60s. Staffordshire makers declared sales meant a loss. The competition from hematites is severe. These were offered at 55s. to 56s. for forge sorts delivered into this district. Best Ulverstone forge hematites were quoted 56s. 6d. Thorncliffe pigs were 54s. 6d.

Best Derbyshires were quoted 43s. 9d. to 43s. 6d., but good ordinary sorts were 42s. 6d. to 42s. delivered; Northamptons, 41s. 6d. to 41s., all less 2½ per cent.; native part-mine pigs were 45s. to 42s. 6d.; and cinder pigs, 40s. to 37s. 6d., and occasionally 36s. 6d. Welsh white pigs were something under 40s. delivered; buyers did not generally offer more than 37s. 6d. for them. Welsh scrap iron—sheet shearings—was quoted 47s. 6d. to 50s. delivered, but consumers would only give about 46s. to 48s.

The Birmingham quarterly meeting to-day fully confirmed the tone of the Wolverhampton meeting. There was no alteration in crucial prices. Sheets were the only branch that showed a little stiffness. The tin-plate makers reported trade quiet, particularly on American account. Stocks were stated to show a little increase. The total exports so far this year show an increase on a year ago of 262,000 boxes. Fifteen shillings was named for Welsh coke plates, and 18s. for charcoals. On the open market prices were rather lower. The galvanised sheet makers announced themselves fully engaged on better prices than three months ago. The Sun and Blackwall brands were quoted £14 10s. packed.

Mail advices from Melbourne this week state that when the mail left galvanised iron quotations ranged from £19 to £21. Bars and rods were in moderate request at £9 to £9 10s. Sheets had been quoted at £11 10s. for Nos. 8 to 10, while hoops had been sold at from £9 10s. to £10. For fencing wire a slightly better demand had arisen, and fair sales were being made. Quotations ranged from £11 10s. to £12 10s.

The cable and anchor trade is dull, but here and there one or two contracts have recently been executed. Messrs. H. P. Parkes and Ross, of Tipton, have just completed a cable and anchor for a new Cunard boat. It will be the largest cable and anchor of its sort that has ever been sent out from this district, with the exception of one which is now being finished at Saltley, and which is intended for a sister ship.

The Patent Shaft and Axletree Company, Wednesbury, has decided to add to the already very varied character of its work the manufacture of cast iron pipes. It has a large foundry suitable for the purpose, and it has resolved to adopt the most recent improvements in the matter of appliances. Thus it hopes to be able to compete successfully with the older houses in the trade. The first contract upon which the company will begin is one for 700 tons of pipes, valued at £3500, for the Wednesbury sewerage scheme, and other valuable contracts are expected to follow from the same source.

Cultivating tools and horseshoes are fairly brisk. The Chillington Iron Company, Wolverhampton, has advanced the price of best Crown hand-made horseshoes 10s. per ton.

Export trade in hardwares does not show much improvement. Business with the Mediterranean continues sadly checked by the cholera scare; and the unsettled state of Egypt is affording an excuse to hardware consumers out there for delay in the payment of accounts. South American merchants are buying better, particularly in a few branches. India is purchasing steadily miscellaneous hardwares, but without activity.

At a monthly meeting of the South Staffordshire Institute of Mining Engineers held this week, Mr. Geo. Addenbrooke, of Leamington, read a paper on the Bulkley injector condenser.

Mr. J. Tindall, of Walsall, has been elected this year's president of the Midland Association of Gas Managers, as successor to Mr. G. E. Stevensen, of Peterborough.

The North Staffordshire iron trade is a little improved. Business is in a somewhat healthier condition; but considerable quietude still prevails in some of the branches. Buyers of finished iron are more willing to purchase at current rates, being of opinion that prices have reached bottom. Makers, however, state that at present prices business is unsatisfactory, and they are disinclined to sell large lots at current figures. Home consumers are pressing makers to complete the orders they have on hand, which is of itself a cheering feature. The export demand is also reviving a little. Several important mails have come to hand recently. Melbourne and Sydney are specifying for larger supplies, and merchants doing business with those markets are buying rather better. The United States and Canadian demand shows a falling-off, as is usual at this season. There is less doing in plates than in any other department. The competition existing in this trade is severely felt, and the mills are not making above half-time. Prices are generally pretty firm, but without any advance. Quotations are nominally:—Crown bars, £5 12s. 6d. to £6; best, 10s. extra; plates, ordinary quality, £7 to £7 7s. 6d.; best, £7 17s. 6d., delivered Liverpool or equal. Pig iron in some degree shares in the improvement in the finished branch.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business in this district continues to drag on slowly at low prices. Consumers as they have requirements to cover give out orders at the minimum current rates, which are now generally accepted as at the lowest probable point that prices are likely to touch, and in some cases there is a disposition to buy forward, but at the present unremunerative rates makers are not anxious to sell more than just keeps them going. Although prices do not get any worse, there seems to be just as little chance of their getting any higher, and makers who attempt to put up their prices, as they have been doing recently here and there as their order books have got full for the time being, are unable to get buyers to follow them. In most cases ironworks are kept employed with the small orders given out; a large number of the furnaces are, however, out of blast, and it is only this restriction of the production that prevents the accumulation of heavy stocks, whilst the output at many of the finished ironworks, although they are nominally kept in full time, is not at all equal to the capabilities of the plant. There is, therefore, a considerable reserve of productive power held in abeyance, and it is chiefly this fact that persistently keeps down prices at their present very low level.

A very dull tone characterised the Manchester iron market on Tuesday, and the weight of business offering seemed to be if anything smaller than it has been of late, whilst in some instances prices were a trifle easier to the extent that makers, who have been holding for rather better prices, were more disposed to entertain the low offers that have formed the basis of the bulk of the business that has been done of late. Lancashire pig iron makers report that they are getting a moderate weight of small orders, and as these, with deliveries against contracts, are taking away their present make, they are very firm at 41s. for forge and 42s. for foundry, less 2½, delivered here. Lincolnshire iron could in some cases be got at a little under the figures recently asked, but 42s. to 43s. less 2½ remain the minimum quotations for forge and foundry delivered here, with good Derbyshire brands quoted at 44s. to 45s. less 2½. In Middlesbrough and Scotch iron there is a tendency towards firmness, and at about 6d. under the quoted makers' rates North-country iron could have been sold freely at Manchester on Tuesday.

The hematite trade continues very depressed, with prices probably as low as they have ever been known before, 53s. 6d., less 2½, remaining about the figure at which good foundry brands can be bought delivered into this district.

