NEWTON'S LAWS OF MOTION.

By Prof. Oliver Lodge.

It is extremely unlikely that my views differ in any essential respect from those of Professor Hudson, as some of your correspondents seem to suggest. We have different ways of expressing ourselves. Professor Hudson uses more scholastic and proper modes of expression, while I prefer the most ordinary and commonplace words and modes of speech that I can lay my hands on. We may differ in our nomenclature and mode of regarding things, but in all matters of actual fact I expect that we agree. Similarly with the opinions of Professor R. H. Smith, as given in The Engineer of March 27th, p. 237. In many places, indeed, Professor Smith has expressed himself just as I would wish to do myself: for instance, in the top paragraph of the middle column, omitting the last sentence, and in the three concluding sentences—not paragraphs—of his article.*

Professor Smith points out, about the middle of his first column, that it is not easy always to discriminate accurately between the terms "reaction" and "resistance," and to use them with exact propriety; even supposing one particular meaning were agreed on as exactly proper, which at present it is not. This is quite true; and in common life, provided we have our principles well engrained, and are not talking to junior or ill-taught students, a certain semi-carelessness in the use of terms is quite permissible, and anything else would be felt to be mere pedantry. But in a discussion on principles, and in forming the ideas of students, it is necessary to be exact, even at the risk of being a little pedantic; and carelessness in the use of terms under such circumstances is inexcusable. What I might say, therefore, in casually talking to Professor Smith himself, I do not know; half-hints would be probably quite sufficient to convey ideas. But if a student, whom I knew I should fog if I were not careful, were to show me a freely suspended cannon-ball, and to ask me whether, on prodding that ball with his stick or with his fist, he would meet with no resistance, I should reply, "Yes, he *would* meet with resistance, and so would the stick:—resistance due to the inertia or reaction of the ball." But if he were to ask me whether *the ball itself* would experience resistance on being prodded, I should say, "Certainly not, provided its mode of suspension leaves it perfectly free." It is apparent, I think, that the reaction of a body cannot properly be called resistance to *its own* motion, but it can very easily constitute resistance to the motion of something else; and if the ball be considered in two halves, the reaction of either half may be a true resistance to the motion of the other, but it cannot be thought of as resisting its own motion.

I hope Professor Smith will agree with this distinction, and will not consider it a mere splitting of straws. The fact is that the term resistance is a mere occasional convenience; it is not, strictly speaking, necessary. It is the name given to a part of the resultant forces acting on a body, viz., that part which tends to diminish the one particular kind of motion to which we happen to be attending at the time. But whether we choose so to analyse the forces into propelling and resisting, or whether we more simply attend only to their resultant, involves no matter of principle whatever; we can do what we like, and call either propelling, or either resisting, or we can make no distinction between them, at our own sweet will. The only reason for introducing the term resistance into the discussion at all, is because people do, as a matter of fact, think of *reaction* as a resistance—a resistance to the motion of the reacting body itself—and so naturally ask how it can be accelerated if the resisting and propelling forces are equal.

Any of the forces exerted on a body by other bodies attached to it, may be called resistance, if so we please; but the mass-acceleration, or inertia-force, or $m\frac{dv}{dt}$, or reaction, of the body itself, is not to be considered as one of the forces acting on it, and is not either a resistance or a propulsion so far as that body is concerned. It may act either as a resistance or as a propulsion to some other bodies; it may oppose, *i.e.*, retard, or it may assist, *i.e.*, accelerate, their motion; it must, in fact, do either the one or the other unless exactly balanced by some other force; but on its own motion it has no such effect; it is called out by, and is the direct consequence of, the inertia and acceleration together, but it does not either assist or oppose that acceleration in the slightest degree.

This is, indeed, the whole difficulty; the reaction of a body is constantly thought of as one of the forces concerned in changing its motion. Let it be understood that it is *not* one of these forces. Is it a force at all? Well, that depends on how we regard it. If with reference to the reacting body itself, certainly it is not a force; if with reference to other bodies, certainly it is: just as much a force as any produced by strain. In the commonest cases of impact no one would deny that a bullet exerts force on a target, or a hammer on a nail; yet what is this force but inertia-force, mass-acceleration, $m\frac{dv}{dt}$, of the bullet or hammer head. However, we are now drifting into a mere question about the use of words. It matters very little comparatively whether we call reaction a force or not, though it does matter a little. I have said enough to indicate my own view on the matter, but, unless they generally commend themselves, individual views on such points are useless.

In thus discussing some points of nomenclature with Professor Smith, I may venture to hope that I have partially answered the questions put to me in your correspondence columns, p. 242, by "An Old Student." This gentleman very clearly reiterates all the old difficulties and dilemmas, and proves the truth of his own statement that, so far as he is concerned, my article has left the matter exactly where it was before. I must take comfort in the thought that if, as his signature suggests, the difficulty be really one of long standing with him, it is not likely that I should have the good fortune to remove it in the course of one article. I might, however, have hoped that the tug-of-war puzzle would have ceased to perplex, for I laid great stress upon cases quite similar in principle, though more simple to think of than this.

To state the facts expressly for this case, however, neglecting the inertia of the rope: it is true that the pull of either side on the rope must be the same, whatever is happening; but the pull on the rope is not the sole measure of the muscular exertion, except in cases of steady or of zero motion. To start the victory to either side requires muscular force on that side sufficient to overcome the inertia of both victors and vanquished, as well as the muscular force of the vanquished. Let the effective components of the total force exerted by either side be called F and F' respectively; their reactions, or rates of change of momenta, R and R'; and the tension in the rope T; then we have always

$$F - R = T = F' + R',$$

where the winning side is undashed. In case of exact equilibrium R and R' are both zero. We see then that, to gain the victory, one side must exert R + R' more horizontal force against the ground than the other, although the pull of both sides *on the rope* is the same.

"An Old Student" further wants to know whether, when he pulls a stone by a rope, his pull is the cause of the stone's motion? He must go to the metaphysicians if he wants a long, circumspect, and elaborate answer to any question about "causes"; from me he will only get the common-place one, yes. I can assure him that I have set no traps for him by juggling with words, nor have I provided myself with handy retreats in the direction of metaphysics. The whole thing is on the surface, and wants only a little clear thought, and a desire to dissipate the fog rather than an attempt more intensely to make it manifest.

Your other correspondents on page 242 can be disposed of more quickly.

"J." leaves the immediate point under discussion to harp upon the ancient confusion between "momentum" and "*vis viva*"—in other words, between "impulse" and "work." He should discard all such ridiculous old maxims as "like causes produce like effects." Is it not obvious that everything depends on how you measure your effects, and what you call your causes? In all cases of impact, the forces are equal and they last for the same time—*i.e.* their *impulses* are the same, and hence the change of momentum produced by each is likewise the same. But *work* is defined to be the product of force and *distance*—not force and time—and the result of equal works done on two bodies are equal *vis vivas*—to put a barbarous plural to an obsolete singular—or kinetic energies, not equal momenta.

"J.'s" final puzzle about the transfer of momentum from one gun to another by means of a shot, is one made by his own gratuitous assumption "that nothing is lost as heat." When impact takes place between perfectly elastic bodies of no size, or of properly adjusted size and shape, so that no energy *is* lost as heat, sound, or any other mode of vibration, then, not only is momentum conserved, as it always is in all cases of impact, but *vis viva* is conserved too: whenever velocity of recoil is less than velocity of approach, it can always be accounted for by the production of rotation, or vibration, or heat.

Mr. Longmore's want of acquaintance with elementary rules of algebra enables him to deduce certain very absurd conclusions from a very simple and perfectly true equation.

The letter of Mr. Lyon somewhat surprises me. I do not know whether he is really unacquainted with the terms inertia, momentum, and mass-acceleration—Clifford's name for $m\frac{dv}{dt}$ not mine, I wish to call it reaction; and whether he really has never heard that moment of inertia is a second moment and not a first; or whether he is only pretending all these several ignorances. I shall assume that he is only pretending. Near the beginning of his letter, moreover, he says "why one part of the force acting on a body should be called a Force, and another part an Action, and a third a Reaction, I fail to see." So do I; and I also fail to see where Mr. Lyon gets these singular subdivisions from, and what he is driving at.

Finally, Mr. Muir surprises me even more by the statement that it is in *Statics*, and not in Kinetics—or, as he calls it, Dynamics—that the difficulty is felt about the equality of action and reaction. I have had a good deal to do with students' difficulties, but I can honestly say I never came across this particular one. So far as I can at present form an opinion, I should think it must be a very formidable difficulty indeed, and one that would certainly require some "right-angled-sliding-action-theory" to properly surmount.

There are one or two other points on which it may be useful to say a few words. And, first, with reference to my use of the term "motion," to which Mr. Lyon objects. I regard this term as a popular and vague one, convenient at times; but I agree with him that when one wants to be precise it is much better to use the proper term, whether it be velocity, or acceleration, or momentum, or some other aspect of motion which we wish to designate. Our present nomenclature is not quite complete, however, unless the term reaction be admitted in the sense I wish to recommend. We have a name for rate of change of velocity, but we have no generally adopted name for rate of change of momentum. We have the phrase "force of inertia," which Minchin uses, and we have the term "mass-acceleration," which Clifford used; we have the doctrine of Professor Tait that force *is* this quantity and nothing else, and now we have Mr. Lyon asserting roundly that "it is simply absurd to say that a mass multiplied by an acceleration [*i.e.*, a rate of change of momentum] is a force." Well now all this is unsatisfactory, and it can be easily amended. The term "reaction" has been used for this quantity—let it be definitely limited to this quantity—let the proper name for rate of change of momentum be *reaction* and nothing else. All confusion will then vanish, and the three laws of Newton will be replaced by, and comprehended in, the one single statement:—

The reaction of a body is equal to the resultant force acting on it, both in magnitude and in direction;

or,

Force = Reaction;

no longer three laws, but one law.

Do I then mean to traverse Professor Tait's doctrine that force is only a name for rate of change of momentum? Yes, I do. Force is conveniently *measured* by the acceleration it can produce in a standard piece of matter, but the measure of a thing is not the thing itself. Moreover, it can be measured in other ways, as by the *strain* it can produce in a standard piece of matter; and it is so measured practically. Force is a thing for which we have a special sense, and it is the equivalent of a rate of change of momentum, or reaction; but when two things are written equal they are not necessarily, or even frequently, identical. A sovereign is equivalent to twenty shillings, but the sovereign and the twenty shillings are not identical; one is a small piece of gold, the other a number of pieces of silver. To a chemist they are utterly different; and the sign of equality between them has, or, let us say, ought to have, for him no meaning.

I have the highest respect, and more, for Professor Tait, and we all owe him a debt of gratitude for the important and laborious service he has performed in clearing away from mechanics the incrustation which had come to hide and confuse the beautiful simplicity of the Newtonian laws—a simplicity in striking contrast with the overgrowth of weeds and rubbish which had collected around them; though I believe the time has now come for insisting on still further simplification and a reduction of all the laws of motion to one. Yet I venture to think that by his statement that force, because it is not conserved, has no real existence, he has done harm. It is only proper to say that in criticising Professor Tait's opinion in this article I am really criticising only the generally received aspect of those opinions; I have not his lecture on force by me to refer to, and it would be absolutely necessary to examine it very carefully before venturing to criticise the actual views themselves. If they are what I have assumed, my criticisms may stand; but if, as is very probable, the common edition is only a parody of Professor Tait's real views, then I am to be understood as only attacking the parody.

Our experience teaches us that matter and energy are conserved, and that most other things are not conserved; very good, but by what right do we assert that therefore matter and energy are the only things that exist? Force surely exists as much as any of our other sensations, or external causes of them; though that may not be saying much. We have no direct sense for matter and energy, they are inferences; and are convenient ones because they represent quantities always constant in amount; but this is no reason for believing that they specially exist. If conservation is the test of existence, Professor Tait himself does not exist.

It seems to me, however, that directly we begin to talk about "existence" we are on swampy metaphysical ground, and had better waddle back to solid land as soon as we can.

Trefriw, 6th April, 1885. O. J. L.

* In the first column of my article in the 20th March issue, p. 217, line 33 from bottom, for "down slower" read "up slower."

LOST ENERGY.

By Professor R. H. Smith.

No. I.

Any engineer who furnishes the means of recovering even a small fraction of the lost energy referred to may earn a reward of tens of thousands of pounds. We know that the ultimate useful resulting work done by our engines is never more than a comparatively small portion of that we are compelled to make our steam do in the cylinders. In an engineer's machine shop the useful work done is that of cutting shavings off various pieces of metal and other substances, and is at each machine tool measured by the product of the pressure on the tool point by the length of surface cut. If the useful work so done amounts to a quarter or one-fifth of the indicated power of the driving engines, the arrangements would be considered fairly satisfactory. In a spinning mill the useful work done consists in teasing out and twisting series of fine fibres, and we do not suppose that this final mechanical work done on the fibres amounts to more than a very small percentage of that done by the steam in the cylinders. In these, and similar cases, we are accustomed to satisfy our mechanical consciences—how guilty must we not often feel when we go on glibly proclaiming with unabashed boldness the "Grand Doctrine of the Conservation of Energy!"—by considering that the gearing between the driving piston and the final work is necessarily very complex, that it unavoidably involves a very large number of frictional rubbing surfaces, and that, therefore, a very large frictional waste of power cannot be helped. But since Professor Thurston's experiments were first published, we know that the coefficients of friction at fairly lubricated journals are far smaller than they were formerly believed to be, and that, in point of fact, they are so minute that they will not help us to account for nearly all the power that we see continually disappearing we know not where from our workshops. Again, consider the case of a marine engine. Here the mechanism between the engine and the useful work done is extremely simple and direct, involving a very small number of frictional joints. Yet here, as is well-known from Froude's experiments, the actual work done in hauling or pushing forward the ship through the water bears only a small proportion to the indicated power developed in the cylinders. Here, besides the frictional losses, we know of a large amount of energy thrown into the stream of water that the propellers have to discharge backwards from the ship, because the screw does not gear in a solid nut, nor the paddle-wheel in a solid rack, which do not budge in obedience to the pressure put on them; the only abutment for the forward thrust on the ship is obtained in the resistance to backward acceleration of momentum offered by the water that is continually being thrown violently sternwards. The screw blades also, not being perpendicular to the line of motion, throw the water sidewise and give it rotational or whirlpool motion, besides the absolutely necessary backward motion. But if we calculate liberal allowances for these evident losses, there remains a large portion of the total loss, known to exist by direct experimental evidence, still to be accounted for.

My present object is to point out one way in which undoubtedly a considerable quantity of energy is wasted—in many cases, I fear, it is a very large amount. This source of loss may be shortly described by the one word "Vibration." The vibration may be either *slow* or *rapid*. A vibration consists essentially in a periodic alternation of the condition of stress and strain in the mass vibrated. The vibration may be rapid, as in the "chattering" of a badly-clamped tool. Throughout every part of an engine, including its frame and bed-plate, there are an alternation and succession of changing stresses and strains, the full period of which coincides with that of the revolution of the crank shaft. In a driving belt the period of the vibration is still slower; it is the time occupied by any one part of the belt in travelling from a definite position, say, on the tight side round the driving pulley, along the loose side, over the driven pulley, and back to the original position again on the tight side, which period is evidently the whole length of the belt, divided by the speed at which it runs.

Now, work is always spent in producing any sort of strain in whatever kind of material the strain is caused. For instance, if a certain length of belt be stretched by a force gradually increasing from O up to T, and the effect be to stretch it a length, say C T, proportional to the force, then since the average force is $\frac{1}{2}$ T, the work done in stretching is $\frac{1}{2}$ C T^2. In passing from the loose side where the pull is, say, T_2 to the tight side, where it is, say, T_1, the work done in increasing the stretch would then be $\frac{1}{2}$ C $(T_1^2 - T_2^2)$. Similarly in every other case of increase of strain we can calculate the amount of work done against the elastic and inelastic resistance to deformation.

I am far from saying that the whole of work so done is lost. If it were so the efficiency of our machines would be even less by a good deal than it is. But a large part of it is lost. On the other hand, in some circumstances nearly all of it is recovered in the shape of usefully performed work during that period of the vibration in which the piece is being unstrained again. I hope to show that different members of a mechanism are very differently circumstanced as to the recovery of this strain energy. I notice, first, that in order that there may be a possibility of its recovery the strain must be an elastic one. So far as the strain is inelastic, the work spent in producing it is always absolutely lost without possibility of recovery. The bending of an iron or steel rope is about three-fourths inelastic, from one-tenth to three-eighths only being an elastic strain. Probably more than one-half of the bending strain of a leather belt is inelastic, while the direct tension strain in the belt has probably a large fraction of it elastic. So far as the inelastic strain is concerned, it takes as much work to unstrain it—to straighten it out from the bent condition—as it did to bend it.

Although the strain be wholly elastic, or nearly so, it by no means follows that the work periodically spent in producing it is wholly or even partially restored during the unstraining intervals of the vibration. I will first take a case in which it is to a large extent usefully restored.

A wrought iron crank shaft of length L inches and diameter d inches, when exposed to a twisting moment M inch pounds, will twist through an angle equal as a fraction of a radian to about $\frac{1}{10^6}\frac{ML}{d^4}$. In producing this twist from the unstrained condition the average moment has been $\frac{1}{2}$ M, and therefore the work done in twisting the shaft has been $\frac{1}{2\times10^6}\frac{M^2 L}{d^4}$. Suppose that this has been done during a quarter revolution from one of the dead points forward to mid-stroke; and suppose the steam pressure has remained constant during this half-stroke. The whole work done equals the whole steam pressure multiplied by the half-stroke; but this product also equals approximately the turning moment round the crank shaft centre at mid-stroke. This is the twisting moment M, which we may therefore write equal to the whole work done. The ratio of that part of it spent in twisting the shaft to the whole is therefore $\frac{1}{2\times10^6}\frac{ML}{d^4}$. If the shaft be dimensioned for strength, so that the moment M causes a shear stress of about 5000 lb. per square inch, we will have $M = 1000\,d^3$, and the above ratio then becomes $\frac{1}{2000}\frac{L}{d}$. This would become 1 per cent. if the length were twenty times the diameter of the shaft. If, on the other hand, the shaft be designed for stiffness so that the moment M will twist it about $\frac{1}{4000}$ of a radian, or 51½″ per inch length—or 1° 43′ per 10ft. length—we would have $M = 250\,d^4$. The above ratio would then become $\frac{L}{8000}$, which would be 1 per cent. if the length were 80in. In the first case, viz., with $M = 1000\,d^3$, the work spent in twisting the shaft from the unstrained condition up to M is $\frac{1}{2}$ L d^2 inch-pounds; and in the second case, viz., with $M = 250\,d^4$, the work so spent is $\frac{1}{32}$ L d^4. This work is done on the crank shaft twice every revolution. During the latter half of each stroke, however, it is nearly all restored during the untwisting of the shaft, in consequence of which the angle moved through by the driving pulley is as much greater than that simultaneously moved through by the crank as it is less than the same during the first half of the stroke. The action is precisely similar to that of the fly-wheel; during half the stroke part of the work done by the steam is stored up as resilience in the shaft, which is re-delivered to the driving belt during the second half. Here we have an example of a piece of nearly completely elastic material working under conditions such as allow the recovery of nearly all the energy spent in straining it. In the case of a long shop main shaft we have a smaller proportion recovered. Along such a shaft the variations of driving moment send waves of alternately increased and diminished twist. These twist waves run along a wrought iron shaft at a speed of between 9000ft. and 10,000ft. per second. In producing each wave a certain amount of energy is spent. On reaching a pulley keyed on the shaft, part of the energy of the wave flows into the pulley and sends a small wave of increased tension along the belt; part of it is reflected back along the shaft from the pulley attachment, and part travels onwards along the shaft until it meets another pulley, where the process is repeated. Thus a not inconsiderable part of the wave energy runs from end to end of the shaft back and forwards, and is eventually rubbed down into heat by internal friction. The portions that find their way through the pulleys into the belts probably do some useful work, but must be mostly lost in producing simply vibration and unsteady sagging of the bands.