In the finished iron trade a fairly good demand is reported for sheets, chiefly for export and largely to the colonies. For good qualities of sheets rather better prices are being got, and £5 5s. to £5 10s. are about average quotations, with some of the Staffordshire makers asking £5 12s. 6d. for delivery equal to Manchester or Liverpool. Other descriptions are only in moderate demand, and prices remain at about £5 12s. 6d. for good qualities of bars, and £6 2s. 6d. for hoops delivered here, with local makes in some cases to be got at about 2s. 6d. less.

The leading boiler-makers in this district are pretty full of work, but orders have to be taken at very low prices. Locomotive builders are also still kept well employed. Generally, however, the reports I receive as to the condition of the engineering trade are anything but satisfactory, and in most branches there is a falling off, which must soon make itself seriously felt, unless new work comes forward much more freely than it is doing at present.

Mr. J. K. Cross, M.P., the Under-Secretary for India, shows a good deal of anxiety to put himself right with the public with reference to the Indian State Railway contracts, of which so much has been said of late, and to which I have previously referred in these "Notes." At one of the local franchise demonstrations, held in a small country district, the hon. gentleman went somewhat out of his way to offer an elaborate explanation of the whole matter, and it is satisfactory to learn that, as the result of communications he has entered into with the English steel makers, they will have a good chance of securing in the future large orders for railway material, which the Indian State Railway department has recently been buying abroad. This applies chiefly to the steel axle-boxes that have been adopted for the Indian State Railways, and which the department have been purchasing in Germany, owing, it is explained, to the English houses being unable to produce them at the prices taken by the German manufacturers.

In the coal trade, although the upward movement in prices at the commencement of the month has not been maintained to the full extent, a fairly steady business is being done in all the better classes of round coal at an advance upon the September prices of 10d. per ton in the Manchester, and about 6d. per ton in the West Lancashire districts, and pits are being kept going about full time. Common round coals for steam and forge purposes continue only in moderate demand, and in some cases prices for these have only been advanced nominally; engine classes of fuel also continue plentiful in the market, and except the advance of 10d. in the Manchester district, which has only tended to put the Manchester firms out of the market, prices for burgy and slack are practically unchanged. At the pit mouth the average prices that are being got are about 9s. 6d. for best coals, such as Wigan Arley; 7s. 6d. for seconds, such as inferior Arley and Pemberton four-feet; 6s. 6d. for common house-fire coals, 6s. for steam and forge coals, 4s. 6d. to 5s. for burgy, 4s. for good slack, and about 3s. for common sorts.

For shipment there is a moderately good demand, but prices are being taken very little above those ruling last month, steam coal delivered at the high level, Liverpool, or the Garston Docks, being obtainable at about 7s. 6d. per ton.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE advance in house coal, to which I referred last week, has now been generally established, not only over South Yorkshire, but in the coal-producing districts of the adjoining counties. Stocking is very general, and those who lay in coal at present will get it in fine condition, the dry weather having been exceedingly favourable for screening. When the rains begin to fall the quality—or, rather, the condition—of the coal will not be so good. Messrs. Newton, Chambers, and Co., of Thorncliffe, whose tonnage to London is always at the head of all companies who send coal to London by rail, have advanced their prices by 10d. to 1s. per ton. Their quotations at Park station are now as follows:—Best Silkstone, 14s. per ton; thin seam, 12s. 11d.; brazels, 12s. 11d.; Silkstone nuts, 10s. 5d.; Silkstone brights, 10s. 10d.; common house, 10s. 5d. These rates are higher than at the corresponding period of last year by 6d. per ton in the best qualities, and 5d. per ton in the inferior sorts. Other kinds of coal—Thorncliffe—are:—Screened, 7s. 11d.; engine, 7s. 11d.; steel coke, 13s. 6d. The Nunnery Coal Company, who do the bulk of the town—*i.e.*, Sheffield—trade, has advanced by 6d. to 1s. per ton.

Our armour-plate mills are fully employed on work for the English and foreign Governments; and it is not expected that there will be any diminution of activity in this important speciality for many months. The anticipation, indeed, is that the orders for our own Government will increase, after the country has been so fully and clearly informed of the necessity for strengthening the British navy. Wherever I have gone of late among the larger firms, THE ENGINEER'S lucid comparison of the maritime strength of Great Britain and France was the theme of conversation. It is believed that whatever Government continues in office there must be an important addition to our fighting power at sea; and this, of course, means work for armour-plate makers as well as for shipbuilders.

I am told that negotiations are now going on between the Postmaster-General and the Sheffield Telephone Exchange Company, which will bring about alterations of an important character. The tariff is to be re-arranged and considerably reduced. Subscribers will be able to send their telegrams to the Post-office by means of the telephone on more favourable terms than have hitherto existed. "Call" or "talking" offices will be opened in various parts of Sheffield, to which the public may be admitted to speak to any of the subscribers on payment of a small fee. Another sign of progress is the announcement that Sheffield is to be placed in telephonic communication with the neighbouring towns.

At the Victoria Works, Gell-street, the property of Mr. John Wain, cutlery manufacturer, Sheffield, a fire took place on Saturday evening, which caused serious damage, destroying several cutlery shops and all their contents. Messrs. William Horridge and Co.'s stag, horn, and bone establishment, Pool Works, Burgess-street, were also much damaged by a fire on Sunday morning, several cutlers' shops being destroyed. Indeed, the Fire Brigade were returning from the one fire when they were called to the other.

The steel controversy still continues. All the Sheffield manufacturers with whom I have conversed, while admitting the immense services rendered by Sir Henry Bessemer and the extraordinary improvements made in his well-known steel, combine in saying that so far from crucible steel going out of use, more of it is made than ever, and the quantity of high-class Swedish iron imported for the purpose proves it.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

THERE were no exhibits at the Cleveland iron market held at Middlesbrough on Tuesday last, and nothing specially to mark it as a quarterly meeting. The tone was somewhat firmer and more hopeful than it has been for some time past. Consumers seem to be convinced that prices will not be lower, at least in the immediate future. They are, therefore, giving out long-withheld orders more freely, and are even willing to pay the slightly higher prices asked by the makers. Merchants are asking 36s. 9d. per ton for No. 3 G.M.B., for prompt delivery. This is 6d. per ton more than they would have been content with a month ago. Makers ask, and in some cases obtain, 37s. Indeed, No. 3 being exceedingly scarce at the moment, producers have the fixing of the price almost in their own hands.

Forge iron is not quite so plentiful as it was, and makers' prices range from 34s. to 34s. 6d. per ton.

Warrants are unsaleable, and seldom mentioned.

Messrs. Connal and Co.'s stocks of pig iron have decreased during the past week both at Middlesbrough and Glasgow. The decrease of the former stock is 120 tons, and of the latter 695 tons. The quantity at Middlesbrough on Monday last was 54,619 tons, and at Glasgow 583,002 tons.

Exports of pig iron from the Tees have not, so far, been brisk this month, only 14,480 tons having been sent away on Monday last. During an equal portion of September 23,329 tons were exported.

Of the finished iron trade there is little fresh to report. The outlook is somewhat brighter so far as shipbuilding is concerned. Messrs. Raylton Dixon and Co., of Middlesbrough, have received an order for a vessel to be commenced as soon as possible. She is to be made of steel, and the plates are to be manufactured by the Siemens process by Messrs. Bolckow, Vaughan, and Co., at their new plate mills at Eston. It is reported that Messrs. Palmer and Co.'s shipbuilding yard at Howden-on-Tyne, which has been closed for some months, will be re-opened shortly. Messrs. W. Gray and Co. and R. Irvine and Co., of West Hartlepool, and Richardson, Duck, and Co., of Stockton, each launched an iron vessel on Saturday last. The West Hartlepool Rolling Mills which have been idle for some months, were partially re-started on Monday last. An order has been received which will give employment to about 120 men for a fortnight.

Quotations for manufactured iron are unaltered, ship plates being £5 per ton; angles, £4 15s.; and common bars, £5 2s. 6d., less 2½ per cent. Puddled bars are £3 5s. to £3 7s. 6d. per ton net, all on trucks at makers' works.

The ironmasters' returns for September were issued on the 2nd inst. They show that ninety-eight furnaces were in blast, seventy-six of which were producing Cleveland iron, and twenty-two hematite, &c. The total make of iron of all kinds was 196,306 tons, being 5457 tons less than in August. Stocks decreased 4439 tons during the month, the quantity held on September 30th being 288,155 tons.

The average net selling price of No. 3 Cleveland pig iron for the three months ending September 30th was 36s. 5·93d. per ton, as against 36s. 4·65d. for the previous quarter. Miners will receive a slight advance, but blast furnacemen's wages will be unaltered.

The certificate issued by the accountant to the Northumberland coal trade shows that the average net selling price of coal for the quarter ending August was 5s. 2·46d. per ton, being a slight increase above the previous ascertainment. The wages of underground workmen and banksmen will be advanced 1¼ per cent.

Messrs. Bolckow, Vaughan, and Co. have decided to bore for salt on land belonging to them at Eston. The contract for the boring has been taken by Messrs. Vivian and Co., of Whitehaven, and operations will be commenced this week. It is expected that salt will be reached at a depth of about 1200ft. The boring at their Middlesbrough works is going on satisfactorily, and it is hoped salt will shortly be reached.

Dr. Spence Watson, of Newcastle, has once again consented to act as arbitrator for the North of England finished iron trade, and fix the wages of the operatives for the months of October and November. In accepting the position he has taken the opportunity to point out how exceedingly difficult and laborious the task of a wages' referee is, and how uneconomical of the energies of the many persons involved it is to go through it for a two months' settlement only. The same thing was forcibly pointed out by the employers at the last meeting of the Board. But the operatives were offended at the bare idea of another reduction, and were in no humour to consider the convenience of any one but themselves—not even that of an honorary referee—so that they would not agree to commit themselves beyond two months, and backed up by a single employer, they carried their point. Undue frequency of referees is greatly promoted by the present system of paying delegates, which allows them 10s. per meeting. To operatives this is handsome pay, and the more days' work of the kind the better they like it. To employers, however, who only get the same, it is equivalent to a loss. And to the unpaid referee, it is simply presuming upon good nature. At the next annual meeting of the Board it is contemplated to propose some new system of remuneration for operative delegates.

Mr. E. Trow, the able operative secretary of the Board of Arbitration, is seriously ill, and ordered away for three months. This is unfortunate, as the operatives have no one on their side fit to replace him.

The Council of the Cleveland Institute of Engineers have unanimously elected Mr. Alfred C. Hill, general manager of the Clay-lane Iron-works, South Bank, as their president for the ensuing two years. Mr. Hill is one of the only three members now surviving who was present at the first meeting of the Institute held in 1863. Some years since he contributed a valuable and exhaustive paper on blowing engines for blast furnaces, and he has taken an active part in the proceedings from the commencement. He is an able and experienced engineer, and his appointment has given great satisfaction. At the annual meeting to be held shortly, Mr. E. F. Jones, the retiring president, will vacate the chair in favour of Mr. Hill, and the latter is expected to give an address upon some department of iron and steel manufacture. The programme of the Institute for the forthcoming session will shortly be issued, and will announce several new papers of great interest to engineers.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

TOWARDS the close of last week there was a slight improvement in the warrant market in consequence of favourable reports as to stocks from the Cleveland district. But the market was sluggish in the early part of the present week, and a decline of several pence a ton occurred in the speculative quotations. The past week's shipments of Scottish pigs amounted to 9653 tons, compared with 9242 in the preceding week, and 12,023 tons in the corresponding week of 1883. The stock of pigs in Messrs. Connal and Co.'s Glasgow stores has been reduced 930 tons since last week. There are 92 furnaces in operation, as compared with 104 at this date last year.

Business was done in the warrant market on Friday up to 41s. 9½d. per ton for cash. On Monday transactions took place at 41s. 9d. to 41s. 7½d. cash. Tuesday's market was quiet at 41s. 7d. to 41s. 6½d. cash, and 41s. 8½d. one month. Business was done on Wednesday at 41s. 7d. to 41s. 8d. cash, and 41s. 9d. to 41s. 9½d. one month. To-day—Thursday—transactions occurred at 41s. 8d. cash, and 41s. 9½d. one month.