Applying similar principles to the calculation of the transmission of the power from the piston to the crank-pin, we find that even in this short distance, and exclusive of all frictional loss, from $\frac{1}{10}$ to $\frac{1}{30}$ per cent.—according to the ratio of expansion used—of the whole work done by the steam is spent in stressing the piston-rod and connecting rod. What proportion of this is recovered it is hard to judge, but seeing that the recovery takes place close to the dead points where the thrust is along the centre line of the engine without any leverage on the crank shaft, it seems probable that most of it is permanently lost in straining the framework. Besides this loss there is that in bending the piston and the crank, which, however, must be for the most part restored to do useful work.

Consider now the work done in periodically tightening up a belt as it passes over the driven pulley. I will take as a suitable maximum working pull on a leather belt 45 lb. for single and 90 lb. for double belting per inch of width, and will assume that under this tension they stretch $\frac{1}{100}$ part of their length. This is about true for average quality of leather so used. If T_1 be the pull on the driving side, and b be the breadth in inches, we have $T_1 = 90\,b$ for double belts. In stretching each foot length to this tension from zero pull, the work done is $\frac{1}{200} \times 90\,b = \cdot45\,b$ foot-pounds. If T_2 be the pull on the slack side, each foot length in passing from slack to tight side has done in stretching it work equal to $\cdot45\,b \left\{1 - \left(\frac{T_2}{T_1}\right)^2\right\}$. This work is probably wholly lost in frictional "creeping" of the belt over the pulleys, this creep resulting in what is more commonly known as the "slip." The action is this:—The belt being stretched $\frac{1}{100}$ on the tight side, is stretched $\frac{1}{100} \times \frac{T_2}{T_1}$ on the loose side. The belt velocity is, therefore, greater on the tight side than on the loose side in the ratio $\frac{1 + \frac{1}{100}}{1 + \frac{1}{100}\frac{T_2}{T_1}}$. The peripheral velocities of the two pulleys differ nearly, or perhaps exactly, in the same ratio, and the loss of work involved in this "slip" is done on friction in the creeping of the belts on the pulley surfaces.

In bending down each foot of length of belt on to a pulley of diameter D, it can easily be proved, assuming the approximate accuracy of the ordinary theory of bending, that the work done is $\frac{24,000}{6} t^3 \frac{b}{D^2}$, where 24,000 is taken as the tensive modulus of elasticity of leather, and t means the thickness of the belt. For ordinary double belting this gives about $200\,\frac{b}{D^2}$ foot-pounds per foot length laid down. But the belt is always being paid on at two places—on to two pulleys—at the same time, and in consequence the above loss occurs twice in each foot length during its travel round the whole circuit. Also owing to the large permanent set taken by the leather in bending, it probably takes to unbend the belt more than half the work taken to bend it. If we allow one-half as a moderate estimate for unbending, and if D_1 and D_2 be the diameters of the driving and driven pulley, then for each foot of length passed over we find a loss of work through bending of $300\,b \left(\frac{1}{D_1^2} + \frac{1}{D_2^2}\right)$. The total work done per foot of belt passed over is, since $T_1 = 90\,b$, equal to $90\,b\left(1 - \frac{T_2}{T_1}\right)$. Adding the two losses in bending and stretching together, and taking the ratio of whole loss to whole work done, we find this proportion to be for double belting, the pulley diameter being in inches—

$$\cdot005\left(1 + \frac{T_2}{T_1}\right) + \frac{10}{3}\,\frac{\frac{1}{D_1^2} + \frac{1}{D_2^2}}{1 - \frac{T_2}{T_1}}$$

As an example, let the pull on the tight side be double that on the loose side, which will correspond to a coefficient of friction a little greater than one-fifth, and let the pulleys be 40in. and 10in. in diameter, there will then be ¾ per cent. lost in stretching, and rather more than 7 per cent. in bending, or, altogether, nearly 8 per cent. If the coefficient of friction were increased to ·44, giving a maximum ratio of pull on tight side to that on slack side of 4, we would have, with the same pulley diameters, ⅝ per cent. lost in stretching and nearly 4½ per cent. in bending, or a total loss of 5¼ per cent. With single belting the proportion of loss in stretching is the same, but that of loss in bending is one-fourth of that experienced in the use of double belting.

THE INSTITUTION OF CIVIL ENGINEERS.

THE ELECTRICAL REGULATION OF THE SPEED OF STEAM ENGINES AND OF OTHER MOTORS FOR DRIVING DYNAMOS.

At the meeting on Tuesday, the 24th of March, Sir Frederick J. Bramwell, F.R.S., president, in the chair, the paper read was on "The Electrical Regulation of the Speed of Steam Engines and of other Motors for Driving Dynamos," by Mr. P. W. Willans.

The author referred first to the necessity for electrical governors in arc lighting, and other cases where a constant current was required, and where the resistance of the circuit was variable. He then alluded to the irregularities in incandescent lighting caused by the resistance of the armature, the resistance of the leads, the material of the field magnets, or to these causes combined. He went on to say that there were cases in which the length of the mains, the cheapness of the power employed, and the necessity for economy in first cost, would make a reduction in the section of the leads desirable, were it not that such a reduction introduced serious irregularities in the lighting. What was required in such cases was an electrical regulator which would ensure a constant difference of potential where the light was used, rather than where it was generated. The error due to the resistance of the leads was of the same nature as, and must be added to, the error due to variations in speed when a centrifugal governor was used; and it was pointed out that centrifugal governors in no way compensated for the loss in electro-motive force due to the heating of the dynamo either from within or from without. Attention was directed to the difficulty of winding compound dynamos for each circuit, and to the fact that subsequent changes in an installation might upset the most careful compounding. The author then alluded to the well-known difficulty of ensuring that each of several machines connected to the same mains did its fair share of work, and he pointed out that a shunt machine combined with an electrical regulator effected a reduction in the loss due to the mechanical friction of the motor when the load was not at its maximum. Many of the earlier electrical governors had been designed with a view to the maintenance of a constant speed of engine, but, so far as the author was aware, none of them had had any extended practical application.

After alluding to the governors of Lane-Fox, Sawyer and Man, Andrews, Richardson, Carns-Wilson, and Westinghouse, the author stated that the older forms of governor might be broadly divided into three classes: (1) Those in which a centrifugal governor was used in conjunction with an electro-magnet, and he observed that these were necessarily complicated, and that they combined some of the disadvantages of both classes of governors. (2) Those in which the electro-magnet did the whole work of moving the throttle valve. These, the author considered, could not be depended on, because the electro-magnet had too much to do. (3) Those in which an intermediate relay of power was used, which he considered had the necessary power, but had not the necessary control over it. He next referred to Mr. Jamieson's and Mr. H. S. Maxim's governors, and expressed surprise that Mr. Jamieson in his paper on the electric lighting for steamships insisted on the necessity of a self-regulating dynamo.

The author did not claim to have been the first to recognise the advantages to be expected from electrical regulation; but he believed he had been the first to secure a practical success, as his governor had been adopted in more than fifty instances. He then proceeded to describe in detail governors in which he employed a differential connection between the core of the regulating solenoid and the relay mechanism, so as to ensure that the former should move in perfect unison with the throttle valve or expansion gear. He explained by diagrams the experimental governor made two and a-half years ago, and showed the governor itself in action, so far as its hydraulic mechanism was concerned. He described the difficulties encountered at first, and explained that these were mainly due to the core of the solenoid not moving in unison with the regulating mechanism of the engine. The two got, as it were, into cross time, and the result was hunting, and consequent serious fluctuations in the light. He explained how these difficulties were eventually overcome, and went on to describe the ordinary form of the governor as used for regulating the position of the throttle valve. This governor was fitted with a safety arrangement, in case of the belt breaking or the main lead being severed, and was much more simple in its action than the original experimental governor. He gave figures showing the expenditure of power in the core of the solenoid, which, in the case of a 60-horse power engine, was not more than one-half that absorbed in a 20-candle power Swan lamp. He showed graphically, by means of diagrams, the method adopted for balancing the core by a spring, and explained how the governor could be made either more sensitive to minute changes in current, or more stable, so as to avoid oscillation in the case of sudden variations in the load. The results were given of various experiments made with cores of different proportions, with a view to determining the best for the purpose; and the action was explained of a particular form of reducing valve, which could be used in connection with the governor where absolute accuracy was required. The author next described the governor now in use at the Edison and Swan Company's installation at Victoria Station, and gave a chart of its performance, which showed great accuracy, a variation in electro-motive force of 1 volt being the greatest observed during four hours, although the variations in steam pressure and currents were very considerable during that time. He then described a governor suitable for controlling the expansion gears of powerful engines, and stated that the friction of the regulating mechanism in this governor did not exceed ¼ oz., and that the power available for the work was upwards of 500 lb. acting through 6in. He mentioned that in addition to their application to the regulation of the speed of motors, these governors might be applied with advantage to insert resistance in a circuit, where the speed of the engine could not well be varied to suit the exigencies of the lighting. He then proceeded to describe a duplex governor suitable for one of the units of a large installation, which not only determined the difference in potential in the mains, but regulated the currents generated by each unit. In conclusion, the author alluded very briefly to the use of electrical relays; these, he stated, had not yet been used, but had in many cases considerable advantages. He showed several governors, and the promptness of their action was seen as they were connected to the water main. He also exhibited some of the governors in pieces, and their details were fully explained by the aid of diagrams.

TENDERS.

List of tenders for the supply and erection of a boiler 7ft. diameter and 30ft. long, with two internal flues, and all necessary mountings and fittings in connection therewith, for the Sewage Works at Leicester. Specification and conditions by Mr. J. Gordon, C.E., borough surveyor.

	Of boiler plates. £ s. d.	Of steel. £ s. d.
Gimson and Co., Leicester—accepted.	315 0 0	315 0 0
W. and J. Galloway, Manchester.. ..	385 0 0	365 0 0
Death and Ellwood, Leicester	400 0 0	383 0 0
W. F. Coleman, Loughborough	365 0 0	370 0 0
J. Adamson and Co., Hyde	430 0 0	425 0 0

List of tenders for the supply and erection of two boilers 7ft. diameter and 30ft. long, with two internal flues to each boiler, and all necessary mountings and fittings in connection therewith, for the Borough Lunatic Asylum, Leicester. Specification and conditions by Mr. J. Gordon, C.E., borough surveyor.

	Of boiler plates. £ s. d.	Of steel. £ s. d.
Gimson and Co., Leicester—accepted.	615 0 0	615 0 0
W. F. Coleman, Loughborough	620 0 0	630 0 0
Death and Ellwood, Leicester	757 10 0	757 10 0
J. Adamson and Co., Hyde	762 0 0	752 0 0
W. and J. Galloway, Manchester.. ..	775 0 0	795 0 0

Steam Tramways in London.—The North London Tramways—now worked by ten Merryweather engines, to be followed by more—are greatly appreciated by the public. The steam cars and horse cars work alternately on the same line, and in a single day the amount collected on the steam cars was twice that of the horse cars.

RAILWAY MATTERS.

THE first sod of the new railway which is to run through Pendlebury and Swinton has, says the *Manchester Courier*, been cut.

THE Cavan, Leitrim, and Roscommon Light Railways and Tramway Company has advertised for contracts for the construction of its main line, which is about thirty-three miles long.

THE rails will be completely laid and the Canadian Pacific Railway be available for through traffic on August 25th next. Uninterrupted railway communication will then exist between Halifax, Nova Scotia, and the Pacific Coast entirely through British territory.

INFORMATION has reached Sheffield that the Russian Government has instructed the Petersburg-Moscow Railway Company to increase their rates of charges upon English coal from 1·2 copecks per poud per verst to 1·8 copecks, while the rate upon home coal is to remain unaltered.

THE first sod of a new branch line in the Isle of Man has been cut. The Foxdale Railway will start from St. John's, the junction for the exchange of traffic between the Manx Northern and the Isle of Man Railways, and run to Foxdale. The gauge will be the same as the existing Manx railways, viz., 3ft.

ON the Rohilkund and Kumon Railroad the fare for a distance of sixty-seven miles is 12 rupees first-class, and only 1 rupee third-class, there being no second-class—about 20s. and 1s. 8d. respectively. Probably nowhere else in the world is the difference in fare by the two classes so great.

IN Prussia all express trains are to be provided with means of communication before the close of the current year, and all other passenger trains within a year more. The Prussian roads simply use a cord, running outside and just above the level of the window. This cord is to be connected with the locomotive whistle for giving the signal.

MESSRS. A. AND J. MAIN & CO., Clydesdale Ironworks, Glasgow, are about to construct several large carriage sheds of galvanised corrugated iron at Horwich Junction, near Bolton, for the Lancashire and Yorkshire Railway. The dimensions of each carriage shed are 400ft. by 50ft., and the value of the contract approaches £10,000.

DURING February Mr. Knorpp, engineer, made an exploration of a large part of the country to the north of Auckland, New Zealand, with the view of determining how best it can be opened up by railway. There are completed or under construction in the north several small pieces of railway, and the *Colonies and India* says, in all probability the time is near when a large extent of land can be opened up.

ARRANGEMENTS have, it is said, recently been made with the Canadian Government under which the Canadian Pacific South-Western Railway will be extended eighty miles from Manitou in the direction of Clear Water Lake, and the Manitoba South-Western Railway continued thirty miles during the present year. The two extensions will be made under the charter of the Manitoba South-Western Company.

WRITING on Sunday at Handoub, the *Times'* war correspondent says: "The head of the Berber Railway is now abreast of the wells here, and on Tuesday next a regular service of trains will begin." Work will be very uncomfortable in a short time unless the following is considerably overdrawn. "The heat is becoming daily greater; it is impossible, shortly after sunrise, to bear the hand in the water of the iron reservoir tanks."

THE *Railroad Gazette* record of accidents on American lines in January contains notes of 47 collisions, 92 derailments, and 6 other accidents—145 accidents in all, in which 24 persons were killed and 182 injured. Seven collisions and 10 derailments caused death; 11 collisions, 28 derailments, and one other accident, injury. In all, 17 accidents caused death and 40 lesser injuries, leaving 88, or 61 per cent. of the whole number, in which no serious injury to persons is recorded.

MR. WORSDELL, locomotive superintendent of the Great Eastern Railway, has been offered the post of locomotive superintendent of the North-Eastern Railway, and has accepted it, Mr. MacDonnell having resigned, and taken an influential position with Messrs. Armstrong, Mitchell, and Co. We understand that Mr. Tomlinson has resigned his post as locomotive superintendent of the Metropolitan Railway, and that Lord Cecil, locomotive superintendent on the District Railway, is also resigning.

THE other day a huge crucible stern-frame for a London and North-Western steamer, sent from the works of Messrs. Wm. Jessop and Sons, Brightside Steel Works, blocked the Midland Railway at Woodesford, near Leeds. Last Friday night a heavy dredger, which was being conveyed from Retford to Liverpool, struck the top of the Woodhouse tunnel, on the Retford side, with such force as to throw the wagon on which it was being conveyed off the line, and fouled both lines so effectually that it was three o'clock on Saturday morning before the line was restored for traffic.

UNDER the head of accidents to trains, rolling stock, and permanent way, the Board of Trade Report for 1884 states that 55 persons met their deaths by such accidents, and that 980 were injured. These figures, especially those of the fatalities, show a very marked advance upon those of the previous year, when only 22 were returned under this head as killed, and 749 as injured. Of the 55 killed in 1884, 31 were passengers and 23 servants of companies. Among the injured the proportion of passengers to servants is far higher, the numbers being 864 of the former to 115 of the latter. In each kind there is one case unclassified.

ACCORDING to the Board of Trade report on the accidents and casualties reported by the railway companies during the year 1884, the most fatal accident in its results is the failure of axles, by which 24 out of 31 passengers met their deaths. There were 385 such failures, of which 223 were engine axles; 69 passengers and 4 servants were injured from the same cause. There were 57 cases of passenger trains, or parts of them, leaving the rail; and from this cause 5 passengers and 4 servants were killed and 83 passengers and 9 servants injured. One passenger was killed by the bursting of a boiler, and 1 by a slip in an embankment. Several kinds of accidents are more numerous, and cause injury to more passengers, without being fatal. Thus, in 88 collisions between passenger trains and others, 579 passengers were injured. In other cases no personal injury was caused. For example, there were 1060 failures of tires, 1005 of them being wagon tires, 719 of which belonged to owners other than the companies. Of these tires 974 were of iron, and 86 of steel. There were 306 cases of broken rails.

WHAT the precise effect is of a difference of gauge on curve resistance—and in fact, of all other modifying conditions—is still a matter of doubt, but theory and experience combine to indicate that, all other conditions remaining the same, the curve resistance is directly as $\sqrt{\text{gauge}^2 + \text{length of wheel-base}^2}$; from which it follows that a reduction of either the gauge or length of wheel-base alone will not materially modify the resistance, but if both be reduced together, so that the rectangle of the wheel-base remains always "similar," the curve resistance may vary very nearly as the gauge. Approximately this condition obtains with standard and narrow-gauge rolling stock as now designed, but whether or not practical conditions make it necessary or expedient that it should be so, so that it is a legitimate, instead of merely accidental, advantage of the narrow-gauge rolling stock, it is profitless to inquire, because the *Railroad Gazette* says the direct loss of power and wear and tear from curve resistance is comparatively a trifling matter, and any assumed difference in hauling capacity—which is not often a very serious consideration, however, for light traffic roads—may be easily compensated for by a slight increase in the rate of compensation for curvature, an increase which will have far too trifling an effect on the average gradient to make any measurable difference in the location or profile.

NOTES AND MEMORANDA.

THE agricultural statistics compiled by the *Register* of South Australia show that the gross production of the 1,910,000 acres which were placed under crop last year was 17,190,000 bushels, or an average of 9 bushels per acre.

INSTEAD of oil, which thickens and smears whetstone, a mixture of glycerine and spirit is recommended by an American contemporary:—"The proportions of the composition vary according to the class of tool to be sharpened. One with a relatively large surface is best sharpened with a clear fluid, three parts of glycerine being mixed with one part of spirit. A graver having a small cutting surface only requires a small pressure on the stone, and in such cases the glycerine should be mixed with only two or three drops of spirit."

TH. FLEITMANN, of Iserlohn, has shown that pure nickel and its alloys with copper, cobalt and iron can have other metals added without their losing the property of being welded, and therefore can still be used for making plate. The metals which can be added in this way are zinc, tin, lead, cadmium, iron and manganese up to as much as 10 per cent.; any additions, however, are not of much practical value, as the alloy of 25 parts of nickel with 75 of iron has a white colour, and resists the action of the atmosphere far better than iron alone.

FROM 1859 to 1883, inclusive, the production of silver in the United States greatly increased upon the production of gold. In 1859 the production of gold was 50,000,000 dols., while that of silver was only 100,000 dols., and in 1860 it had only increased to 150,000 dols. In 1860, however, the production of silver jumped to 2,000,000 dols., and in 1883 it had increased to 46,200,000 dols., while the production of gold was 30,000,000 dols. The greatest production of gold in any year was in 1866, when it was 53,500,000 dols. Since then it has fluctuated between 51,725,000 dols. and 18,000,000 dols. In only two years, however, did the production get so low as this, the next lowest year's production being 30,000,000 dols. The highest production of silver was 46,800,000 dols. in 1882.