There is very little change in the values of makers' iron, which are as follows:—Gartsherrie, f.o.b., at Glasgow, per ton, No. 1, 56s. 6d.; No. 3, 51s.; Coltness, 60s. 6d. and 52s.; Langloan, 58s. and 52s. 6d.; Summerlee, 54s. and 47s. 3d.; Calder, 53s. 6d. and 47s. 6d.; Carnbroe, 51s. and 47s.; Clyde, 48s. 6d. and 45s.; Monkland, 43s. 9d. and 40s. 9d.; Quarter, 42s. 6d. and 40s. 6d.; Govan, at Broomielaw, 43s. and 40s. 9d.; Shotts, at Leith, 54s. 6d. and 52s. 6d.; Carron, at Grangemouth, 49s. (spectially selected, 53s. 6d.) and 48s.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 50s. 6d. and 43s. 6d.; Eglinton, 44s. 6d. and 41s. 6d.; Dalmellington, 47s. 6d. and 43s. 6d.

The general engineering trades are in a fairly active condition, but marine engineers are becoming very slack, with no immediate prospect of an improvement, which cannot be looked for until there is a revival in the Clyde shipbuilding trade.

There were shipped from Glasgow in the course of the past week £13,000 worth of machinery, including a sugar mill, valued at £6665, for Demerara; another at £3916, for Trinidad; there being besides locomotives and tenders to the value of £18,620, mostly for the Indian railways, together with a great variety of miscellaneous iron and steel goods.

In some departments of the coal trade there has been rather less animation, but there is still a good shipping demand at a number of the ports, and, taking the trade as a whole, no reasonable complaint can really be made with respect to it. On the Ayrshire coast there is a fair business doing.

A meeting of the Mining Institute of Scotland was held a few evenings since in Glasgow, Mr. James M'Creath in the chair. Discussions having taken place on papers read at previous meetings, Mr. Ralph Moore, Inspector of Mines, read a paper on "The Occurrence of a Flash of Lightning Passing Down a Shaft into the Workings of Swinhill Colliery, Stonehouse." This took place on 12th August last, while six miners were sitting in the dock, with their feet in water, on steam pipes connecting with the surface. Suddenly the men heard a crack near the engine, and saw a flash not so large as that of a lamp. Four of the men were pitched forward, and a fifth felt the shock, but was not thrown down. On recovering, the men rushed to the pit bottom, and hearing thunder, they concluded that what they had seen was lightning. No damage was done to the pit. An interesting discussion followed the reading of the paper, in the course of which it was remarked that such an occurrence, although often heard of, had rarely been so well authenticated, and that it might possibly throw light upon some of the great and mysterious explosions of past times.

The will of the late Mr. Anthony Inglis, ship-builder and engineer, Glasgow, who in early life was a blacksmith, shows that he died worth £152,779.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.

THE approach of winter is heralded in a most gloomy manner, and unless a decided change should set in, there will be very little work in the iron and steel works. This week notices were issued at Treforest Steel Works to all the workmen. Whether this means a reduction or stoppage is not known. Restricted make is probably in contemplation, the same as at the other works. Within the last day or two a slight improvement has been shown, and a few orders placed, but not of any great consequence, or such as to interfere with the evident intention at Dowlais, Rhymney, Tredegar, and other places, of restricting the number of turns per week. With the exception of the furnaces, and mechanics' and "tradesmen's" departments, Dowlais on Monday and Tuesday seemed all but at a standstill. The colliers, too, were disposed to come to a rupture in respect of the hours of labour, and on Monday took a holiday because the manager refused to let them leave the collieries on Mondays at two in the afternoon. Another occasion for discontent is urged by the colliers to exist in relation to their surgical and medical staff. This staff, whose head is Dr. Cresswell, are paid out of a doctors' fund contributed, or rather stopped, from the men's pay. The men complain that the "doctors" take private practice, and thus neglect the workmen; and 4000 of the colliers have voted their determination to have a reform in the arrangements. On the surgeon's side it is maintained that he has kept the same arrangements for twenty-five years, and that it is late in the day to discover any defect. Further, that the colliers can at any time dismiss their doctor—and who would take office unless with a nucleus of private practice to fall back upon?

There is little change in the tin-plate trade. Prices are much about the same as they have been for the last three weeks, 15s. being the ruling price for ordinary cokes. Some alarm has been caused by an increase in demand for unfinished plates for America, the idea being that the States were endeavouring to be independent of this country. This, however, is an old scare. Welsh coal is the best in the world for tin-plate making—steam for one process, and the bituminous for the other.

A fair amount of activity prevails in the steam and house coal trade—in the first particularly, and the lull experienced of late is evidently disappearing. Swansea, for example, sent off 7000 tons extra last week over the preceding, and both at Newport and Cardiff there was a good deal more vigour shown. Still, in the case of Cardiff, there is a good deal of scope yet for a regainment of the old averages. Last week the exports were 117,000 tons. Six months ago it was a common occurrence to record 150,000 tons.

House coal is advancing in price, and inquiries for new takings on the increase. In all respects the house coal trade promises well. Another new colliery into the house seams was started this week at Ystrad Urynach, which promises well. The sod was cut on Monday. This will give employment to one branch of the Taff Vale Railway, which has been stagnant for a time—that of Llancaiach.

The new line from Rhondda to Newport is doing good work. Powell Duffryn sends five or six trains daily. The Powell Duffryn Company is also arranging with the Taff for the conveyance of their Aberaman coal, instead of by the Great Western.

Various new projects are being discussed in the district, one for floating the Glamorgan Canal as a railway; another, much more likely, for converting the Cardiff tidal harbour into a dock. It is a wonder this hopeful scheme was not broached before. The Barry Dock scheme is progressing, and advertisements are out. I regret to hear that one of the prime movers, Mr. David Davis, lately elected vice-chairman of the Barry Dock and Railway, is in a serious condition of health.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

30th September, 1884.

12,957. VELOCIPEDES, &c., C. Rosenthaler, Liverpool.
12,958. PORTABLE APPARATUS for MAKING LACE, &c., W. Hogarth, Liverpool.
12,959. SOLITAIRES, &c., W. H. White, Birmingham.
12,960. ACTUATING SIGNAL WIRES, F. R. Clarke, London.
12,961. STEAM BOILERS, F. D. Rose, Manchester.
12,962. RAILS and CHAIRS for TRAMWAYS, M. H. Smith, Halifax.
12,963. LOCOMOTIVE ENGINE FIRE-BARS, &c., T. Robinson, Farnworth.
12,964. HIGH-SPEED MOTORS, A. B. Brown, Glasgow.
12,965. VIVIAN'S STRAIGHT PIPE CISTERN, W. H. Vivian, Llanelly.