A PAPER was recently read before the Chemical Society, entitled, "Notes on Fractional Distillation in a Current of Steam," by Dr. M. G. Lazarus. Difficulty having been experienced in the separation of iodothiotolen and iodothioxen from toluene and xylene respectively, owing to the two former compounds being almost totally decomposed on distillation even under reduced pressure, experiments were made to ascertain whether a separation could be effected by distilling in a current of steam. Mixtures of benzine and toluene, benzine and nitrobenzine, toluene and nitrobenzine, toluene and xylene, benzine and carbon bisulphide, turpentine and nitrobenzine, and aniline and nitrobenzine were employed. A perfect separation could not in every case be effected, but the results are so far satisfactory as to render the method of practical use, and it was found that pure iodothiotolen and iodothioxen could be obtained by it.

M. MORIZE, of Rio de Janeiro, has devised a selenium apparatus for measuring the relative intensities of the rays of the sun at different altitudes above the horizon. It consists of a selenium cylinder prepared according to the plan of Professor Graham Bell, thirty-eight discs of copper being isolated from each other by smaller mica discs, and the edges filled in with selenium. It is insulated by glass supports inside a glass envelope from which the air has been exhausted. The vessel is elevated in a place where surface reflection does not reach it, and the axis is placed parallel to the axis of the earth, so that the rays of the sun fall normally on the selenium cell and illuminate the same surface. Its position can be altered to keep up this condition from day to day. A constant current traverses the selenium and a galvanometer in circuit with it. From darkness to the most intense radiation of the sun is the range to be observed, and a scale is graduated accordingly.

NO method has yet been discovered, it would appear, for removing obstructions from pneumatic tubes, preferable to that resorted to in Paris, its location being determined by simply firing a pistol into the tube. The resulting wave of compressed air, traversing the tube at the rate of 1000ft. a second, strikes the impediment, and is then deflected back to its origin, where it strikes against a delicate diaphragm, its arrival being recorded electrically upon a very sensitive chronograph, on which also the instant of firing the pistol has been recorded previously. The wave of sound, on reaching the diaphragm, is recorded, and then reflected back, a second time striking the obstacle, and returning to the diaphragm. This operation being several times repeated, several successive measurements are thus made of the time required by the sound-wave to traverse to and fro within the pneumatic tube. Other means have been applied to the accomplishment of the object in question, but this has proved itself to possess special advantages.

AT a meeting of the North of England Institute of Mining and Mechanical Engineers, a paper "On the Shrinkage of Paper," was read by Mr. C. C. Leach. It contained an account of experiments upon the shrinkage of different kinds of drawing paper made under various conditions, and shows how very capricious is the behaviour of this material under the ordinary conditions to which it is subjected as a medium of plotting and mapping. The mode employed by the writer in showing the variations was to mark off accurately upon the paper experimented upon distances from a scale representing 120 chains, a wooden scale being chosen as much less liable to alter in length than an ivory one. The following are the conclusions arrived at by the writer:—That machine-made papers vary less, and less unequally, than hand-made sheets. That mounted paper varies much more than unmounted. That new paper, and especially new mounted paper, varies more, and more unequally, than older, and older mounted plans. That papers, mounted or not, and irrespective of age, continually vary. No two plans vary alike. Daily and yearly variations are similar for all plans. Making a scale on the paper, as an accurate standard of measurement, is all but useless, as different parts of the same plan vary in size so differently at most times. The very uneven and changing alterations in the sizes of plans, which twist the base lines and otherwise affect their general accuracy, are of sufficient importance for the extent to be ascertained, and, if practicable, for some means to be devised for obviating these variations.

AT the last meeting of the Meteorological Society, the report of the Committee on Decrease of Water Supply was read. This committee was appointed to take into consideration the question of the decrease of water in springs, streams, and rivers, and also the simultaneous rise of the flood level in cultivated countries. As far as any inference can be drawn from the records collected by the committee, it appears that the years 1820, 1821, 1824, 1835, 1838, 1845, 1847, 1850, 1854, 1855, 1858, 1859, 1864, 1865, 1871, 1874, 1875, and 1884 have been periods of marked low water. On the other hand, the years 1817, 1825, 1830, 1836, 1841, 1842, 1853, 1860, 1861, 1866, 1873, 1877, 1879, 1881, and 1883 have been periods when there has been exceptionally high water. In 1852 the water was very low in the early part of the year, while at the end of the year it was very high. In the intervening periods the water has been of moderate altitude. It does not appear from existing records that there is any diminution in the water supply of this country, and the large quantity of water which has been stored or has flowed off the ground between 1876 and 1884 is confirmatory of this view. There appear, however, to be periods when there is exceptionally low water, and these are almost immediately followed by periods of exceptionally high water. With reference to the increase of floods, it does not appear from the records that there is any great increase in the height to which the floods rise in this country. Whether or not the height to which floods have risen in recent years has been affected by river improvements and the greater facility with which floods can be got rid of, or whether there is a diminution in the quantity of water, are questions upon which the Committee have not at present sufficient information to speak positively.

MISCELLANEA.

THE South Yorkshire colliers are sending delegates round into this district soliciting contributions for the strike hands. At Dudley the colliers have already determined to make collections on Saturday.

THE Senate of Glasgow University have resolved to confer the degree of LL.D. upon Mr. Francis Elgar, the "John Elder" professor of naval architecture and marine engineering in that University.

ON Wednesday the quarterly meeting of the South Staffordshire and East Worcestershire Mining Accident Fund was held in Wolverhampton, when £23 was allowed in grants to four widows and a number of children.

AN ordinance passed both branches of the Baltimore City Council, on the 24th ult., requiring that all streets torn up by gas companies or others for putting down pipes shall be repaired from curb to curb, under the supervision of the City Commissioner, and at the expense of the company or individual putting down such pipes.

THE Admiralty have placed an order for an ironclad with Messrs. Armstrong, Mitchell, and Co., and an order for two belted cruisers with Messrs. Palmer and Co., of Jarrow. Messrs. Earle's Shipbuilding and Engineering Company, of Hull, have also received instructions to build a belted cruiser. The total cost of these ships will exceed £1,500,000.

A WRITER in the *Scientific American* describes a way of filling his boiler:—"I built a fire of light stuff in the furnace, after putting in a few pails of water, connected hose with the water reservoir, and after the fire had burned down, opened the connection, and the water came in with a rush, the creation of a vacuum impelling the inrush of the water."

A BOILER explosion, causing severe injuries to two workmen, occurred this week at the Bromley-lane Colliery, near Dudley, of Messrs. Smith and Grove. It took place whilst water was being drawn, and so great was the force that the boiler was changed from end to end, or completely reversed. The engine-house was also nearly demolished. The boiler is stated to have been a new one two years ago.

THE Formidable, a new ironclad, said to be the most powerful vessel of the kind in the French Navy, was launched last week at Lorient, with complete success. The Formidable has been in course of construction for six years, and is a sister ship to the Amiral Baudin, which is still in the Brest dockyard. She is 342ft. long, 69ft. beam, 49ft. deep, and built of steel and iron. She draws 11,336 tons, and her speed is to be fifteen knots per hour.

MESSRS. JOHN BROWN AND CO., Atlas Steel and Ironworks, have received from the Government an order for the armour-plates—650 tons—for the barbettes and conning tower of H.M.S. Anson, now building at Portsmouth. Tenders have now been sent in for the plates for the five belted cruisers and four armour-clads for the English Admiralty. Both the Sheffield firms—Messrs. John Brown and Co. and Messrs. Charles Cammell and Co.—have sent in tenders, and the probability is that the work will be entrusted to these firms.

THE requirements of the Admiralty in respect of torpedo warfare are proving a good thing for the chain makers in the Cradley, Old Hill, and surrounding districts. Certain of these makers have booked orders for hundreds of tons of shackles, rings, chains, and the like, to be used in the construction of iron netting or link armour, which will be thrown over the sides of gunboats as they lie at anchor, to prevent successful attacks by torpedoes. Further large inquiries are also being received, and some of them are, there is reason to believe, on account of the Russian Government.

DEATH has been busy this week in South Staffordshire. The decease is announced, at the age of seventy-nine, of Mr. David North, of Wolverhampton, formerly a colliery proprietor and colliery director and ironmaster well known throughout Staffordshire. The death is also announced of Mr. E. Crapper, of Walsall, at the age of seventy-eight, who was known in local business circles as the proprietor of the Hatherton Lime Works, and of certain collieries. Mr. David Skidmore, of Moxley, part-proprietor of the Moorcroft Colliery Company, died suddenly on Wednesday from heart disease, at the age of sixty-six.

AN American contemporary notes that the *Verein zur Befoerderung des Gewerbefleisses*, of Berlin, offers the following prizes for essays:—£50 for the best comparative examination of the several methods heretofore used for the determination of the hardness of metals and alloys, including an exposition of their sources of error and limits of accuracy; and £150 for the best paper on the resistance to pressure of ironwork in buildings, at increased temperatures. It appears that after a certain fire at a factory in Berlin, the police authorities issued notices concerning the use of cast iron columns in high buildings, and these notices met with considerable opposition in many quarters, since it was maintained that neither practice nor theory had yet shown any proof that cast iron is less trustworthy than wrought iron in cases of fire.

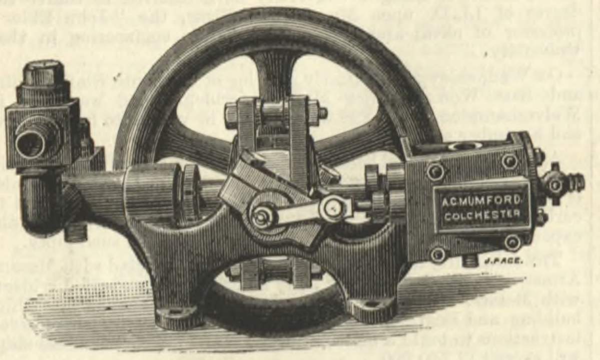
A BOARD OF TRADE report has been published on the explosion of a Howard safety boiler, causing the death of one man. Mr. T. W. Trail says:—"This explosion appears to have been caused by the local overheating of one of the wrought iron tubes. It is thought that sediment collected in the interior of the tube, and prevented the water from getting into contact with the iron; consequently it got hot, which rendered it unfit to sustain the internal pressure, and the explosion occurred. Water-tube boilers have not been very favourably looked upon in this country, and when used the feed-water should be practically free from deposit; and there are comparatively few places where such water is available for feeding boilers. It is essential that the heating surfaces of all boilers be kept clear, but where tubes are used, and almost in the fire, unless great care be taken, deposit is sure to collect, and in this case, unfortunately, it has apparently caused the death of one man."

IN the preamble of a Bill on the rating of machinery, introduced by Mr. Norwood, M.P., it is recited that questions have from time to time arisen as to how far machinery and plant are to be taken into consideration is estimating for the purposes of the poor-rate the value of the premises in which a business is carried on. The Bill accordingly proceeds to define the machinery the annual value of which is to be estimated. It includes, first, fixed motive powers, such as water-wheels and steam engines, and the steam boilers, donkey engines, and other fixed appurtenances of these motive powers; second, fixed power machinery, such as shafts, wheels, drums, and their fixed appurtenances, which transmit the action of the motive powers to the other machinery fixed and loose; and, third, pipes for steam, gas, and water. But all other machinery and plant, whether attached to the premises or not, are to be exempt from rating. It is proposed for the measure to be temporary only, the limit of its operation being fixed at the end of the year 1887.

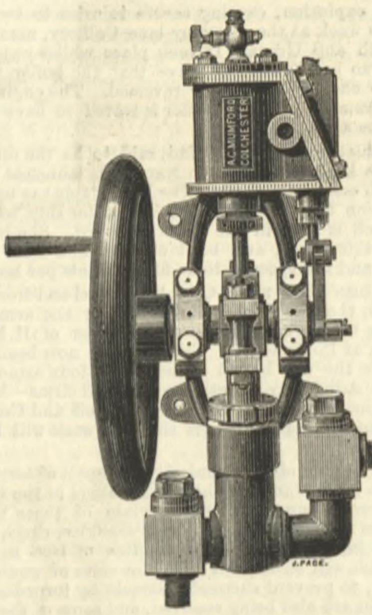
MR. JAMES LAING, shipbuilder, and chairman of the Sunderland Shipbuilders' Association, has written a letter to a public journal giving his views on the strike at present existing among certain operatives employed at shipyards. He says that Sunderland has obtained an unfortunate notoriety for strikes, and that the evil consequences are obvious to everyone except the workmen themselves, whose experience seldom extends much beyond the narrow circle of their own comrades and sympathisers. With regard to the position and prospects of shipbuilding, he remarks: "An impression prevails that the tide has turned, and that more work exists on the river. I wish I could endorse the opinion as to the turn of the tide. There may be more tonnage in the several yards, but it will be found on inquiry that a larger percentage now exists than did a year ago of unsold ships. I myself hold 11,000 tons of unsold vessels, which were laid down for the purpose of providing work for my men during the winter. I shall only be too glad to find at the end of 1885 a better state of things than now exists. I have, however, grave doubts thereof."

THE DESIDERATUM DONKEY PUMP.

The accompanying engravings illustrate a new donkey pump specially designed for use in steam launches, &c., by Mr. A. C. Mumford, Culver-street Works, Colchester. The fly-wheel can be fitted with a handle, which screws in and out, and the



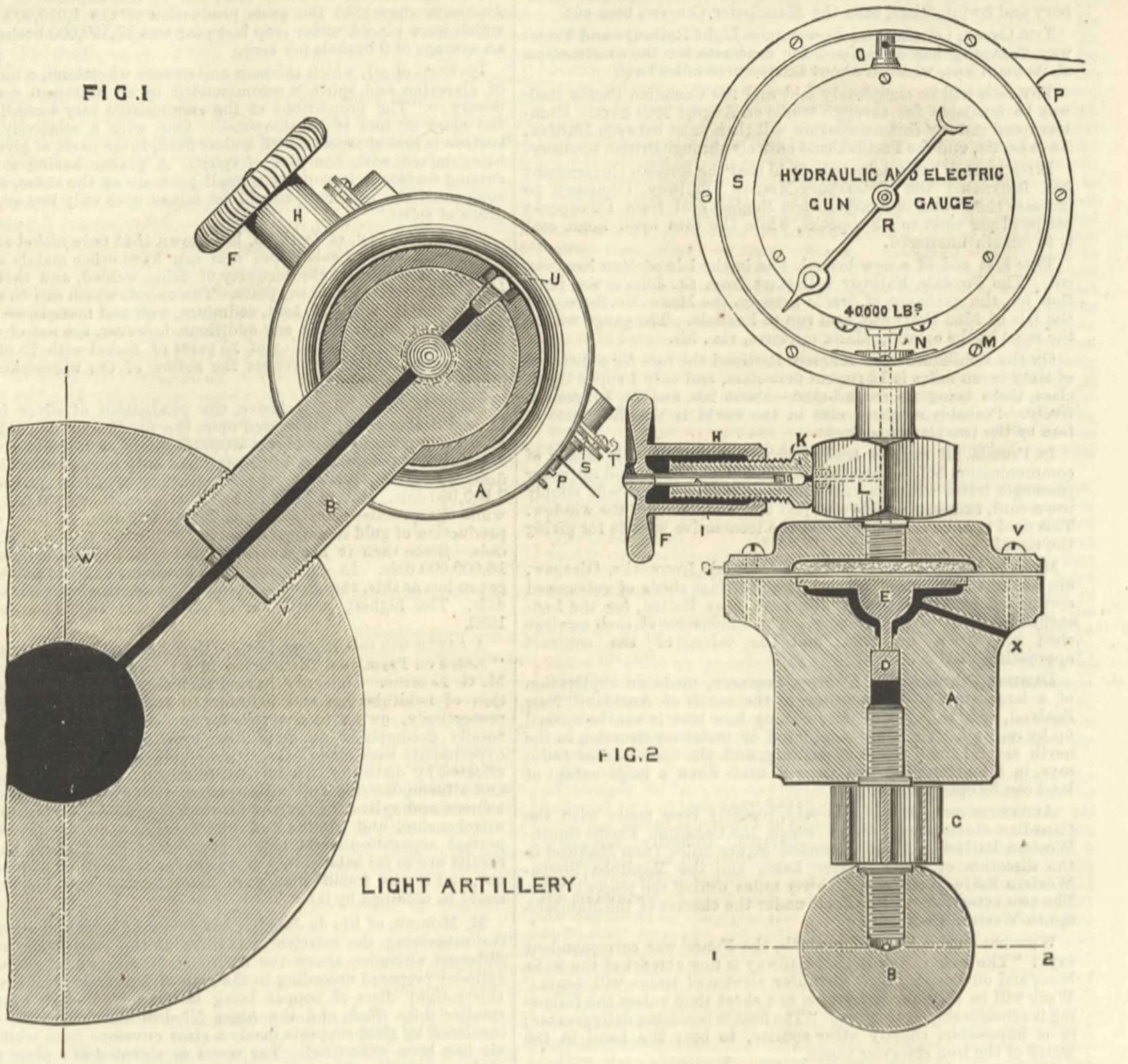
pump can then be readily worked by hand, thus supplying a read method of testing a boiler by a hydraulic pressure aft repairs. Thus, if tube ends have been re-caulked, it is onl necessary to fill the boiler full of water, and then a few strok of the pump will show whether the work has been properl



done or not. The little machine is remarkably well made, and is not a toy. It can be arranged as shown, either horizontally or vertically. The valves are large, and so are all the surfaces. It is made in two sizes, as shown by the following particulars:—

	No. 1.	No. 2.
Diameter of cylinder	2	4½
Diameter of ram	1	2⅜
Length of stroke	2	5
Number of revolutions	200	120
Gallons per hour	50	660
Nominal horse-power of boiler	4	40
Diameter of steam pipe	¼	¾
Diameter of exhaust pipe	⅜	1
Diameter of water pipe	½	1½

SHAW'S HYDRAULIC ELECTRIC GUN PRESSURE GAUGE.



SHAW'S HYDRAULIC AND ELECTRIC GUN PRESSURE GAUGE.

We illustrate a gauge for recording instantaneously the pressures of gunpowder at the moment of explosion. So far as we are aware, this is the only gauge of the kind in existence. The inventor is Mr. Thomas Shaw, M.E., of Ridge-avenue, Philadelphia. The gauge has been in use for some years by a firm of gunpowder manufacturers, who have not allowed any one to inspect it. The following description of its construction and mode of action are the inventor's:—

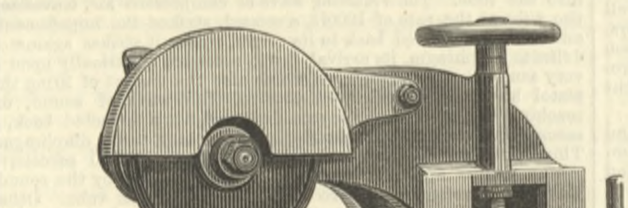
Fig. 1 represents the gauge, secured to small ordnance, the gun shown in cross section. Fig. 2 represents face view of the gauge and indicator, exposing a vertical section through the hydraulic portion of the gauge, on line 3 and 4 of Fig. 1. The same principles of reduction of high-pressure are used in this gauge as in Shaw's hydraulic gauge. It will be observed that a solid steel piston E in the cylinder A is provided with a plunger on its under side, which comes in contact with an elastic packing D; the plunger may stand as 1 to A 1000 or as 1 to A 100, in point of area of exposed surface, as compared with the large piston head, as desired. Assuming the proportions to be, 1 to A 1000, the 1000 lb. pressure on the plunger means only 1 lb. pressure in the fluid chamber, above piston head E, and this greatly reduced pressure is now susceptible of measurement by any of the ordinary light-pressure instruments for measuring pressures. All the passage ways connecting to dial gauge R, with the fluid chamber above piston E, are filled solid with fluid, permitting no air spaces that can be avoided. The steel plug L, that forms a passage way between the fluid chamber and the dial gauge, is provided on one side with a small screw hydraulic pump, with a reservoir supply of fluid. This part is shown in longitudinal section; the steel plunger I is firmly secured to wheel F; the long hub H of which is provided with a screw thread on its inner side, which thread screws upon the exterior of pump barrel K. After first filling the interior of the pump barrel with fluid, the said hub is screwed upon the pump barrel, causing the plunger I to force the fluid into the fluid chamber and passage way leading to the dial gauge, causing the hand or pointer to move to any pre-determined pressure on dial, in advance of pressure applied in the high-pressure chamber at D. The purpose accomplished in this act is to give the least possible movement of the pointer to record any maximum pressure; as, for example, assuming that 20,000 lb. was the expected pressure from any one explosive, then the pointer, by the means above described, can be set at, say, 18,000 lb., in which event the pointer is reduced to the minimum movement of only 2000 lb. to register 20,000 lb.

It will be evident that much greater accuracy of measurement of maximum pressures can be obtained by the minimum movement of the pointer, as both the inertia and the momentum are reduced to the minimum quantity. The subsidence of pressure resulting from explosives being about as sudden as the creation of pressure, causes the pointer to move too rapidly for correct occular observation; on which account a static electric current is employed, causing a stream of electric sparks to shoot off from the end of the pointer R to the brass outer ring M. The gauge is insulated for that purpose by glass plate S, which is secured concentrically to the gauge proper and the ring M. Binding posts for the electric wires are provided at O and P, which wires are shown in Fig. 2. A spring clamp N, Fig. 2, enables the insertion of chemically prepared or other paper, which lies against the inner side of brass rim M, and held in place by the clamp N. The electric sparks above spoken of pierce the strip of paper with small holes and coloured marks. These holes, &c., show the exact limits to which the pointer has travelled under pressure, and thus an indelible record is kept by the electrical indications shown upon the strip of paper. The paper can have the pressures corresponding to gauge printed upon the same, when the holes are made prominent by holding the paper to the light, exposing an exact indication of the pressures or explosives operated with.

The gases resulting from the explosives are injurious to the gauge packings, &c., on which account the bore in gun W, and the connecting steel plug B, are filled with fluid. A screw plug U enables the insertion of the fluid, after first pushing an elastic wad of rubber B, or cork, in the bore near the inner wall of the gun, which wad will prevent the escape of the fluid to the interior, and be sufficiently free to prevent any interference with the pressures. The patentee and manufacturer of this gauge, is prepared to fill orders up to 50,000 lb. per square inch. This gauge is made of the best steel, and is very compact, the weight being inside of 25 lb.

The inventor has heretofore made mercury column gauges for gunpowder pressures, which were too large for direct attachment to guns, but were connected with special powder chambers to test the pressure, &c., of confined explosives. The experience thus gained enabled the construction of the instrument here shown, which is adapted to direct attachment to the gun, making it as easy now to measure gunpowder pressures as it had been, heretofore, to measure steam pressures. The effect of this movement is to reduce the exaggerated statement of high pressures, obtained from ordinary sporting powders; these have been accredited with pressures up to 40,000 lb. per square inch, but they only really gave 22,000 lb. by actual gauge measurement. Artillerists and ordnance officers have, in this instrument, a true pulse of the internal pressures of the gun, of inestimable value when determining the quantity of powder and the proper weight of shot. These are important matters in ordnance practice.

This gauge is a compact machine, designed to measure and indicate the quick pressures resulting from gunpowder explosives and the slow pressures of hydraulic force: the same mechanism used in both cases permits the ready testing and examination of gauge under hydraulic pressure, to determine its accuracy, for the more sudden pressure occasioned by the use of gunpowder.



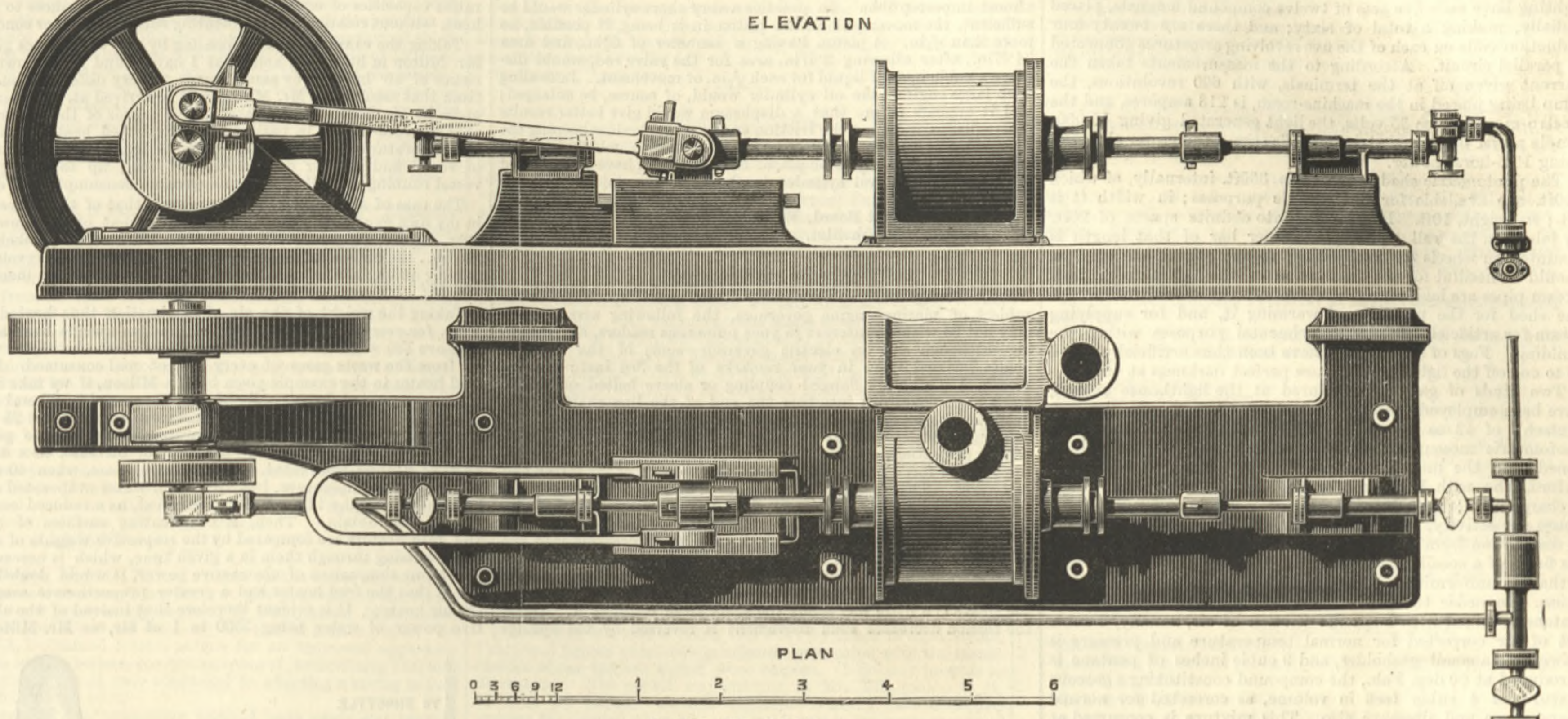
WHEEL TOOTH CLEANING MACHINE.

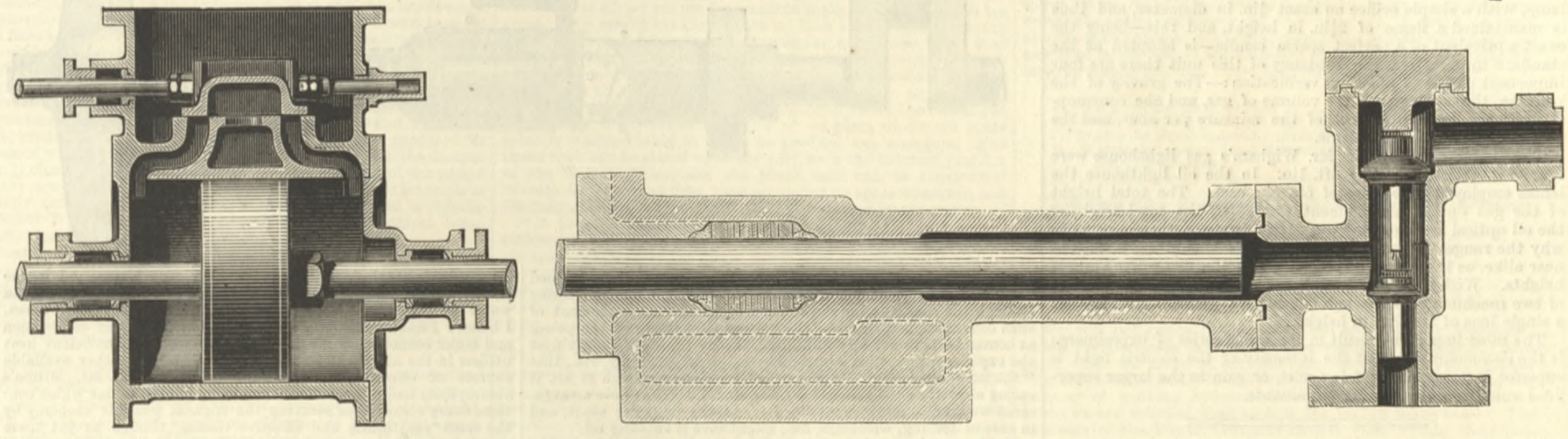
IMPROVED WHEEL TOOTH CLEANING MACHINE.

We illustrate a machine for cleaning with an emery grinder the teeth of wheels, now being introduced by Messrs. Wilkinson and Lister, Keighley, Yorkshire. This class of machine is found very useful in shops where quantities of gearing are produced, as by its use, with a properly shaped emery wheel, the teeth of such wheels are made equal in appearance to machine-cut wheels, and can be worked fully in gear, running together smoothly. The advantages claimed for this machine are obtained by arranging the slide carrying the wheels to work in a horizontal position instead of vertically, as is usual in other machines. The work may be more readily put on the machine, which may be done without stopping the emery wheel. The machine is also made stiff and strong, so that wheels of large pitches and diameters may also be operated upon. In the machine shown, wheels up to 3ft. diameter and 1½in. pitch of teeth may be cleaned. The machine is self-acting in the picking motion, which is adjustable for any pitch, the stroke of ram and position of the same being also adjustable.

HYDRAULIC PUMPING ENGINES.

MESSRS. DRYSDALE AND CO., GLASGOW, ENGINEERS.

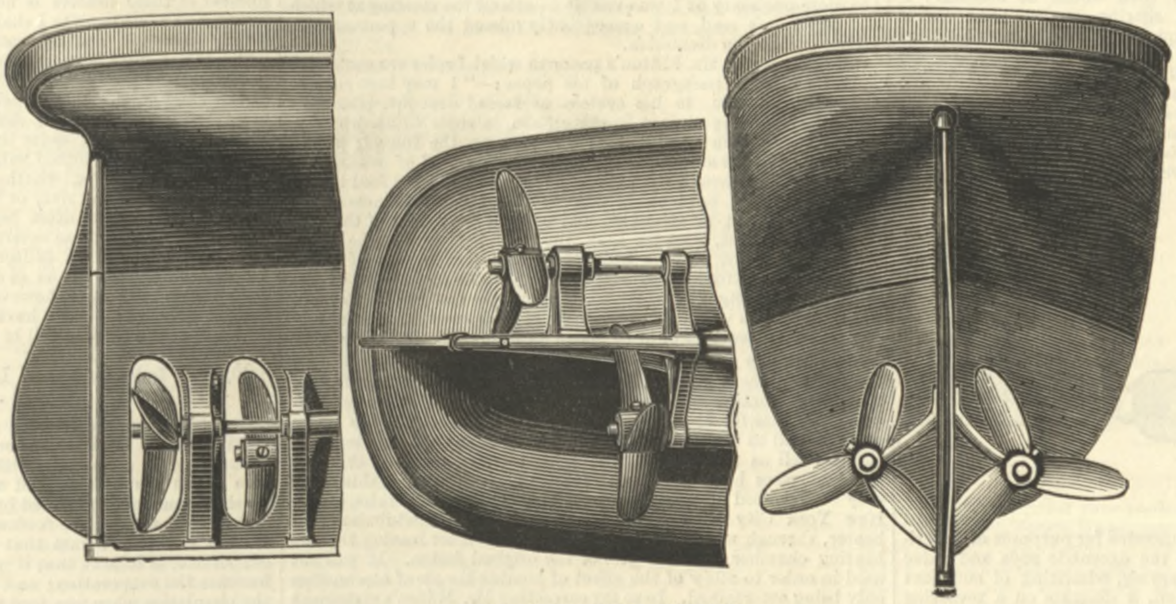




THE pumping engines illustrated in the accompanying engravings have been made by Messrs. Drysdale and Co., Bon Accord Works, Glasgow, for a large Turkey-red dye-works, to pump up a number of accumulators loaded to a pressure of about 2000 lb. per square inch, but were made sufficiently powerful so that if required they could work up to double this pressure. Cylinders are 17in. diameter by 12in. stroke. The pumps made of gun metal, four in number, placed fore and aft, having steel plungers 1½in. diameter, and very easily accessible valve boxes, so that by the slackening of two bolts and removal of cover, both suction and discharge valve can be readily examined. The boiler pressure available in the works is only from 35 lb. to 40 lb. per square inch, and the speed of pumps is about fifty strokes per minute. The hydraulic power is used for working lifts, baling yarn, squeezing yarn, and many other purposes to which hydraulic power can be applied. The pumps are stopped and started automatically from the accumulator. They have now been working for a considerable time, and have given great satisfaction to the users, Messrs. John Orr Ewing and Co., Vale of Leven, Dumbartonshire.

MACLAINE'S TWIN SCREWS.

THE MacLaine Perfect Piston Company, of Belfast, is now introducing the system of fitting twin screws, illustrated by the accompanying engravings, which show in three different aspects portions of a model of a steamship 500ft. long and 50ft. wide, with load draft of 26ft. The twin screws are each 19ft. in diameter, overlapped 5ft., and 11ft. apart fore and aft, and the ends of the blades project through two separate propeller spaces each 6ft. by 16ft., with a solid 4ft. space between them. By increasing the diameter of the propellers, together with overlapping them 5ft. and going forward 16ft., the propeller shafting outside the hull becomes so shortened, and is brought so much nearer the centre line, that it can be readily built into the vessel, and the stern tubes on both sides finished watertight up to the forward propeller space, one shaft being continued aft to carry the after propeller, and be secured on a bracket placed on the solid 4ft. space between the apertures. The general result is that the propellers are so far distant fore and aft that the tips do not interfere with each other in their working, and the solid 4ft. space retains the body of the water from the forward propeller on its own side of the vessel, and prevents it interfering with the working of the other. The propeller width is materially reduced, which facilitates docking; all brackets that might be damaged by floating ice are dispensed with, and all the dangers and difficulties of twin screw propulsion are, it is claimed, avoided. In small vessels the propellers can be kept a few feet apart fore and aft, and the propeller spaces made merely sufficient to permit the tips of the blades to project through them, thereby enabling the diameters of the propellers to be enlarged to increase their efficiency.



MACLAINE'S TWIN SCREWS.

THE SOUTH FORELAND LIGHTHOUSE EXPERIMENTS.

THE result of the experiments at the South Foreland on the relative value of gas, oil, and electricity for lighthouse illumination, is generally in favour of the electric light. The experiments have been of a very comprehensive character, and a very complete installation of buildings and photometric appliances has been employed in the research. The towers and photometer gallery, with observing hut 6200ft. from the lighthouses, are to remain now that the experiments are completed, as they may be of high value for further experiments, no such complete buildings having been before available for such research. The three experimental lighthouses were adapted specially for the contest, and were fitted respectively with new electrical apparatus, with Mr. Wigham's gas apparatus, similar to that in use at the noted Galley Head Lighthouse, and the six-wick oil burners in extensive use in the Trinity Lighthouse service. The electric light was furnished by three powerful arc lamps supplied with current by three De Meriten's machines, each arc as fed singly being about 12,000 candles power. These lamps were disposed in the lantern of the lighthouse in triform arrangement, superposed one above the other, and could be used separately or in groups. The Galley Head gas burners have sixty-eight jets, but the Wigham burners, first used in these South Foreland experiments, were provided with eighty-eight jets. Subsequently burners with 108 jets have been employed under a quadriform arrangement of four such burners superposed. Such burners in the photometric room have given an illuminating value of 2400 candles; but in the experimental lighthouse they have not developed quite so much light. The breadth of the flame is 11in., so that through the ordinary lighthouse lenses there must be much ex-focal light. The Trinity Service six-wick burners have been employed for oil illumination; the power of each burner being 800 candles; the diameter of the flame 4½in., and the superposition of the lights in the lantern being triform in arrangement. The photometric measurements of these experimental lighthouse illuminants have been made for the Trinity House by Professor Adams, of King's College, who is now engaged upon his report.

A great deal of attention has been paid to the question of the penetrative power of the lights of the several kinds, the result being generally in favour of the electric light. In dense fogs on the Foreland, by the direct testimony of observers walking towards the light, the electric became visible at distances varying from 1900ft. to 1500ft. The oil and the gas lights have been detected together at from 1500ft. to 1250ft. It appears that the high temperatures caused by the combustion of such furnaces of gas in the lantern are a serious detriment. With the original 88-jet burners the temperature rose during the exhibition of the light to 200 deg. Fah.; but the use of four 108-jet burners has elevated it from 300 to 350 deg.

It is said that from the general observations made by mariners at sea, the electric light appears to be in the ascendant; and by the personal observations of Professor Adams, Mr. Dixon, Mr. Hall, and others, it has been ascertained that, with the three illuminants shown as single lights, the rays of the oil and the gas were lost at eight miles, whilst the range of the electric was maintained up to fourteen miles. With the lights all at full power under their respective combinations the gas and the oil were lost at ten miles, whilst the electric was a good light at 14½ miles, beyond which it was not pursued.

The new magneto-electric machines used in the experimental lighting have each five sets of twelve compound magnets, placed radially, making a total of sixty; and there are twenty-four induction coils on each of the five revolving armatures connected in parallel circuit. According to the measurements taken the current given off at the terminals, with 600 revolutions, the lamp being placed in the machine-room, is 218 ampères, and the electro-motive force 35 volts, the light generated giving 19,000-candle power by photometric determination; the power absorbed being 13·5-horse power.

The photometric shed in length is 360ft. internally, of which 350ft. are available for photometric purposes; in width it is 8ft.; in height, 10ft. It is divided into definite spaces of 20ft. by labels on the wall, and a photometer bar of that length is mounted on wheels for transporting to any part of the shed as should be needful for the observation of the lights under test. Steam pipes are laid continuously round the whole interior of the shed for the purposes of warming it, and for supplying steam for artificial fogs for experimental purposes within the building. Fogs of such density have been thus artificially raised as to cut off the lights and produce perfect darkness at 40ft.

Two kinds of gas, manufactured at the lighthouse station, have been employed, namely, cannel of 24 to 28 candles, and Pintsch's of 42 to 46 candles. The ordinary unit of English photometric measurement, the sperm candle, has been abandoned, and the unit introduced by Mr. Vernon Harcourt, of Oxford, who, with Mr. Dixon, of the same university, have been in charge of this branch for the Board of Trade and the Trinity House respectively, has been employed. One of the products by distillation from gasoline is pentane—a clear, volatile, colourless fluid, of a specific gravity varying only from 0·628 to 0·630, so that its uniformity in this respect is a specially good qualification. In order to ensure its constancy as a standard, the pentane is mixed with a specific portion of air, namely, 3 cubic feet of air corrected for normal temperature and pressure is drawn into a small gasholder, and 9 cubic inches of pentane is introduced at 60 deg. Fah., the compound constituting a gaseous mixture of 4 cubic feet in volume, as corrected for normal temperature and pressure also. This mixture is consumed at the rate of half a cubic foot per hour in a cylindrical metal lamp, with a simple orifice an exact ¼in. in diameter, and thus is maintained a flame of 2½in. in height, and this—being the exact equivalent of a perfect sperm candle—is adopted as the standard unit. Upon the constancy of this unit there are four important checks or means of verification:—The gravity of the pentane, the accuracy of the volume of gas, and the consumption of the half cubic foot of the mixture per hour, and the exact height of the 2½in. flame.