12,966. Automatic Safety Saddle-bar, T. J. Haslam, Dublin.
12,967. Lighting and Extinguishing Gas, T. Caink, Leigh.
12,968. Oil Press Wrappers or Envelopes, J. E. Chapman, Hull.
12,969. Engine Governors, J. L. Heald, London.
12,970. Printing Machines, &c., W. R. Lake.—(*C. B. Cottrell, United States.*)
12,971. Gas Cooking Stoves, W. Holbrook, London.
12,972. Carriage and Safe Keeping of Boots and Shoes, C. R. G. Smythe and R. Hill, London.
12,973. Kitchen Ranges and Stoves, H. K. Bromhead, London.
12,974. Tires of Wheels, T. Holmes, London.
12,975. Explosive Projectiles, A. M. Clark.—(*J. L. Bachelder, United States.*)
12,976. Utilising the Wind as a Motive Power, E. Wood, Hatcham.
12,977. Squeezing Liquids from Hops, &c., H. J. Worssam, London.
12,978. Filtering Material, W. E. Bovill, London.
12,979. Estimating Nitrogen and other Gases, A. W. Gerrard, London.
12,980. Stirrups, C. W. Polito, London.
12,981. Skelp Bending Tools, E. Love, London.
12,982. Sewing Machines, A. M. Clark.—(*B. F. Landis, United States.*)
12,983. Hydraulic Packing, W. H. Gales and J. H. White, London.
12,984. Propelling and Steering Boats, &c., J. Bramall, London.
12,985. Metallic Boxes, C. R. E. Bell, London.
12,986. Combing Wool, &c., J. W. Bradley, London.
12,987. Check Bits for Horses, Baron E. L. A. G. de S. de Cortenberg, London.
12,988. Centrifugal Flour Bolting Machinery, F. van den Wyngaert, London.
12,989. Safety Appliances for Two-wheeled Carriages, &c., V. C. di Tergolina, London.
12,990. Combustion of Liquid Fuel, J. Imray.—(*H. de Bay and C. de Rossetti, Cairo.*)
12,991. Applying the Electric Light to Speculums, C. Smith, London.
12,992. Umbrellas and Parasols, J. H. Davies, London.
12,993. Electric Cables, J. G. Turner, London.
12,994. Distance Measurer, A. J. Boult.—(*R. Schaffer, Breda.*)
12,995. Shoes, T. B. Bethell, London.
12,996. Water Gauges for Steam Boilers, A. Lilley, London.
12,997. Invalid Bedstead, R. Mitton, London.
12,998. Automatic Musical Instrument, M. A. Wier, Upper Norwood.
12,999. Raising Water above its ordinary Level, A. H. Williams, London.
13,000. Auxiliary Vehicle Starters, J. H. Betteley, London.
13,001. Steam Boiler, &c., Furnaces, R. Paulson, Mansfield.
13,002. Numbering Attachments for Printing Presses, A. M. Clark.—(*A. R. Baker, U.S.*)
13,003. Reciprocating Rotary Engine, L. Mills, London.
13,004. Coupling Hook, L. Short, London.
13,005. Axle Lubricators, W. L. Wise.—(*C. Pagé and L. Goulliond, Canada.*)
13,006. Ventilating Apparatus, T. and A. J. Thorley, London.
13,007. Ice Caves, A. W. Marshall, London.
13,008. Umbrellas, W. W. Box, London.
13,009. Metal Casks, R. Atkin, London.
13,010. Generators, H. H. Lake, London.—(*C. Klotz, C. Günther, and W. Kops, Merseberg.*)
13,011. Moulds for Casting Iron, T. Nordenfelt.—(*C. G. Wittenström, Motala, and E. Faustmann and P. Ostberg, Stockholm.*)
13,012. Decorticating Paper, R. Crampton, London.

1st October, 1884.

13,013. Points of Steel Pens, W. E. Wiley, Birmingham.
13,014. Ship Ventilator, R. Munn, Glasgow.
13,015. Rope-driving Gear, J. Wainwright and G. H. Richmond, Manchester.
13,016. Flushing Water-closets, A. G. Browning, Llanelly.
13,017. Ventilation of Mines, F. W. Willcox, Sunderland.
13,018. Collecting, &c., Sewage, C. Smith, Glasgow.
13,019. Hydro-pneumatic, &c., Engine, S. A. Chease and E. F. Boehm, Liverpool.
13,020. Knotter for Sheaf-binders, B. Culpan, near Thirsk.
13,021. Door Springs, A. McMillan, Glasgow.
13,022. Casting Steel Ingots, J. Melling, London.
13,023. Grip Levers, J. and A. Duckett and W. Bracewell, London.
13,024. Joints for Pipes, W. Hassall, London.
13,025. Chlorine Gas, J. Taylor, Cheltenham.
13,026. Atmospheric Hydrocarbon Soldering Machine, T. Briggs, London.
13,027. Combined Metallic Bung and Vent Peg, W. Rose, London.
13,028. Pulley Frames, B. Knight and J. Durant, London.
13,029. Treating Iron and Steel, W. A. and C. A. Biddell, London.
13,030. Boots and Shoes, W. Stuart, Halifax.
13,031. Extinguishing Fire, E. G. Reuss, London.
13,032. Scutchers, &c., G. Wood and J. T. Brown, London.
13,033. Bakers' Ovens, L. Dathis, London.—18*th August*, 1884.
13,034. Secondary Batteries, &c., A. Pfannkuche, Dorking.
13 035. Iron Frames of Upright and Grand Pianos, J. Bourry, London.
13 036. Combined Street Lamp, Post-office Letter-Box, and Fire Alarm, T. Lumley, London.
13,037. Corking Bottles, A. W. L. Reddie.—(*E. Gervais, Paris.*)
13,038. Threading Sewing Machine Needles, V. de Stains, London.
13,039. Presses for Shaping Hosiery Goods, A. H. Death, London.
13,040. Bung Hole Liners, R. Askie, London.
13,041. Hand-hole Seats for Steam Boilers, C. A. Knight.—(*The Babcock and Wilcox Company, U.S.*)
13,042. Screening Coal, J. Shaw, London.
13,043. Preparation of Mineral Oils, J. Swallow, London.
13,044. Hygrometers, P. Calliburcés, London.
13,045. Sulphide of Zinc, &c., J. H. Johnson.—(*T. Macfarlane, Canada.*)
13,046. Electro-dynamic and Dynamo-electric Machines, J. H. Johnson.—(*A. de Meritens, Paris.*)
13,047. Forming Plush, &c., Figures upon Fabrics, I. Thomas and C. Cullen, London.
13,048. Scissors, P. Hayman, London.
13,049. Finishing Terne and Tin-plates, G. Nurse, London.
13,050. Protector Chain for Watches, E. Camp, London.
13,051. Adjusting Packing Rings of Pistons, H. H. Lake.—(*L. Schnabl and L. Koreff, Vienna.*)
13,052. Fishing Rod Rest, R. Chantry, London.
13,053. Girders for Fire-proof Structures, W. H. Lindsay, London.
13,054. Girders for Fire-proof Structures, W. H. Lindsay, London.
13,055. Rowlocks for Boats, R. J. Woodhouse.—(*J. Feldtman, U.S.*)

2nd October, 1884.

13,056. Saddles for Bicycles, J. B. Brooks, Birmingham.
13,057. Fastenings for Solitaires, &c., W. C. Alldridge, Birmingham.
13,058. Knitting Machines, J. Higham, Newton Heath, Manchester.
13,059. Treating Sewage, W. Scott, London.
13,060. Gas Burners for Cooking, &c., T. Redmayne, Sheffield.
13,061. Condensers for Marine Engines, A. J. Wakefield, Bristol.
13,062. Pulley and Sheave Blocks, W. O. Walley, Manchester.
13,063. Brakes, W. O. Walley, Manchester.
13,064. Artificial Teeth, W. O. Walley, Manchester.
13,065. Nut Locks, S. W. Smith, near Coventry.
13,066. Metallic Folding Furniture, W. H. Jones and B. Jones, Wolverhampton.
13,067. Dynamo-electric and Electro-dynamic Machines, L. J. Groves, Glasgow.
13,068. Transmitting at an Angle Motion from one Shaft to any other Shaft, J. White, W. Ross, and J. T. Creasy, London.
13,069. Lifting Jacks, W. P. Thompson.—(*F. Westmeyer, St. Johann-on-Saar.*)
13,070. Rotary Engines, A. N. Porteous, Edinburgh.
13,071. Stair Rod Eyes or Clips, J. Walker, Birmingham.
13,072. Mattress, H. H. Waddington, Manchester.
13,073. Lubricators, D. Sugden, London.
13,074. Obtaining Gold and Silver from Auriferous and Argentiferous Sulphide of Antimony Ores, J. Simpson and E. W. Parnell, Liverpool.
13,075. Prevention of Accidents in Trains, R. Rees, Ampthill.
13,076. Supports for Workmen on Glazed Roofs of Buildings, F. W. Primrose and J. Mellowes, London.
13,077. Cutting Tobacco, T. P. Lockwood, London.
13,078. Velocipedes, H. J. Lawson, Coventry.
13,079. Propelling and Repelling Pencils, &c., D. H. Sansum and S. Sansum, London.
13,080. Deodorising Refuse Substances for Manures, W. H. Samson, London.
13,081. Bridle Bits, G. Craddock, London.
13,082. Plate Racks, W. S. Dimes, London.
13,083. Door Springs, S. Coombs, London.
13,084. Gas Cooking Stoves, J. Somerville and W. H. Y. Webber, Forest Hill.
13,085. Rain and Dew Gauge, H. Curzon, London.
13,086. Spectacle Frames, M. Haymans, London.
13,087. Cutting Fustian and other Fabrics, A. C. Condor, London.
13,088. Telephonic and Telegraphic Apparatus, C. W. Corbett and J. L. Corbett, London.
13,089. Sash Fastenings, R. Hodges and J. Archer, London.
13,090. Action for Vertical Pianofortes, J. Hines and A. Hines, London.
13,091. Cricket Stumps, J. T. Ford, Southsea.
13,092. Rotary Electric Batteries, A. C. Henderson.—(*E. Bazin, Paris.*)
13,093. Gas Cooking Apparatus, T. Fletcher, Manchester.
13,094. Preventing Alteration of Words on Documents, M. Sugar and L. Hidveghy, London.
13,095. Building Sanitary Houses, W. K. Brock, Boscastle.
13,096. Stopping Horses by Electric Action, W. K. Brock, Boscastle.
13,097. Hydraulic Forging Press, M. Gledhill, London.
13,098. Cutting Wood, M. and H. T. Stevenson and T. J. Moyns, London.
13,099. Wheels for Traction Engines, J. and H. McLaren, London.
13,100. Lift suitable for use in Private Houses, J. J. Udall, London.
13,101. Balance or Scale, J. Gilmore and W. R. Clark, London.
13,102. Spherical Engines, R. H. Heenan and R. H. Froude, London.
13,103. Reproducing Photographs by Printing, L. H. Philippi, London.
13,104. Lowering Ships' Boats, &c, J. E. Liardet, Brockley.
13,105. Bleaching, J. B. Thompson, London.
13,106. Constructing Kettles, &c., W. Outrim and H. Wade, London.
13,107. Producing Photograph Pictures on Canvas, W. T. Morgan and R. L. Kidd, London.
13,108. Gas Burners, H. H. Lake.—(*L. B. Bainbridge, U.S.*)
13,109. Making Cigar Lights, &c., G. A. Sweetser, London.
13,110. Stem for Cigar Lights, &c., G. A. Sweetser, London.
13,111. Lifting Machinery, H. C. Walker and R. Carey, London.
13,112. Producing Imitations of Wood on Surfaces, T. S. Worthington, London.
13,113. Machine Guns, H. S. Maxim, London.
13,114. Making Steel, F. M. Eppley.—(*J. E. Sherman, U.S.*)

3rd October, 1884.