The lenses employed in Mr. Wigham's gas lighthouse were four of a vertical height of 4ft. 1in. In the oil lighthouse the lenses employed were three of 6ft. 6in. each. The total height of the gas optical arrangement was 18ft.; the total height of the oil optical arrangement was 21ft. It is easy thus to perceive why the ranges of these two illuminants should have been so near alike, as the beams corresponded to the respective vertical heights. With the electric light, as employed with the current of two machines sent through one arc, the optical apparatus was a single lens of 2ft. 9in. in height.

The most important result in the whole series of experiments is the demonstration that the intensity of the electric light is superior in penetration of fog, mist, or rain to the larger superficial volume of combustion illuminants.

LETTERS TO THE EDITOR.

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

FRICTION OF SLIDE VALVES.

Sir,—The discussion on friction of slide valves which is appearing in your columns is of great interest to all engineers, as it cannot be doubted that anything which tends to reduce this element of cost in working will be greatly to the benefit of mechanical science. It is, perhaps, needless to state that the excessive friction of large unbalanced slide valves, besides being costly in working, leads also to cost in design—the excentrics, straps, and all gear, have to be much heavier than would be necessary if friction could be reduced, and in marine engines and inside cylinder locomotives the space occupied by broad excentric straps can ill be spared. There is another loss produced by this great friction which is not measured by the mere horse-power required to drive the sheave inside the straps—the arrangement being not unlike the R.A.S.E. brake. This loss is occasioned by the loss of travel of the valve through the springing and eventual wear and tear of the brake motion. From this cause valves may easily lose, after wear has taken place, $\frac{1}{16}$, or even $\frac{1}{8}$, of an inch, whereby the diagram is seriously affected.

FIG. 1

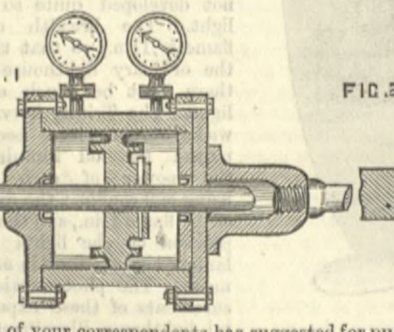
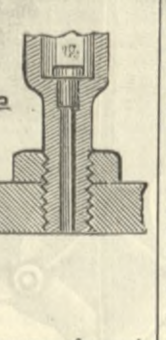


FIG. 2



One of your correspondents has suggested for purposes of experiment that the connection between the excentric rods and valve spindle should be by means of a spring, admitting of sufficient motion to make, by means of a pencil, a diagram on a revolving drum. Has your correspondent reflected as to what would be the effect of the motion thus lost on the movement of the valve and the admission and emission of steam, whereby the pressure on the valve and its friction would be affected? It appears to me that the principle of Duckham's hydrometer weighing machine is eminently adapted to test the friction of slide valves. To this end I propose to arrange the apparatus as shown in the sketches. Fig. 1 represents an oil cylinder, through both covers of which the slide valve rod passes. At the centre of length of the cylinder is fixed a piston, which, like the glands, is packed with U leathers. Two pressure gauges, with check valves—see Fig. 2—are mounted one at each end of the cylinder. The piston is, of course, a dead fit on the rod, and is fixed to it by a pin passing through the piston boss and rod. The attachment to the excentric or link motion, if a reversing engine, is by means of a stirrup, which clutches the top and bottom covers of the cylinder.

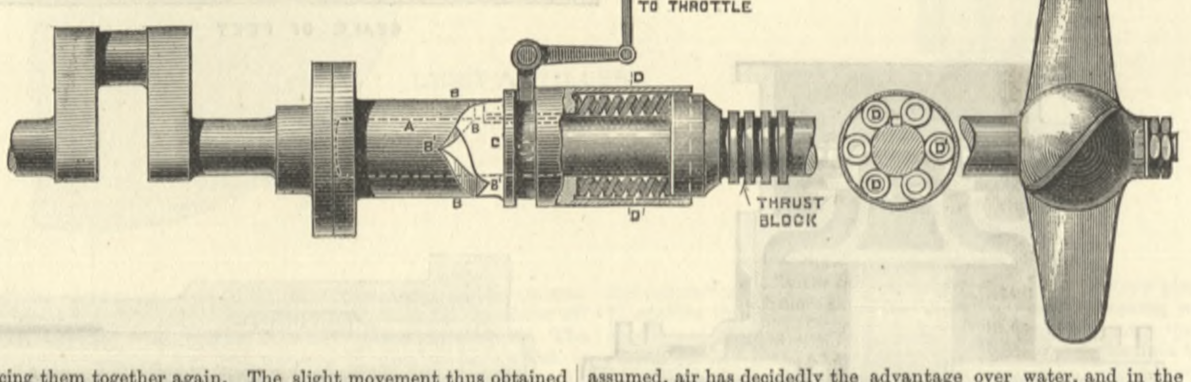
It will be evident that with good workmanship and adjustment this device will show by the gauges the maximum resistance to motion of the slide valve, for the power which moves it is conveyed by pressure on the oil in the cylinder. It is also evident that by substituting two Kenyon indicators for the gauges a diagram may be drawn on paper moving longitudinally. I say "Kenyon indicators," because they give diagrams with less to-and-fro volume of fluid than a piston indicator; although, by increasing the area of the oil cylinder, even the loss of motion due to the flow to and from the cylinders of ordinary piston indicators might be rendered almost imperceptible. In practice a very short cylinder would be sufficient, the movement of the piston in it being, if possible, no more than $\frac{1}{32}$in. A piston having a diameter of 6$\frac{5}{8}$in., and area 34·47in., after allowing 2·47in. area for the valve rod, would displace a cubic inch of liquid for each $\frac{1}{32}$in. of movement. In dealing with large engines the oil cylinder would, of course, be enlarged; and it appears to me that a diaphragm would give better results than a piston, reducing the friction and leakage, besides keeping the slide valve at a known distance from the motion, which a piston would not do if leakage took place. In the sketch I have exaggerated the length of the oil cylinder to show the principle on which it works.

Stephen H. Terry.

Local Government Board, Whitehall, S.W.,
March 31st.

MARINE GOVERNORS.

Sir,—Seeing that you very justly attach great importance to the subject of marine engine governors, the following arrangement may not be without interest to your numerous readers, as possessing—although not an electric governor—some of the cardinal points insisted upon in your remarks of the 3rd inst.:—In the sketch, A is a hollow flanged coupling or sleeve bolted on to the crank shaft coupling; into this the end of the line shaft enters, but is not keyed or secured there. Projections and recesses B B[1], forming a series of four or more inclined planes, engage with similar projections and recesses on a second sleeve C, the projections of the former accurately fitting the recesses of the latter, and *vice versâ*. The sleeve C being mounted on one or more feather keys fixed in line shaft is free to slide in the direction of the line shaft axis, but not to revolve independently, and bearing upon suitable coiled springs D, is thrust with its projections into the recesses of sleeve A, and there remains while the engines are at rest, but when the torsion on the shaft increases, the inclines slide upon each other, thus further compressing the springs and moving the sleeve C a little way along the shaft from coupling A. When the torsion decreases such movement is reversed by the springs



forcing them together again. The slight movement thus obtained being always in exact proportion to the different strains passing through the shaft, and always occurring at the exact moment of such difference, is utilised to control the throttle, or as the power at command is practically unlimited, it may be used to shift over the expansion link, thus overcoming one great difficulty, viz., that "the compound engine always contains steam enough to set it racing even after the throttle is quite closed." The above arrangement would also allow great elasticity to the propeller shaft, and in case of fouling, wreckage, &c., might save it twisting off.

Unfortunately, I am not in a position to give actual data, as the governor described has not yet been tried at sea, but shall be pleased to do so when the opportunity presents itself.

Lancaster, April 8th. Anchor.

THE EFFICIENCY OF MARINE BOILERS.

Sir,—The paper read by Mr. J. T. Milton at the Institution of Naval Architects, on the "Efficiency of Marine Boilers," and published in your last issue, contains some remarks bearing on my system of forced combustion, and on the capability of air as an absorbent of heat, which remarks, being based on mistaken assumptions, I trust you will afford me the opportunity of correcting. The publicity of your columns in making these corrections is the more necessary as I was unable to attend the meeting at which the paper was read, and consequently missed the opportunity of taking part in the discussion.

The remarks in Mr. Milton's paper to which I refer are contained in the following paragraph of his paper:—"I may here remark that Mr. Howden, in his system of forced draught, places an amount of heating surface in the uptake, in order to absorb some of the heat which would otherwise pass up the funnel; but he prefers to heat the air supply in this manner instead of heating the feed-water. Although with the same area exposed the feed heater must be heavier, both on account of the greater thickness of the tubes on account of strength, and also by the weight of the contained water, yet, area for area, the feed heater must be much more efficient, not only on account of the specific heat of water being more than four times that of air, but also on account of the much greater weight of water. Assuming the abstractive power of water and air to vary as the products of their specific gravities and specific heats, water would be about 3500 times as efficient as air."

Mr. Milton is mistaken in supposing that I prefer to heat the air supply from the escaping gases instead of the feed-water; for my system of working boilers by air-pressure combustion, when complete, provides for the heating of the feed-water from the waste gases as well as the air for combustion. For convenience in practice, as well as for theoretical reasons, I prefer generally that the escaping gases heat the air before the feed-water; but this order may be reversed if necessary. In the boiler now working in the New York City with forced combustion, a multitubular feed heater, through which the gases were to pass after leaving the air-heating chamber, formed part of the original design. It was not used in order to allow of the effect of heating the air of combustion only being ascertained. In so far correcting Mr. Milton's statement in regard to the mode I adopt in carrying out my system of forced combustion, I may take the opportunity of stating that, in marine boilers, heating the feed-water from the hot escaping gases can only be accomplished to much advantage when forced combustion is employed. When a feed heater is so used with natural draught, unless it is unusually large, the draught is appreciably lessened, and the evaporative power of the boiler reduced.

The other remark made by Mr. Milton in the paragraph I have quoted, to which I must take exception, is that regarding the comparative power of water and air to abstract heat from the waste gases. Mr. Milton assumes this power to be in the proportion of the product of their specific gravities and specific heats, or 3500 to 1. It is evident that Mr. Milton must have made this astounding assumption without sufficient, or, rather, without any consideration. Stating the matter roughly, Mr. Milton credits the capability of air to absorb the waste heat from the escaping gases at least 3500 times less than it deserves. I am not aware if an actual comparison of the abstractive powers of water and air has ever been made by passing the same weights of air and water in the same time over equal areas of heating surface having the same temperature. If there have been such tests made, I am prepared to say from my experience that the air will be found to have absorbed the greatest quantity of heat.

This product of specific gravities and specific heats has no such relation to the comparative powers of water and air to abstract heat as Mr. Milton has assumed, being merely that of the comparative capacities of equal volumes of the two substances to receive heat, without relation to time, heating surface, or other conditions.

Taking the examples of feed heating by the waste gases given by Mr. Milton in his paper, and what I have found in my own experience of air heating by same means, a very different conclusion from that assumed by Mr. Milton will be arrived at. The example given by Mr. Milton of the abstractive power of the water shows that the feed-water, in passing through a feed heater, was raised in temperature by the escaping gases 25 deg. with the lower speed of vessel and smaller consumption of coal, up to 40 deg. with vessel running at full power, and greater consumption of coal.

The case of air heating by same means, that of the waste gases, in my own experience, to which I refer, is that of the New York City, where, on trial with the temperature of the stokehole at 70 deg., the air for combustion was 250 deg. in the reservoir after passing among the tubes in the air heating chamber, an increase of 180 deg.

Taking the weight of the air of combustion thus heated to be 20 lb. for every lb. of coal consumed, and its specific heat at ·264, we have $180 \times 20 \times {\cdot}264 = 950{\cdot}4$ units of heat abstracted by the air from the waste gases of every 1 lb. of coal consumed. By the feed heater in the example given by Mr. Milton, if we take 8 lb. of water evaporated by every lb. of coal consumed—a liberal allowance—we have for the 25 deg. of increase of temperature $25 \times 8 = 200$ units of heat abstracted by the water from the waste gases of each lb. of coal consumed, and at 40 deg of increase, $40 \times 8 = 320$ units of heat so abstracted. In the latter case, when 40 deg. is added to the temperature, less than 8 lb. water evaporated should be credited to the 1 lb. of coal consumed, as a reduced economy would then obtain. Then, if the heating surfaces of the air and feed heaters are compared by the respective weights of air and water passing through them in a given time, which is necessary to give a fair comparison of abstractive power, it would doubtless be found that the feed heater had a greater proportionate area than the air heater. It is evident therefore that instead of the abstractive power of water being 3500 to 1 of air, as Mr. Milton has assumed, air has decidedly the advantage over water, and in the practice I adopt is much more simply and effectively employed than water could be in utilising the escaping heat from the waste gases. I believe I have sufficiently shown that my system of combustion and boiler economy, so far from dealing with an inefficient heat utiliser in the air of combustion, or of neglecting other available sources of economy, as it would have done if Mr. Milton's assumptions had coincided with the actual facts, is one which contains every element for securing the highest possible economy by the most practicable and effective means, though as yet these means have only been employed to a limited extent, leaving a wide margin yet to operate on.

James Howden.

Glasgow, April 14th.

Sir,—In the article in your last impression on this subject, you refer to the heating of feed-water with live steam. As I have for some time been working in this direction and have obtained satisfactory results in every case, and as I believe I am the only advocate of this system, will you permit me—though you naturally speak very doubtfully on the subject—to say that while theoretically there should be no gain by this mode of heating, I am, and those at sea who are employing my heaters in this way, are making an actual saving of some considerable value.

The explanation of this I at present prefer to withhold. A number of these heaters is now at work, and after a further experience of some months I shall have proof of strength sufficient to satisfy everyone, and to warrant my publishing an explanation which is not quite in accordance with the theory as to exchange of heat and as to conductivity. Meanwhile let me point out that one of the chief advantages which follow the use of my heater is the great reduction, I might say avoidance, of those conditions in boiler working which cause their rapid deterioration and the need of frequent repairs. Fitted with my patented arrangement, not only are the boilers always, whether the main engines are standing for a time, as in entering river or harbour, or not, fed with hot water, but they are filled, after being emptied for cleaning, with hot water, and thus all those severe strains are avoided which Mr. Marshall, Mr. Parker, Mr. Milton, Mr. Kirk, Mr. Seaton, and many others have pointed out as so destructive to boilers when steam is got up from cold water, however slowly, or when, as in lying under banked fires, the boilers have a cold feed. I trust that the importance of the subject will be a sufficient excuse for my troubling you.

Jno. Kirkaldy.

40, West India Dock-road, London, April 14th.

Sir,—In your notice of a paper read by Mr. Milton, on the "Efficiency of Marine Boilers," you allude to an engineering conundrum in connection with feed-water heating by live steam. You say it has been proved apparently beyond question that a sensible economy is attained by drawing live steam from the boiler and using it to heat the feed-water. I can fully believe that. As it is a well-known fact that a bad circulating boiler is a bad evaporator, it follows that if you improve the circulation you will increase the evaporation; and I think you most decidedly increase the circulation when you feed the boiler with hot water. Professor Rankine says it is only by the continual circulation and mixture of the particles of the fluid that uniformity of temperature can be maintained or heat transferred from a solid body to a liquid mass. This we know to be the case, as water is such a bad conductor; so that an arrangement that improves the circulation will undoubtedly assist the convection. If this is done by heating the feed-water up in a separate vessel before passing it into the boilers, it becomes a mixture of water and vapour when delivered into the boilers, instead of a comparatively solid body; and the steam globules, instead of being condensed, or at least prevented from rising to the surface by reason of this solidity, are now in their altered condition allowed to pass off freely, thus assisting the evaporation and increasing the circulation. That these results can be obtained without any loss only requires that the heating apparatus shall have its internal parts arranged in an efficient manner, and that the external surfaces be well clothed to prevent loss by radiation, care being taken that no loss occurs on the operation. The gain is the difference of the temperature of feed-water heated as against the temperature of feed water not heated, which, I think, might easily be 50 or 60 deg.; also the gain in steady steaming, as the ebullition will be quite regular, as against the fitful evaporation of a boiler using cold feed.

In conclusion, I am of opinion that feed-water heating by live steam, if properly carried out, will be found economical and a necessity with the increasing high temperatures of the modern triple expansion engines. As the condition of working a boiler with steam at, say, 150 lb. pressure, corresponding to a temperature of about 368 deg., the feed being only the usual temperature of about 130 deg., is much the same as if, with a boiler pressure of 75 lb. or temperature of 320 deg., you were using feed-water at 60 deg., which I think all engineers would say was decidedly dangerous, on account of the excessive strains to which the boiler is liable through the sudden introduction of cold feed.

I hope that these remarks on an important matter will be supplemented by some abler correspondents giving their views.

April 15th. ONE INTERESTED.

SIR,—On perusal of Mr. J. T. Milton's paper on the "Efficiency of Marine Boilers," read before the Institution of Naval Architects, and reported in your last issue, as bearing on the subject of the last paragraph of his paper, it may be of interest to Mr. Milton and the readers of THE ENGINEER generally to know that very extensive and, from the facts deduced, valuable trials have recently been made on one of her Majesty's ships, in order to test the relative evaporative and economic efficiency of a patent rocking fire bar and the ordinary pattern fire bar as hitherto used in the Navy, both working under the condition of forced draught, the trials of which, as engineer to the proprietors of the patent bars, I attended. The lowest consumption of coal per indicated horse-power per hour recorded during any one of the six hour trials, and which was obtained by the patent rocking fire bars, was 2·35 lb., the air pressure in the stokeholes being kept at 1½in. of water. The indicated horse-power per square foot of heating surface was ·340. During the trials 18 and 19 indicated horse-power per square foot of grate surface per hour were indicated. L. HOPCRAFT.

259, Gresham House, Old Broad-street,
April 15th.

SIR,—Having read Mr. Milton's paper on the above subject, and also your article thereon, I beg leave to give your readers the result of twenty-eight years' study, assisted by a number of experiments made with the object of reducing the cost of motive power. In June, 1883, I obtained letters patent for an improved apparatus applied to steam boilers for the purpose of economising fuel and consuming smoke, and have succeeded in effecting a saving in fuel of from 50 to 66 per cent.

The result of the numerous trials I have made has proved, beyond the possibility of doubt, that the enormous loss of heat sustained in working by the ordinary method of a chimney draught—whereby the products of combustion are rapidly drawn through the flues and into the chimney—causes an enormous waste of fuel. By working a furnace on my improved principle, a sufficient quantity of oxygen is supplied to the furnace by means of a fan, which discharges air into an inclosed ash-pit, from which it passes upwards between the fire-bars. Being thus divided into small streams, it combines readily with the incandescent carbon, consuming smoke, and producing complete combustion. The heat produced is retained within the furnace and flues by working with the damper nearly closed, being opened only sufficiently to admit of the escape of the incumbustible gases. The application of this principle is strictly confined to the purpose of saving fuel, and is totally different from forced draught, inasmuch as, the damper being nearly closed, the principle of draught does not apply.

Forced draught involves an increased consumption of fuel, and is only useful in obtaining a greater power in a small compass—a very doubtful advantage; while with regard to supplying oxygen at a high temperature, everyone knows who has had any experience in stoking that a boiler will steam faster on a cold day than when the air has been heated, and the life taken out of it, by the action of the sun.