13,115. Valves, J. Day, London.
13,116. Producing Incised Patterns, &c., on Copper, &c., Plates, E. P. Evans and T. Sanday, Worcester.
13,117. Pumps and Hydraulic Engines, P. Bradshaw, Castle Ashley.
13,118. Safety Chair for Railway Metals, A. W. Burgess, Worcester.
13,119. Rolled Plate Glass, F. Mason and J. Conqueror, Sunderland.
13,120. Counter Case for the Delivery of Tickets, &c., J. Batty, Birmingham.
13,121. Bicycles, &c., W. Bradley, Sheffield.
13,122. Steam, &c., Engines, J. A. Gregory, Bristol.
13,123. Steering a Vessel by means of its Screw Propeller, J. White, W. Ross, and J. T. Creasy, London.
13,124. Axes and other Tools, G. W. Elliott, Liverpool.
13,125. Button of Ivory Nut, &c., E. Weyerbusch, Germany.
13,126. Lighting Gas by Electricity, C. L. Clarke and H. J. Coates, Manchester.
13,127. Letters and Numerals, B. W. Hornblower and H. Franklin, Birmingham.
13,128. Automatically Adjusting the Break Pressure on the Warp Beams in Looms for Weaving, F. Loll, London.
13,129. Supporting, &c., Vehicle Windows, &c., M. J. Rowcliffe, London.
13,130. Steam Lubricator, H. Harvey, Birmingham.
13,131. Bearings for Spindles, W. H. Spence.—(*A. S. Hopkins, U.S.*)
13,132. Bags or Envelopes, J. Tomlinson, London.
13,133. Incandescence Electric Lamps, H. Watt.—(*E. Weston, U.S.*)
13,134. Steel, P. M. Justice.—(*L. E. Thomas, Paris.*)
13,135. Coffee and Tea-urns, W. P. Branson, London.
13,136. Locking the Levers of Window-catch Fasteners, G. Guy, London.
13,137. Photographic Lens Shutter, S. W. Rouch, London.
13,138. Tilting Barrels, &c., T. Keeble and L. E. Broadbent, London.
13,139. Dyeing, &c., Animal or Vegetable Tissues, &c., A. C. Henderson.—(*L. Aubert, Lyons.*)
13,140. Direct-acting Steam Pumps, &c., J. Bernays, London.
13,141. Spiral Thatching Spar, J. Walder, Crowhurst.
13,142. Tooth-brush, J. C. S. Harper, London.
13,143. Waste-water Preventer, H. Tuff and C. R. Matthews, London.
13,144. Duplex Pumping Engines, A. W. L. Reddie.—(*C. H. de Lamater and Co., U.S.*)
13,145. Engraving on Plane or Curved Surfaces, A. M. Clark.—(*A. Michaud, Paris.*)
13,146. Reels for Holding Sewing Cotton, &c., C. Whitehill, London.
13,147. Ventilating and Warming Buildings, R. Oakley, London.
13,148. Bridges, W. H. Lindsay, London.
13,149. Combing Wool, &c., J. W. Bradley, London.
13,150. Bait for Fishing Purposes, W. J. Hunter, London.
13,151. Fishing Appliances, H. L. Hunter, London.
13,152. Boring Apparatus, T. Parsons, London.
13,153. Spring Motors for Sewing Machines, C. F. T. Noellner, London.
13,154. Adapting Extra Seats to Vehicles, A. Lumley, London.
13,155. Producing Seamless India-rubber Tubing, J. Iddon, London.
13,156. Photographic Shutters, J. W. T. Cadett, London.

4th October, 1884.

13,157. Metallic Handles for Boxes, &c., J. Lindsay, Govan.
13,158. Fastening Boots, J. Wise, London.
13,159. Wet Spinning Frames, C. H. McCall, Banbridge.
13,160. Portable Hall Lantern Frame, J. Law, jun., Worcestershire.
13,161. Portable Silos, A. Seward and H. G. Walton, Liverpool.
13,162. Electro-dynamic, &c., Machines, G. Scarlett, Liverpool.
13,163. Closing Umbrellas, J. G. Cumming, Edinburgh.
13,164. Self-closing Waste-preventing Valve, R. H. Perks, Birmingham.
13,165. Graduating and Silent Check Fishing Reel, S. Allcock, Redditch.
13,166. Button-hook, E. Sunderland, Birmingham.
13,167. Motive Power, W. H. Benson, Bristol.
13,168. Braid Machinery, N. J. Amies, Manchester.
13,169. Stair-rod Eyes, W. H. Richards and W. D. Wilkinson, Birmingham.
13,170. Pressing Hay and Straw, &c., P. Fewster, Reading.
13,171. Lamps, J. Stokes, Birmingham.
13,172. Steam Tube Cleaners, W. E. Blackburne, Liverpool.
13,173. Military Signals at Night, J. L. Watkins, Clapham.
13,174. Electrical Voltaic Elements, T. Rowan, London.
13,175. Coupling Tricycles, S. H. Nash, London.
13,176. Fastening Buttons, &c., B. Hawerkamp.—(*W. Stueber, Verden.*)
13,177. Breaking-up the Burrs in Raw or Washed Wool, W. E. Gedge.—(*Richartz, Döhren.*)
13,178. Absorbing Shocks in Railway Trains, R. Hill and J. Darling, Glasgow.
13,179. Safes or Strong Boxes, J. C. Mewburn.—(*E. Petit, St. Denis.*)
13,180. Device Partly to Illustrate the Chorus of a Song, &c., W. H. Brown, London.
13,181. Reinforcements for Fire Partitions, I. Rogers, London.
13,182. Measuring, &c., Apparatus, H. and A. Davis, London.
13,183. Fireplaces, J. M. Stanley, Wood-green, and T. B. Stanley, East Dulwich.
13,184. Artists' Colour box, C. Davis, London.
13,185. Cleaning Ships' Bottoms Afloat, J. H. Broker, London.
13,186. Washing or Treating Hops, &c., B. P. Harris, London.
13,187. Receptacle for Tools, &c., J. J. Richardson, London.
13,188. Clay Retorts, W. D. Cliff, London.
13,189. Manure, G. Gilders, London.
13,190. Oilcans, A. Koch, London.
13,191. Flotting Wheel, J. B. Denis, London.
13,192. Steam Washing Machines, G. W. Harris, Leeds.
13,193. Bearings for Bicycles, &c., J. H. Hughes, Birmingham.
13,194. Hanging Carriages, P. Ness, London.
13,195. Scales for Weighing, J. Gillman, London.
13,196. Suture Appliances for Approximating the Edges of Wounds, J. MacMunn, London.
13,197. Steam Engines, T. M. Favell, London.
13,198. Starting and Stopping Tram-cars, &c., G. M. Key, London.
13,199. Fire-arms, W. R. Lake.—(*Dresse, Laloux, and Cie., Liège.*)
13,200. Electric-clock Escapement, W. R. Lake.—(*J. Zimber, Furtwangen.*)
13,201. Casks, &c., W. H. Hall, London.
13,202. Grain Receptacle, C. Junge, London.
13,203. Steam Pumping Engines, &c., G. Hawskley, London.
13,204. Casting of Metals, S. Fox and J. Whitley, London.