My last experiment was made with what is called a return-flued boiler, in which it required 7 cwt. of common slack to evaporate 450 gals. of water working with the ordinary chimney draught, while with the improved apparatus 420 gals. of water was evaporated with 2 cwt. 1 qr. of the same kind of coal. It will be seen from the above that, if steam is ever to be produced economically, the heat produced from the fuel consumed must be applied to the boiler plates, and not wasted in the chimney. The proper working of this apparatus depends, to a great extent, on the stoker, who should be something more than a machine for shovelling coals indiscriminately into the furnace. The ignorance of this genius of the stokehole is often something astonishing.

I am now applying this apparatus to one of my boilers for the purpose of affording those interested in the subject an opportunity of thoroughly testing it. The apparatus is extremely simple, and is regulated by a valve in the air-pipe at the furnace end, and by the damper at the other. I enclose card, but as I do not desire to obtain a cheap advertisement, I beg to subscribe myself,

April 15th. ECONOMIST.

THE TILBURY DEEP WATER DOCK.

SIR,—In the description of the Tilbury Dock Works which you published on the 3rd inst., you state that the engraving illustrating the article shows "that the original plans have been adhered to." With works of such magnitude and of such great importance to London as the docks in question, it is extremely interesting to inquire how far the original plans have been adhered to, or how far, on the other hand, they have been modified to suit either new views of the requirements of the traffic or unanticipated engineering difficulties. Although it may be rather early in the history of the works to draw comparisons between the plans first published and the plans that have been or are yet to be adopted, your two descriptions, if supplemented by a little information from other sources, may serve for usefully pointing out some of the changes in design.

First, the entrance. Here are two long piers jutting into the river. In the 1881 plan these piers are nearly parallel; in the 1885 plan they are nearly at right angles to one another. In the 1881 plan the—river end of the—centre line of the entrance points up stream. As the piers are now being constructed the centre line points down stream. Your recent illustration shows a curious state of things. The down stream pier or jetty abuts on the river bank, and forms a solid junction with the quay of the tidal entrance basin. The up stream pier is extended back into the basin to a sort of inner pier head, and would be quite unconnected with the shore, but for what seems to be a sort of bridge. This difference in construction on the two sides of the entrance is remarkable. In neither of your articles is any account given of the method proposed to be adopted for constructing the entrance works without a coffer dam, although, from quay level to the bottom of the entrance channel, there cannot be many inches off 50ft. in depth of ground to be retained. Next, the tidal entrance basin. Your 1881 plan does not show whether this is to be formed with walled or sloping sides. When the Act was being obtained the sides were to be pitched slopes. The contract was for 1½ to 1 slopes, but as these would not stand they were abandoned, and now, as I understand, walls are being substituted. Judging from the position of the steamers in your bird's eye view, the latter information is probably correct. But the difference in cost will be considerable.

As for the lock and dry docks, whilst the lock remains as in the 1881 plan the dry docks are differently arranged, the advantage being evidently with the new plans. Passing into the main dock, one would judge from your 1881 plan that there were to be no slopes. Be that as it may, there was an extensive adoption of slopes in the contract plans; but these, like the slopes of the tidal basin, have largely had to give place to walls. In your 1881 plan, too, I notice "coaling berths" in a sort of side dock, which is, perhaps, the same as was formerly known as the collier dock. As a matter of fact, a large collier dock just at this part of the main dock was in the contract, and was also to have had 1½ to 1 sloping sides; but they would not stand, and now, as we see from your 1885 plan, the collier dock has gone altogether, and, judging from the position of the barque alongside, a quay wall is to run across there.

Lastly, of the branch docks which in the 1881 scheme were parallel sided, two are now seen to be tapering in width. With these few facts in view it can hardly be said that "the original plans have been adhered to." Z.

Gravesend, April 15th.

HYDRAULIC LIFTS.

SIR,—In your issue of this date, and in the course of a paper by Mr. E. B. Ellington, we find that he has quoted and criticised a statement made by us. It is proper to say at the beginning that his use of our statement before the Liverpool Engineering Society was with our full consent, given in answer to his courteous request. The statement to which he refers was quoted from a hastily-prepared letter which we had addressed to an engineer. After the use of our statement by Mr. Ellington, we addressed a letter to the same engineer reviewing Mr. Ellington's criticism. Since you have published Mr. Ellington's paper we are impelled to ask you to print our reply. Our statement was made to an engineer who was perfectly able to supply the figures needed to cover cost of labour, &c. Now that the matter has been made public we have only to amplify our figures. This we do by quoting from the second letter written by our President to the engineer before alluded to:—

"In my statement I supposed two lifts in an office building, with a rise of 80ft., and with power to carry a load of eighteen passengers. I did not go into all the detail, as will be noticed, but I now take occasion to say that in the case supposed, we should have used cylinders of 18in. diameter, geared 3 to 1. This motor, with a pressure due to 100ft. head, would enable us to lift a load of twenty passengers, that is, 3000 lb.

"Now, I take the efficiency that will be attainable in every case with motors of the size assumed, viz., 80 per cent., that is to say, a load of 3000 lb. To do this we should have to pump, as stated in my calculation, 200 gallons of water per minute 100ft. high, and I said that this was equal to 7·3-horse power, which includes frictional allowance.

"In stating the cost of doing this work by means of a gas engine, I assumed figures which two gentlemen connected with the manufacture of gas engines stated were correct. I do not propose to discuss this. The gas bill may amount, as Mr. Ellington puts it, to £113 per annum. Several engineers whom I have consulted express the opinion that 30s. per week will fully cover wages of mechanic in attendance, and oil and waste. I judge that the allowance of £5 per annum for water to make up waste is much too great. In a case in the City where we have a gas engine pumping water which is used over and over again, experience shows that there is no appreciable waste, the cooling water flowing from the upper tank and being pumped back again. I therefore disallow the £5. In all the cases of which I have knowledge an allowance of £20 for value of space occupied by machinery would be considered quite out of the question. I know of no place where the space actually occupied could be made to produce any such sum. The upper tank can be placed upon the roof, as is the common practice in the United States, and the lower tank can be constructed beneath the basement floor, thus occupying no space whatever, and the only space to be provided for is that occupied by the engine.

"In the special case which was in mind when I made up my statement, such an item would be clearly out of the question, for the space occupied by the steam pump would be all that would be required by reason of the creation of power for the elevators, and that space—boilers, as before remarked, being involved in any case—would be entirely without value, even if the pumps were not there, or if a gas engine were there in place of a steam pump.

"In calculating the cost, if using the patent hydraulic balanced lift, Mr. Ellington makes no allowance for wear and tear and depreciation of the lift proper; his allowance being on £20 only, the cost of service pipe. The Standard hydraulic lift involves no more loss or wear and tear and depreciation than the patent balanced hydraulic lift, except in the one item of rope. Our experience is that the life of the best wire rope will average five years, and a proper allowance therefore upon this ground would be for the annual cost of replacing a suit of ropes. This, in the case contemplated, would amount per annum to £2 18s. Once fixed, the tanks and pipes and lift machinery are certainly just as durable and as free from loss by wear and tear as the balanced lift, and it is just and proper to eliminate that matter in the one case as in the other. The only item to take into account, therefore, will be the wear and tear on the gas engine and pump. I understand from you that an engine of six nominal horse-power would be furnished and fixed in the building ready for use for, say, £200. A pump might cost, say, £75: making a total of £275. I further understand from you, and from other engineers whom I have consulted, that, ordinary care being assumed, 10 per cent. per annum would be an ample allowance for wear and tear, &c., and replacement when worn out. We have, therefore, 10 per cent. upon £275, which is £27 10s.

"Summarised, we have therefore—

	£	s.	d.
1. Gas (as taken by Mr. Ellington)	113	0	0
2. Man, oil, waste (as taken by Mr. Ellington)	78	0	0
3. Replacing rope per annum	2	18	0
4. Wear and tear, depreciation, &c...	27	10	0
	221	8	0

or dividing by 280, as Mr. Ellington does, = 15s. 10d. per day.

"Second, using steam power.—I have before remarked, that in the case which was before me when making my calculation, steam power was involved in any case, and therefore a boiler had not to be provided, by reason of the provision of lifts. I named the Worthington steam pumping engine because these are constantly used by our American house, and we therefore knew the quality and cost of the service obtainable by their use. The statement of the coal consumption is therefore not conjectural, but is an exact quantity. Since now we are going into particulars, and have to meet Mr. Ellington's paper with detailed items, I have thought it not best to depend upon merely general information, but to use exact figures.

"I have therefore obtained from Messrs. T. Middleton and Co. an estimate for the necessary plant in the case supposed, and its amount is £325.

"In the note which accompanied this estimate, Mr. Middleton remarks as follows:—'The expense of maintenance should be very small with a slow working machine like the Worthington, and for some years would be nothing more than new packings for the glands. At the end of five or six years the pump valves might require renewal. The boiler would require cleaning out two or three times a year, and perhaps a new set of fire-bars. The pipes would last for an indefinite time. I think that £7 10s. or £8 a year would be a very liberal allowance for repairs and renewals to boiler and pump. A very usual allowance for depreciation of boilers is 7 per cent., but I think this is high. However, if you take that figure, no one can say you have understated it. Engines depreciate 3 per cent. per annum, and the Worthington would certainly not exceed this. To enable you to make the estimate of depreciation, I state that the cost of the boiler and mountings, including inspirator and proportion of fixing, would be, say, £80. The Worthington pump fixed and connected to boiler would be, say, £160.'

"The wear and tear will be taken in accordance with Mr. Middleton's statement. I shall not include any allowance for interest, because, with Mr. Middleton's estimate before me, I feel entirely safe in assuming that the excess of first cost in the assumed case of the hydraulic balanced lift over the first cost of the standard hydraulic lift would equal the sum of Mr. Middleton's estimate. We are now, therefore, prepared to state the cost of using steam, which is as follows:—

	£	s.	d.
Coal per annum, say, as stated by Mr. Ellington	90	0	0
Wages of man, as stated by Mr. Ellington	78	0	0
Water for steam, evaporated at 8 lb. per 1 lb. of coal, and at 1s. per 1000 gallons	7	11	0
Oil and waste, as per Mr. Middleton	13	0	0
Wear and tear of boiler and pump	8	0	0
Depreciation on boiler and mountings, 7 per cent. on £80	5	12	0
Depreciation on pump, 3 per cent. on £160	4	16	0
Annual cost for new ropes	2	18	0
	209	17	0

"Divide by 280 working days = 14s. 11¾d. per day—a very different statement, as will be seen, from that made by Mr. Ellington, and not only so, but all the particulars are given by which the statement can be verified.*

"Now let us examine the figures as to the cost of driving a pump by the hydraulic power, and following Mr. Ellington's example, we will assume that the pump will give us 80 per cent. efficient. Then using a plunger 8½in. diameter = area 56·75in., to pump against a head of 100ft. = 43·5 lb. pressure. Hydrostatic pressure on plunger, 8246 lb., which at 80 per cent. efficient, requires power of 3085 lb.

"Taking water company's pressure at 700 lb., this requires piston area of 4·4in.

"Piston speed of 80ft. per minute for ten hours per day gives 576,000in. × 4·4 = 9140 gallons at 280 days:

	£	s.	d.
= 2,559,200 gallons at 2s.	255	18	5
Wages, as by Mr. Ellington	15	0	0
Oil, &c.	5	0	0
Wear and tear and depreciation on pump, 10 per cent. on £80	8	0	0
Wear and tear and depreciation on connections, 10 per cent on £30	3	0	0
	286	18	5

divided by 280 = per day, £1 0s. 6d., or with water at 2s. 6d. = £1 4s. 7d.

"Fourth.—To use standard hydraulic lifts worked by hydraulic power.—

Load, 3000 × 4 = 12,000 × friction 30 per cent. = 17,150.
Piston area, 24·49.
Piston motion 240in. = 21·2 gallons × 400,
= 8480 gallons at 2s. = 17s.

"Patent hydraulic balance lift.—

Load 3000, friction 30 per cent. = 1286 = required power 4286.
Ram area, 6·123in.
Ram motion, 960in. = 21·2 gallons × 400,
= 8480 gallons at 2s. = 17s.

"Inasmuch as Mr. Ellington makes no allowance at all for oil, space, wages, &c., for the patent hydraulic balance lift, and concedes the same efficiency to the Standard, I make no such allowance in either of the cases, except the proper allowance for new rope in the case of the Standard machine. Now to recapitulate the results reached, I give the following summary:—

	£	s.	d.
A. Gas pumping plant, per day	0	15	10
B. Steam pumping plant, per day	0	15	0
C. Hydraulic power indirectly through pump	1	0	6
D. Hydraulic power directly applied by Standard hydraulic elevators..	0	17	0
E. Hydraulic power by balanced ram lifts	0	17	0

"Compare with this summary that made by Mr. Ellington, which I here quote:—

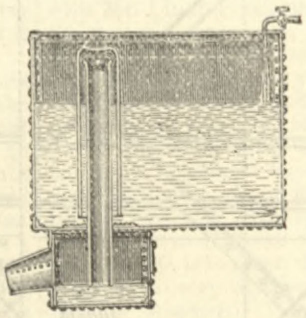
	£	s.	d.
Gas pumping plant, per day	1	6	6
Steam pumping plant, per day	1	6	3
Hydraulic power applied, *i.e.*, through pump and tanks, per average day	1	4	6
Hydraulic power applied direct	0	15	4

We will not quote further from the letter of our President, unless the discussion in your columns should be continued. The point which we make is, not that the use of the power, as thus supplied, is more costly in the actual expenditure of £ s. d. for the purpose of working hydraulic lifts; although at their present prices we are satisfied that such is the fact in many cases. The directors of the Power Company have it quite within their province to so reduce the charges for water furnished by them as to arbitrarily make it cheaper if they choose. Whether this can be done with profit to themselves it is not for us to consider. Our argument is, however, that, all points being considered, the use of the power for passenger lifts, and in many cases for goods lifts, is distinctly adverse to the interests of the consumer.

38, Old Jewry, E.C. AMERICAN ELEVATOR COMPANY.
April 10th.

FLUSH TANKS.

SIR,—I read with interest your account of a self-acting flush tank in last week's issue. May I, however, draw your attention to a flush tank with no working parts at all, the movable parts being an objection to most of them? I mean the one invented by the original inventor of flush tanks, Mr. Rogers Field. The working is as follows:—The water being fed by a small dribble rises in the tank until its level is that of the top of the inner leg—shown by dotted lines—when a small volume falls over and is guided clear of the sides by means of the lip. This displaces a small quantity of air, when a partial vacuum is formed and the whole of the contents of the tank is discharged. The tank then again refils. Particulars of this tank may be obtained from the manufacturers, Messrs. Bowes, Scott, and Read, Broadway-chambers, Westminster. H. SCOTT.



34, Cheyne-row, S.W., April 22nd.

FACTORY INSPECTION IN WALES.

SIR,—It may interest your readers to learn that the post of factory inspector in South Wales, which was rendered vacant by the death of Mr. Piers Mostyn, is to be filled by Mr. Augustus Lewis, grocer and tea dealer, of Burry Port, near Llanelly, Carmarthenshire. Mr. Lewis has a very extensive acquaintance with the grocery and drapery business, and this is no doubt the cause of his having been appointed out of some 200 applicants for the post.

London, April 23rd. R. J.

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* In those instances where steam is needed for other purposes, a man must be employed even if there are no lifts, and therefore his wages must not be charged as a part of the cost of working the lifts. This remark also applies to other items, so that, in such cases, the following would be a correct statement of the cost:—

	£	s.	d.
Coal	90	0	0
Water for steam..	7	11	0
Oil and waste	13	0	0
Wear and tear on pump..	3	0	0
Depreciation on pump	4	16	0
New ropes	2	18	0
	121	5	0

Divide by 280 working days = 8s. 8d. per day.
Or 8s. 8d. per day, as shown by the foot-note on page 22.

THE LA TARDES VIADUCT, MONTLUCON AND EYGURANDE RAILWAY.

(*For description see page 322.*)

Fig. 1

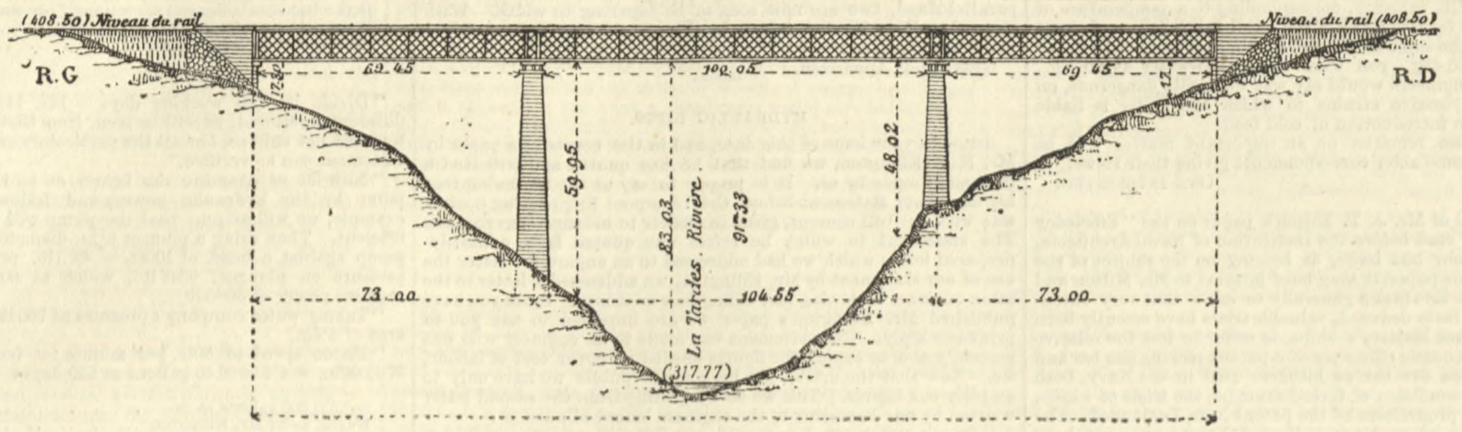


FIG. 3.