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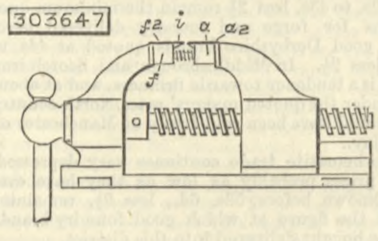
13,205. Velocipedes, J. Carpenter, London.
13,206. Self-coiling Adjustable Reel for Garden Hose, D. M. Nelson and J. L. Bruce, Glasgow.
13,207. Fixing Postage Stamps, T. P. Frank, Kifbymoorside.
13,208. Ring Spinning Frames, J. W. Dawson and H. Simpson, Manchester.
13,209. Puddling Furnaces, S. Perkins and W. Smellie, Manchester.
13,210. Harness, L. Johnson, Manchester.
13,211. Dyeing Silk, D. Dawson and G. W. Oldham, Halifax.
13,212. Box-making Machines, W. P. Thompson.—(*G. P. Sherman and H. Shackell, jun., U.S.*)
13,213. Cycle Ways, A. Pimm, Southsea.
13,214. Electrical Joints, A. Swan, Gateshead-on-Tyne.
13,215. Ring Doubling, &c., J. W. Wilson, Barnsley.
13,216. Safety Bicycles, A. Peddie, Sunderland.
13,217. Burning, &c., Compositions, J. Fyfe and J. Terry, Glasgow.
13,218. Vertical Steam Generators, W. Gardner, Liverpool.
13,219. Hydraulic Counterbalance Waterflow and Power Transmitter, G. Smail, Doddington.
13,220. Drawing Compasses, L. Myers, Birmingham.
13,221. Gas Motor Engines, C. H. Andrew, Manchester.
13,222. Brushes, O. L. Perry and B. A. Dobson, Manchester.
13,223. Coal Washing Machinery, T. Archer, jun., London.
13,224. Sofa Bed, O. Lehmann, London.
13,225. Water-closet Valves, &c., J. Kretschmann, London.
13,226. Ink and Pencil Eraser, D. Hayes and J. J. Perry, London.
13,227. Football Boots and Guards, R. Mercer, London.
13,228. Increasing the Brilliancy of Coal Gas, B. F. Elderton, London.
13,229. Coffin Plates, Handles, and Laces, T. Birbeck, Sunderland.
13,230. Brooms and Brushes, I. A. Spackman, Lee.
13,231. Window Sash Fasteners, &c., F. C. Hustler, London.
13,232. Securing the Screw Caps of Lubricators, F. Smith, London.
13,233. Lock-stitch Sewing Machines, &c., D. Jones, London.
13,234. Smoking Pipes, J. H. Cobbe, London.
13,235. Tinning Plates, T. H. and W. A. Johns, London.—25*th March*, 1884.
13,236. Boots and Shoes in Horsehair Fabrics, H. W. Loads, London.
13,237. Portland Cement, J. W. and T. G. Matteson, and W. J. Chapman, London.
13,238. Kitchen Ranges, R. Hunter, London.
13,239. Thrashing Machines, G. Werther, London.
13,240, Tip Wagons for Railways, H. E. Newton.—(*P. Decauville, Petit Bourg.*)
13,241. Spindles of Spinning Machinery, G. Bodden and F. Ashton, Manchester.
13,242. Electric Telephonic Transmitters, W. B. Hale, London.
13,243. Tinted or Coloured Rolled Cathedral Glass, Sherwood and Co., London.
13,244. Condensing Steam and Supplying Air to Furnaces, A. T. Booth, London.
13,245. Disinfection and Deodorisation of Sewage, C. S. Cross, London.
13,246. Bottles for Aerated Waters, &c., T. Sutcliffe, London.
13,247. Gas Engines, W. Rowbotham, London.
13,248. Gun Locks, C. Wittich, London.
13,249. Potato, &c., Peeling Machine, H. J. Haddan. (*E. Herzog, Leipzig.*)
13,250. Ring Spindles, H. J. Haddan.—(*F. M. Teichmann, Leipzig.*)
13,251. Hydraulic Collars, &c., for Pump Buckets, H. A. Fleuss, London.
13,252. Fastenings for Corsets, W. Pretty, jun., Ipswich.
13,253. Safety Bolts and Nuts, J. Heald, London.
13,254. Non-alcoholic Beverages, J. Hale, London.
13,255. Soles for Boots, H. H. Lake.—(*L. E. Moore, U.S.*)
13,256. Manufacturing Paper, H. H. Lake.—(*W. J. Foley, U.S.*)
13,257. Combined Umbrella and Walking Stick, H. H. Lake.—(*A. F. Ericson, Stockholm.*)
13,258. Cold Scouring, &c., Cotton, W. H. Beck.—(*La Société C. Toussant et Cie, Paris.*)

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

303,647. Vice Attachment, *Theodore E. King, Westport, Conn.—Filed April 2nd*, 1884.

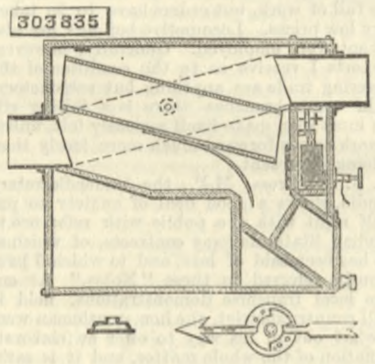
Claim.—(1) In combination, block *a*, having a supporting flange a^2, and removable cutter-blade *i*, block *f*, having a supporting flange f^2, and a removable blade i^1, guide rods common to both blocks, springs whereby the blocks are held apart, and a stop device, all substantially as described. (2) In combination with a vice, cutter-bearing blocks with supporting flanges and guide rods, and a spring whereby the blocks are held apart, all substantially as described. (3) As an



improved article of manufacture, a cutting implement consisting of a pair of blocks with supporting guide rods, each block having a rearward-extending shoulder or flange and bearing a removable cutting-blade, a spring whereby the blocks are held apart, and a stop device that limits the forward movement of the blocks, all substantially as described.

303,835 Pneumatic Carrier, *Robert Gillham, Kansas City, Mo.—Filed October 10th*, 1883.

Brief.—A discharging section of a pneumatic dispatch tube pivotted in a tight box in supports at a point between the ends of the section, and overbalanced at its outgoing end by means of an adjustable weight on the indicator, is normally retained in position as



part of the conducting tube by a spring bolt retractible from a distance by electrical aid, and is provided with a downwardly-extending spring arm to receive the blow of the carrier passing beneath the section, whereby the section is restored to normal position. To facilitate such restoring operation, the outgoing end of the section is arranged at a higher level than the incoming end when completing the conducting tube. The oscillation of the section is limited by stops in the way of the indicating needle.

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