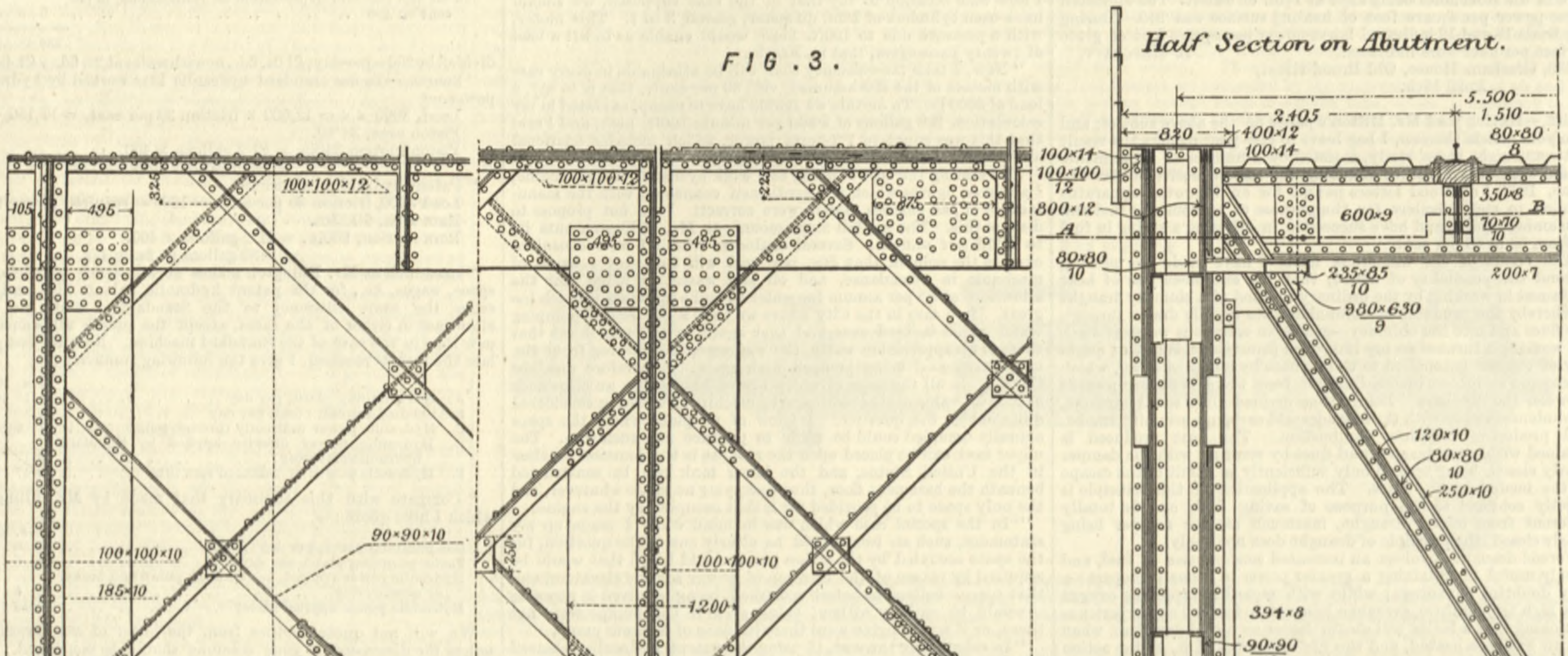
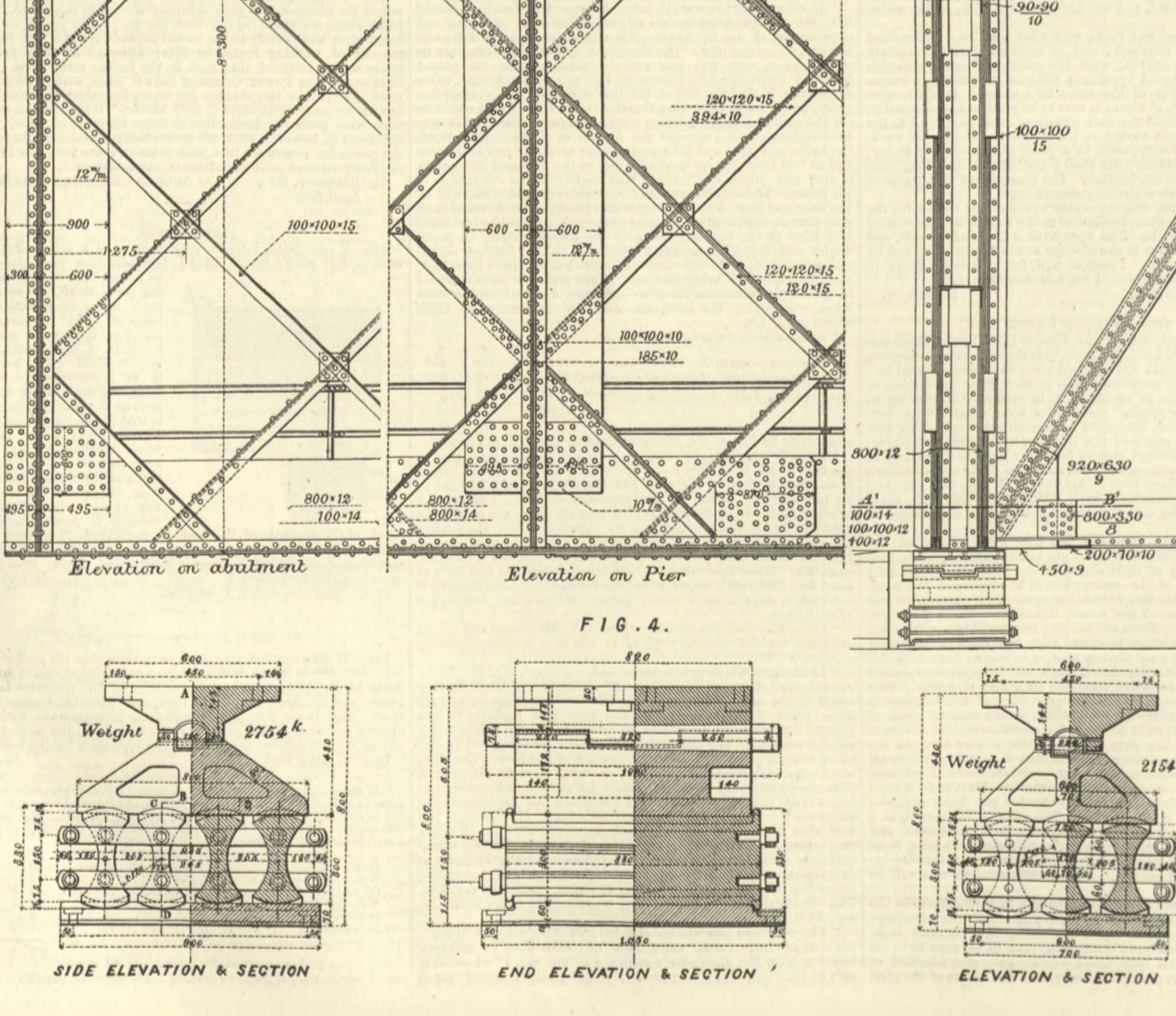


FIG. 4.



TO CORRESPONDENTS.

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

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

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

OLDHAM.—*Woodhead tunnel, a little over three miles: Standage,* 5435 *yards.*

G. D.—*Have not published article described. The "Ironmonger," 42, Cannon-street, E.C.*

J. B.—*There is no examination. Any one can call himself a civil engineer. You cannot learn civil engineering from books.*

S. AND S. (Hamburgh).—*We have made inquiries, and can refer you to the Crown Agents for the Colonies you name, in Victoria-street, Westminster.*

A. C. W. (Pitsmoor).—*A letter addressed to the Secretary of the Institution of Civil Engineers, 25, Great George-street, will, we have no doubt, obtain for you the further information you require.*

J. W. H. (Wilmington).—*Your sketch shows a very good arrangement, but you must take care to keep the heater always full of water, or the top of it may become seriously weakened by overheating.*

Y. R.—*The belt will creep off the pulley. If the belt be long and the angle of inclination of the shafts moderate, the pulley may be made of such a shape that its face on the side where the belt works will be vertical to the plane of the belt, in which case it will not creep off.*

E. S.—*The general idea of your invention is very old—as old as the time of Watt. Everything depends on the way in which the invention is put in practice. Hitherto it has been found necessary to protect the cylinders either by putting them into a jacket containing air or by surrounding them with fire-clay. The temperature of the gas varies continually.*

A VICTORIAN.—*Almost all the principal towns in England now possess colleges where engineering is taught as fully as it possibly can be taught by professors and books. Such colleges as those at Liverpool, Manchester, Birmingham, Bristol, Leeds, London, Glasgow, and Dublin, leave nothing to be desired. The fees vary, but in all cases are moderate.*

GAS ENGINES.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers tell me where I can get the pamphlet by Mr. Thwaite "On the Gas Engine"? G. O.

FLUSH TANKS.

(*To the Editor of The Engineer.*)

SIR,—I beg to say that the inventor of the flush tank you show in your issue of the 17th inst. is Mr. Maguire, of Dublin, and that the same can be seen at the Parkes Museum, Margaret-street, W.

6, Baker-street, Portman-square, London, W., April 22nd. FRANCIS BOTTING.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, April 28th, at 3.30 p.m.: Special general meeting of Corporate Members only, to decide upon proposed alterations in the bye-laws. At 8 p.m.: Ordinary meeting. Paper to be read and discussed, "Mechanical Integrators," by Professor H. S. Hele Shaw, Assoc. M. Inst. C.E. Wednesday, April 29th, at 6 30 p.m.: Annual dinner in the Conservatory of the Royal Horticultural Society, which is to be used for the purpose of the Inventions Exhibition

INSTITUTION OF MECHANICAL ENGINEERS.—Thursday, April 30th, at 3.30 p.m., and Friday, May 1st, at 7.30 p.m.: Ordinary general meeting. The following papers will be read and discussed as far as time will admit:—"Description of the Maxim Automatic Machine-Gun," by Mr. Hiram S. Maxim, of London. "Abstract of Results of Experiments on Rivetted Joints, with their Applications to Practical Work," by Professor Alexander B. W. Kennedy, of London, including the latest experiments described in Professor Kennedy's report issued to the members in February. "Description of the Tripier Spherical Excentric," by M. Louis Poillon, of Paris. "Description of a Blooming Mill with Balanced Top Roll at the Ebbw Vale Works," by Mr. Calvert B. Holland, of Ebbw Vale.

SOCIETY OF ARTS.—Monday, April 27th, at 8 p.m.: Cantor Lectures. "Photography and the Spectroscope," by Captain W. de W. Abney, R.E., F.R.S. Lecture II.—The diffraction spectrum—the ordinary grating—influence of the number of lines on resolving power—the reflection grating—the flat reflection grating—absorption of radiation and atomic motion, and the formation of the photographic image. Tuesday, April 28th, at 8 p.m.: Foreign and Colonial Section. "The Federation of the Empire," by Mr. J. E. Gorst, M.P. The Right Hon. W. E. Forster, M.P., will preside. Wednesday, April 29th, at 8 p.m.: Nineteenth ordinary meeting. "Researches on Silk Fibre," by Mr. Thomas Wardle, F.C.S., F.G.S. Friday, May 1st, at 8 p.m.: Indian Section. "Herat," by Professor A. Vambery.

DEATHS.

On the 30th March, JAMES BOLLAND, C.E., of 6A, Victoria-street, Westminster, S W.

On the 16th inst., at Trewinian, Burnt Ash Hill, Lee, S.E., WILLIAM LADD, F.R.A.S., late of Beak-street, W., aged 70. Australian, Canadian, and Scotch papers, please copy.

THE ENGINEER.

APRIL 24, 1885.

THE NAVY AND THE ADMIRALTY.

ON Monday night the House of Commons resumed committee on the Navy Estimates, and a vote for £934,000 for victualling and clothing sailors and marines supplied an opportunity for discussion. Mr. Rylands, Sir E. J. Reed, Mr. Gorst, Mr. W. H. Smith, and many other members took part in this discussion, the most remarkable feature in which was, perhaps, that both sides of the House united in condemning the policy of the Board of Admiralty. Sir E. J. Reed said nothing about the merits or demerits of ships of war. He contented himself with a remorseless and able criticism of the accounts of the Admiralty, and their general policy. He showed that their statements concerning the cost of ships were inaccurate, the vessels always costing much more than the sums put against them, while the quantities were equally wrong. The Admiralty, for example, asserted that they had built 12,864 tons, while they had really built but 11,000 tons. They had obtained from the country, for the purpose of constructing ships of war, no less than £8,855,000, of which £5,596,000 was lying dead, because the ships which it was intended to supply had not been finished. Since the present Government had come into office—say five years—the Admiralty had not turned out a single ship of more than 1500 tons burthen; and now, when war is imminent, they are raking the dockyards and ransacking the country for ships to defend our commerce. Other speakers took much the same line, and the best defence the Government could put forward was that they hoped soon to have some ships ready, and that they would try in future to make their accounts more accurate. Both sides, however, agreed that this was not a party question, and that the cause of all the mischief must be sought in the nature of the Board of Admiralty and its method of procedure. This is precisely what we insisted upon some weeks ago. We then asserted, and we now re-assert, that there is no hope that naval affairs will be altered for the better until the Admiralty is completely reorganised. If war breaks out now, it will be found that the Admiralty has wrought incalculable mischief—mischief so great that if men, and not a system, were to blame, no punishment could be too severe for them.

The operations of a Government always possess a military character, in the sense that the officials employed become, more or less, mere machines, with limited responsibilities and fixed modes of action, from which they are not expected to deviate. Now, the building of men-of-war is not, in any sense or way, a military operation; and there is no reason whatever why "red tape" should have anything to do with their construction. But it is quite certain that it has a great deal indeed, to do with it, and one of the results usually entailed is that anything like despatch in carrying out work is impossible. No one who has not been behind the scenes, can form an adequate idea of the amount of correspondence carried on between departments which is all, or nearly all, entirely useless. The smallest article cannot be taken out of store without requisitions, and forms, and signatures, in bewildering multiplicity. We do not hesitate to say that there is at least twice too much routine work done in our dockyards. A little thought ought to suffice to show that ironclads can be and are built in a very satisfactory way under a *régime* entirely different from that of the Admiralty. No firm in their senses would adopt the lumbering, creaking methods of the English Admiralty. The system adopted by Sir William Armstrong, Mitchell, and Co., or Messrs. Samuda, or any other great firm building ironclads, ought to be good enough for the Admiralty. It would certainly be incomparably better for the country. The private firms can build a ship in three years; the Admiralty cannot manage to turn out a ship in five years. There is no private firm on earth that could keep out of the Bankruptcy Court if it pursued Admiralty methods.

If it could be shown that although our Navy cost more than it ought to cost, it was efficient in every respect, the errors of the Admiralty might be condoned. But what are the facts? At this moment, if we are not afraid to go to war, we at least look on the prospect of war with doubt and fear, because there is little reason to think that we could protect that commerce to which we owe our greatness. The very rumour of war ran the price of wheat up 10s. a quarter. It has been proposed that an import duty of 2s. a quarter should be put on wheat not grown in English colonies, in order to help our own farmers; and there was an immediate outcry that such a tax would ruin the working classes; yet, as we have said, the bare rumour of war runs up the price of wheat five times as much. What will the working men say to this? Let us go further and ask what will be the price of corn as soon as war is declared? and not only corn, what will be the price of meat? How will sugar, tea, cotton, and the thousand and one things which we import fare; and who will be answerable for all this rise? We answer, without a moment's hesitation, the Admiralty. The reason why commodities will rise in price is simply because importers will run a great risk from Russian cruisers. It is not necessary that a single naval battle should ever be fought, and if Russia is wise she will keep her ironclads safe in harbour. She wants nothing but the reputation of having a fleet of fast cruisers at sea, to inflict incalculable injury on this country. We say the reputation. It is not necessary that she should actually possess such a fleet. Dangers not seen are of all others the most appalling to those who believe in them. There is no national commercial confidence in the ability of the Admiralty to help the merchant or the shipowner. In the hour of trial, it is the shipowner who has to come to the aid of the Admiralty. One of the worst features of the whole matter is this fact, that commercial men have no faith in the power of the Admiralty to assist them. For years and years there has been, year after year, the same display of official incompetence; the same want of appreciation of the actual merits of the case; the same obtuseness with regard to the true functions of a Board of Admiralty; the same patient, child-like faith that no one would go to war with England; the same trustful hope that if anyone did England would beat him; and so it will be, till the end of time itself, unless some absolute, unmistakeable reform is effected in the whole constitution of the Board of Admiralty.

Nothing perhaps about the whole matter is more painful than the total lack of comprehension of the points really at issue manifested by the Board of Admiralty and its defenders. We are assured that we have got ironclads sufficiently powerful to fight any enemy; that we have got enough of them; and that we are really not badly off at all. Take, for example, Mr. Caine's defence of Admiralty policy on Monday night. He deprecated invidious comparisons with the navies of other nations, but did not hesitate to say that we were in a stronger position than in 1878-80. When the programme laid down had been completed, our Navy would be equal to those of any two other Powers. We should have forty-six ships, with a displacement of 361,000 tons; while France and Italy combined would only have forty-four ships, with a displacement of 339,000 tons. France and Germany would together have forty-five ships, with a displacement of 320,000 tons, and France and Russia combined would have forty-four ships, with a displacement of 318,000 tons. With respect to torpedoes, we were increasing the number of men employed in connection with them, and a torpedo range would be established at Malta as well as at Portsmouth. We had ready for sea ten ironclads, eight ships for coast defence, twenty-four corvettes and cruisers, and twenty-seven gunboats, and he was informed by the Admiralty that they could be manned on an emergency in ten days. Now such comparisons of tonnage are mere waste of time. They supply no answer at all to the question, is the Admiralty in a position to guarantee the safety of ships of the mercantile marine in the Atlantic, in the Indian Ocean, in the Pacific, in the Mediterranean? It is nothing at all to the purpose that we could beat the ironclads of France or Russia in a pitched battle. The chances are all Lombard-street to a china orange that such a battle never will be fought; and this for the simple reason that neither party would gain much by fighting it. Let our national life on the waves be destroyed and Great Britain is ruined. But the destruction will be wrought, not by ironclads, but by fast cruisers. Are we in a position to sink, burn, and destroy such craft? Can we say with certainty that within a couple of weeks after war broke out we should have swept the ocean clear of such pestilent foes? What is the answer given by the Admiralty? It is supplied by the hasty acquisition at long prices of our Atlantic greyhounds. If the Admiralty had had a proper perception of its functions it would have seen that England's navies have duties to perform which cannot be discharged by heavy ironclads, but this is one of the points which sucessive Boards appear to be entirely incapable of understanding. To complain under existing circumstances is to waste time. There is only one course open, and that is to re-model the whole system. It has over and over again been pronounced defective. It has been tinkered up time and time again. It is frightfully expensive. It has absolutely nothing to recommend it. Its defects are incorrigible. The only course to be pursued is to clear it away bodily and adopt something more consistent with the wants of a great maritime nation.

HIGH SPEED STEAMSHIPS.

ON the last night of the last meeting of the Institution of Naval Architects, and at a very late hour, a paper was read by Mr. E. A. Linnington, "On the Propelling Machinery of High Speed Ships." It is one of the defects of the system adopted by the Institution of Naval Architects, that valuable or interesting papers are sometimes read far into the night, when those most competent to discuss them are thoroughly wearied out. This was peculiarly the case with Mr. Linnington's paper, which deserved an attention which it did not receive. It is not a long paper, and it is in many respects more suggestive than didactic; but it supplies information on certain points of considerable interest, and raises points well worth discussion. Mr. Linnington's position, too, in the Controller's Department of the Admiralty gives him facilities for imparting information not possessed by everyone. His opening sentences dealt with a class of ships to which all eyes are now turned, namely, high speed cruisers; and he dealt with some fulness of detail on the construction of their machinery. It is evident that the work to be performed by a cruiser is very different from that done by, say, a fast Atlantic steamer. The business of this last is always to steam as fast as she can, and strange as it may seem, the necessity for using economical engines is not in her case based so much on commercial as on mechanical considerations. It is, in other words, necessary that she should burn as little coal as possible, not so much to save money as to enable the utmost possible power to be got out of boilers of a given capacity. The difficulty of getting 250 tons or 300 tons of coal to the fires every day is not imaginary; and the enormous powers now attained could not possibly be reached if the consumption of fuel was, say, 4 lb. per horse per hour, instead of 2½ lb. or thereabouts. It is, therefore, imperative that the engines shall be so large and so proportioned that they may work with a large degree of expansion at full power. Now the case of the cruiser is entirely different. It is only occasionally that she can be called upon to steam at full speed. She may cruise about for weeks, and never want to make more than ten or twelve knots an hour; but she must be able, when the demand for speed comes, to make sixteen or eighteen knots. Mr. Linnington explains how this end is attained. The engines are made as light as possible, and the cylinders, &c., are comparatively small. At slow speeds and low powers they work with a large measure of expansion, and low mean pressure; but when high powers are called for, a forced draught is employed. Economy of fuel is no longer studied. The mean cylinder pressure is high, and so is the boiler pressure. To use Mr. Linnington's own words: "Very high piston speeds have recently been obtained, the highest in H.M. twin-screw cruiser Phaeton, 5500 indicated horse-power, the engines on trial running at 800ft. per minute, the revolutions being 100 and the stroke 4ft. The engines of a large number of cruisers now building are intended to work with a piston speed of 750ft. to 820ft. per minute at the full power. These are all horizontal, two-cylinder, compound engines, with the cranks at right angles. The proportion of mean to initial pressure is very large, and this gives an engine well adapted to quick running; for the small cylinders have small reciprocating parts for the work they perform, and the late cut-off tends to uniformity of the twisting moments on the crank shaft. Light reciprocating parts and uniform twisting moments are two most desirable features in a high-speed engine. The efficiency of the steam is low at the full power—which, however, is seldom required—but at low powers these engines are very economical, not only on account of the efficiency of the steam, but also on account of the small initial friction which attends the use of small pistons, piston-rods, and shafts. It is well known that when engines of large capacity for the maximum indicated horse-power are run at low powers, the greater part of the power disappears in overcoming the initial friction. The cylinder liners, pistons, piston-rods, connecting rods, and shafting are made of steel—a material which, compared with iron, possesses qualities favourable to quick running; for the greater hardness and smoothness of surface much reduces the wear and tear, and the superior strength lightens the reciprocating parts. Steel cylinder liners have been used in the Navy for several years; a cracked liner is a rare curiosity, and the wear is taken by the softer spring ring of the piston. The pistons are of cast steel, dished; the spring rings usually of cast iron. With this dished shape, stiffness is the first consideration, and with proportions which give a weight about 35 per cent. less than the weight of a cast iron piston, the deflection under a water test of twice the working pressure is found to be inappreciable. Steel liners and these light pistons permit the highest piston speed in horizontal engines of moderate dimensions without the use of tail rods or back guides."

It is a pity that no adequate discussion followed the statements we have just quoted. If these cast steel dished pistons, which resemble nothing so much as the pistons used in locomotives, are really so good, why is it that they have not found their way into the mercantile marine? Cracked pistons are well known in our high-speed ocean steamers. It will be remembered that the Austral broke two of her pistons on a single voyage to Australia, and rumour tells a similar story of recent Atlantic steamships. Again, Mr. Linnington is silent concerning valve gear; yet the valve gear of the high-speed engines is all important. On it may in a great measure be said to depend the immunity of the engines from breakdown. When very heavy masses are caused to reciprocate, it is essential that these should be brought to rest gradually, and that as far as possible work should be done on some elastic material. It is necessary, therefore, that compression should be freely used, at least if the engines are intended to run for any considerable period with safety. Now it will be seen that the valve gear to be used in cruisers ought to be different from that used in high-speed mercantile vessels. In this last the link motion is employed, more for the purpose of handling the engines freely than for any other reason, and the point of cut-off is determined by a distinct valve. In cruisers the same arrangement appears to prevail, and it is certain that the link motion will be worked in full gear when the engines are pressed; but these are just the conditions under which the link motion gives little or no compression, and it would be interesting to know whether any inconvenience results, whether the engines thump at the high speeds but not at the low and whether the bearings give trouble; concerning all this Mr. Linnington tells us nothing. It is, we know, too often assumed that if the piston and reciprocating parts of an engine are kept light it may be run at almost any speed. This is, however, only half the battle. Mr. Arthur Rigg was one of the first, if not the first engineer, who showed that the valve gear which will answer for low speeds will not necessarily answer for high; and a masterly investigation of the whole subject will be found in his treatise on the steam engine. We cannot find from Mr. Linnington's paper that these things are at all considered by the designers of the machinery of our cruisers. We have no doubt that they are considered. The question remains, however, how much?

The lesson taught by the performance of the Riachuelo, described last year by Mr. Samuda, ought to bear fruit; it has yet to be seen whether it will or not. Mr. Samuda found it possible to combine superb form under water with heavy armour and guns, and he thus obtained a very high speed with a moderate indicated power. Mr. Linnington tells us, however, that in our own cruisers the proportion of indicated horse-power to displacement varies from $1\frac{3}{4}$ to $2\frac{1}{4}$, while in our fast Atlantic steamers the power equals the displacement. In the Oregon and a few special steamers the horse-power is apparently about $1\frac{1}{2}$ times the displacement. We say apparently, because we do not know what the actual ocean-going horse-power is, but the speeds of these steamers are very much higher than those of our cruisers. The promised speed of the new ships of this class is 17 knots, in practice it will be 16 knots. The fastest ships we have afloat, in the Navy, are the Iris and Mercury, which have run at 18 knots. Such vessels as the Oregon are at least two knots an hour faster than the cruisers, although the full power of the cruisers is much greater per ton of displacement than that of the merchant vessels. This is due to the full forms of the hulls of the cruisers, and we have yet to learn why what answers perfectly in the Riachuelo and the Esmeralda, Brazilian and Chilian war vessels, should not be found worthy of imitation in English ships. It may be incidentally remarked that the very high powers employed in recent additions to the Atlantic fleet are obtained by what would have been regarded not long since as excessive piston speeds. Thus the Oregon's engines have developed at sea 13,000 indicated horse-power, with a piston speed of 768ft. per minute, revolutions 64, stroke 6ft. In the Umbria, on a measured mile light draught trial, with 14,300 indicated horse-power, the revolutions were 70, and the piston speed was 840ft. per minute. The three-cylinder system has been generally used with these high speeds.

A considerable portion of Mr. Linnington's paper is taken up with the question of twin *v.* single screws. He is entirely in favour of the twins. He repeats all the old well-known arguments about the safety secured by duality of propelling machinery, and so on; but he lays much stress on Mr. White's statement concerning trials which showed that for deep draught ironclads the twin screws had a propulsive efficiency 15 per cent. greater than the single screw. If this is really the case all round—that is to say, if it holds good of light draught or comparatively light draught vessels—it seems strange that the twin screw should not enjoy more favour than it does. Mr. Linnington, however, does not appear disposed to press Mr. White too far; his precise words are:—"In passing from these ironclads to the merchant ship we go from a full form to a much finer form, from a speed of $14\frac{1}{2}$ knots to a speed of about 18 knots, and from two-bladed screws of the original Griffith's shape to four-bladed screws of a fuller form towards the tips of the blades. These differences may affect the relative augments of resistance, the gains from the wake in the efficiency of the screws, and the lengths of the shaft tubes and brackets; but 18 per cent. is a large margin to draw upon, and the assumption that the same I.H.P. will propel the ship with either single screw or twin screws does not appear unreasonable." It may be safely predicated that unless the twin screw can prove itself to possess very distinct economical advantages, it has no chance of extended adoption in the mercantile marine. Thus the question of most interest is, What system of propulsion will enable a stated number of tons of cargo to be carried furthest at a stated speed by a ton of coal?

PROOF TESTS OF IRON AND STEEL.

The extent to which iron or steel should be strained by testing it, when made up into a boiler, a small girder, a bolt, &c., has from time to time formed matter for debate amongst the most competent experts for a very long period, and still remains so to some extent, although a sort of general agreement has been arrived at that the test stress ought not to be less than one-third or more than one-half the ultimate strength of the *matériel*. Cases occur now and then, however, where a member of a structure tested before fitting in place to half the estimated ultimate strength, fails soon after it is put to work at, at all events, an estimated stress much below that to which it was exposed in testing. Such cases, though comparatively rare, cause, when they occur, perplexity in the minds of engineers, and shake their faith in the utility of proof tests. Such tests, in common with many other sources of information on things mundane, are valuable in proportion to the intelligence and soundness of judgment with which their results are considered. Because the subsequent behaviour of the material tested may, in stray instances, contradict the testimony of the test, it should not be concluded that tests are therefore altogether valueless. Such tests are of the highest importance, and much of the research devoted to the investigation of the chemistry, the molecular formation, and the effects of working upon iron and steel, has been brought about not only by the results of tests, but also by even the contradictions apparently visible about such tests. To paraphrase Euclid, conditions cannot be the same and yet be different one from another; and it is owing to the operation of this law that many of the seeming contradictions shown between the behaviour of iron in the testing machine and its subsequent performance in actual work are really, when intelligently considered, no contradictions at all. Theory is one thing, practice another—very much another frequently. The trial of a piece of iron or steel in a machine made with mathematical precision, the piece itself prepared with the greatest care, and the strain applied under very special conditions, constitutes, perhaps, the nearest known approach of practice to theory. The iron from which the sample has been taken is probably almost identical in quality with it, yet when worked into a girder, a crane jib, the rib or stringer of a ship, or other structure, it fails at what seems to be a much lower stress than should have sufficed to fracture it, simply because at the time other conditions are present.

The real value of proof tests, as dealt with in commercial transactions or engineering work, is two-fold. First, they enable the engineer, by the process of analogous reasoning, to estimate chances pretty closely; to calculate from past experience even of the percentage of seemingly inexplicable failures, and to specify for a particular class of metal. He may specify on either of two systems—he may stipulate that certain mixtures of ores are to be used, that they are to be worked with certain fuel and in a particular way, knowing by experience that a certain process of manufacture will give material of corresponding nature; or he may take the simple course of demanding material that shall endure a certain proof strain. Unless the engineer be what many otherwise eminent men are not, an expert practical iron worker by training, it is best for him to adopt the latter course; the adage that a little knowledge is a dangerous thing, is essentially applicable to iron or steel making. Those who mean to make good iron must devote all their time to the study of that subject alone. If an imperfectly informed person draw a specification stating a particular method of making his iron, and that it disappoints his expectations when brought to the testing machine, he cannot blame any but himself, he must abide by his bargain. Having taking the premises of the transaction into his own hands, obviously he must stand or fall by the results. Where he leaves the premises to the iron maker, simply demanding a certain result, the maker has to bear the risks.

The second use of tests is really to enable business to be done at all. We have not yet reached the stage where the iron maker is called on to warrant the working endurance—the life insurance in effect—of the stuff embodied in a roof, bridge, or ship, steam boiler, or railway axle. Perhaps by-and-bye a system of life insurance, at least for railway axles, whether plain or cranked, may come into practice, and its introduction might have good results; but all that is in the future. If an engineer wants iron, it is obvious that some intelligible and simple definition of quality must be used, and the subsequent behaviour of the material is another matter. The real point for the users of iron or steel to consider is how best to prolong the life of either; and the method in which either is called upon to perform its work enters as intimately into the question as do the laws of health and sanitation into that of the duration of animal existence. Iron will, it may be almost certainly assumed, have a very prolonged life if exposed to statical strains alone well within its elastic resistance. In a long continued state of repose under stress it perhaps gradually becomes crystalline, but with nothing like the same rapidity as when exposed to vibration. That the natural tendency of iron is to pass from a fibrous to a crystalline state is well known, and the process of transition is rapid in proportion to the amount of vibration brought to bear upon it. Fairbairn's famous experiments on rods and bars exposed to exceedingly moderate stress while at the same time struck rapidly by a revolving cam, with the resulting speedy fracture of the bars, are familiar to most men who have given any thought or attention to the subject. These experiments are borne out every day, especially on railways.

In order to remedy a defect its cause must first be sought. We will take axles of railway wagons and propeller shafts as two examples. In both these examples we have vibration attending on their use, though different in nature; in the axle the vibrations are short, sharp, and incessant, in kind not very unlike that caused by Fairbairn's cams; the result is also the same, though longer deferred. In respect to securing the endurance of axles, two parties are obviously concerned—the maker of the material and the user of the axle—and both are responsible in the matter. We must candidly express the opinion that the axle makers have done far more to give the public immunity from accidents due to broken axles than have axle users. Of the two horses drawing the coach, one does, we will not say more than his share; he does his utmost, however, and no stone is left unturned, no expense spared, no device neglected by our iron and steel makers, to produce unbreakable axles; but we may, and do say, that axle users, and especially private wagon owners, have done nothing on their side of the pole to draw the coach. Wagon axles are fitted now as they were forty years since; no attempt at improvement, no effort to diminish vibration has been, or is being, made. The springs, the only deadeners of shock attempted to be used, are little better than a name. They are too rigid. They do not possess enough elasticity to be long-lived even themselves, and their preservative influence upon axles is almost *nil*. What we have said of axles applies equally to propeller shafts. Makers of these use every effort to produce sound shafts, but marine engineers, like railway men, stir not to improve the conditions of the working of these shafts. Railway men, indeed, go through the form of introducing shock deadeners, but marine engineers do not even this; and it is idle to make tests, obtain certain material, and then put that material to work under conditions that daily experiences prove to be faulty in the extreme.

THE NEW SLIDING SCALE IN IRON MINING.

As the notice that has been given for the termination of the sliding scale in the iron trade in Cleveland has been admittedly given in order that it may be amended, it is interesting to notice the course of the trade under the scales that have ruled in it. It is well known that the realised selling price of pig iron is the determinator of the extent of changes in the wages of the iron miners and of others. The price of pig iron fluctuated a good deal under the first scale, but from about the middle of the year 1881, the average realised price advanced sharply from 36s. 9d. to 43s. 6d. at the end of the third quarter of 1882. From that time to the present it has fallen, though not regularly, and at the present time it is nearly 9s. less than the last-named figure. It should be noticed that the price is not, as with the coal, the price realised for the whole of the produce—it is the average realised price for one quality of iron, though that is probably as good a basis from which the movements of the scale are to be taken as any. But as yet the miners have benefited by the sliding scales, and though the greater rapidity of the movement—the quicker "sliding," that is—makes the scale tell against the miners in a falling market such as the present, yet that would be compensated if the market were to turn, or rather when the market does turn. The last scale was settled on when the course of trade was much more uncertain than it now is—for there had been a partial revival which some thought and most men hoped would prove enduring. We have, however, now come to a time when the range of prices is so low that a change will be brought about by the necessary reduction of the output by firms which cannot very readily produce at so low a rate, and it would be therefore unadvisable to lessen the rapidity of the movement of the scale, for in that is the adjustment to the changing circumstances of the trade that makes it really valuable and useful.

THE MINERS' STRIKE.

After a fortnight's stoppage of the leading pits of South and West Yorkshire, there are a few indications that the men are turning their eyes once more to the pithead. At Thorncliffe, which is usually regarded as the key of the situation, the phalanx of 3000 pit hands has been broken by the return of some 250 to work on the masters' terms. There is little doubt that more of the Thorncliffe colliers, if they were not deterred by fear of their companions, would join the minority who have again descended the pit; but having pledged themselves to stand by the decision of the Rotherham Conference to resist the reduction, they think they cannot well give way. Whenever signs of yielding manifest themselves, a "demonstration" is arranged for that locality, and the Union leaders present themselves to "fix" the men in their determination. Thus, it came about that a mass meeting was arranged for Thorncliffe last Monday, and with a lively recollection of twelve years ago, when the military had to occupy the district, the West Riding police made elaborate arrangements to prevent disturbance. At Thorncliffe, as at Denaby, fortunately everything passed off peaceably. The coalowners everywhere decline most emphatically to make any concession. They point out that though the production of coal from the pits set down is about 1,000,000 tons per month, yet coal is not generally much altered in price, and supplies are freely obtainable from the coalfields of neighbouring counties. They also urge that the state of trade accounting for the diminished output—4,000,000 tons—stated in the Government returns of last year, still exists, and in a more aggravated form. Pig iron decreased by 960,000 tons, involving a decreased consumption of at least 2,000,000 tons of coal. The production of puddled bar for the same period was 500,000 tons less; steel ingots, 250,000 tons less; steel rails, 313,000 tons less; shipbuilding, 400,000 to 500,000 tons less. All these serious decreases caused corresponding diminution in the consumption of coal. Even the railway companies show a diminished amount received for carriage of goods and minerals alone of £850,000, which in itself also implied a decreased consumption. All these facts are kept from the knowledge of the miner by his chosen orators, and when stated by the employers are, it is feared, regarded as mere inventions of that hereditary enemy, the capitalist, to injure the interests of his long-suffering victim—labour. But they are hard facts, which cannot be ignored in the calculations either of capital or labour.

LITERATURE.

Descriptive Mineralogy. By Hilary Bauerman, F.G.S., Associate of the Royal School of Mines. (Text-books of Science.) Longmans, Green, and Co. 1884.

Although good manuals of mineralogy in the English language have been published in America during the last few years, they have generally been too comprehensive to be used with advantage by the majority of students, while in this country Brooke and Miller's "Mineralogy" is a work far in advance of ordinary science classes. In books of this description the beginner, even if he should have mastered the rudiments of crystallography, finds, when he enters upon the descriptive branch of the subject, a vast series of mineral species, all of which are described, as a rule, in equally large type. This impartiality for any particular mineral, or group of minerals, on the part of the printer is consequently a source of great perplexity to him, and feeling his inability to grapple with the host of facts set before him, and failing to realise which are the species most necessary for the purposes of preliminary study, it is not surprising that he should throw up the subject altogether, or else betake himself to some of the smaller mineralogical text-books. This certainly is the course which should naturally have commended itself from the first; but if we turn to the little text-books which have been published in this country, and which did their work more or less efficiently in their day, we find that few, if any, of them have been brought up to date; and as mineralogy is an ever-growing science, it is evident that there is still not merely room, but an absolute need, for a small and trustworthy text-book which shall present the leading facts of descriptive mineralogy in a concise and instructive manner. This defect in our literature is now greatly remedied by the two volumes written by Mr. Bauerman, the first of which—"Systematic Mineralogy"—has been for some time before the public. The second volume—"Descriptive Mineralogy"—is exclusively devoted to the description of a large number of the most important and interesting minerals, well selected, and embodying a great amount of information, which is given in a concise form.

The classification adopted is that used in the second edition of Rammelsberg's "Mineral Chemie." The different groups are headed by short prefatory remarks, indicating the chemical and crystallographic characters common to the minerals which constitute each group. The isomorphous relations of the various species are carefully noted, and in this respect the book is more useful than any which has yet been published in this country. The minerals constituting important ores are especially well described, while the augite-hornblende, mica, and felspar groups are judiciously treated, due regard being given to the views of Tschermak, Des Cloizeaux, Bauer, and other recent observers. Evidence of careful reading is to be found in most parts of the volume, coupled with much discrimination in rejecting unimportant points, and recording only the most interesting and essential facts, including useful notes on the optical properties of many of the minerals described. The descriptions are not supplemented by long lists of localities, although the principal names are given, but many valuable notes are added in relation to paragenesis and the mode of occurrence of the minerals. On this branch of descriptive mineralogy the author is unquestionably one of the greatest living authorities, his extensive acquaintance with the chief mining localities, both at home and abroad, enabling him to deal with the subject in a masterly way.

Two systems of crystallographic notation are employed, Miller's and Naumann's, the corresponding symbols being placed side by side. The figures of crystals are well engraved, and are interspersed with the text relating to them. The pyrognostic characters of the minerals are as a rule very clearly given.

As is usual in first editions, there are errors which sometimes take the form of omissions. We might, for instance, reasonably expect to find descriptions of the minerals glauconite, chrysocolla, &c., but they are not named; while several new and interesting species, which find no place in the book, might also have been described with advantage.

Curious slips likewise occur here and there. Thus on page 2 we find specific gravity, colour, and streak, placed under the general heading of "Structure." On page 203, the crystals occurring in the mica of Pennsburg are described, as in the fifth edition of Dana's system, under the name "magnetite," although it is now known that they are specular iron.

A few other errors might be pointed out which will doubtless disappear when a fresh edition is printed, and when it would also be well that several involved sentences should be rendered in clearer language; but, taking it all in all, it is unquestionably the best little text book on descriptive mineralogy which has yet been printed in England, and it is to be hoped that the time is not far distant when revised editions both of this and its companion volume will be found in every science school throughout the country.

THE TELEPHONE AND TELEGRAPH WIRE QUESTION.

Re-assembling after the Easter holiday, the Select House of Commons Committee on this subject again proceeded with their inquiry, passing from the evidence in favour of telephone and telegraph authorities, to the views of the public as represented by local authorities.

Mr. G. N. Johnson, chairman of the City Commissioners of Sewers, being the first witness on this aspect of the question, said he had come to the conclusion, after paying considerable attention to the matter, that legislation was now greatly needed for the control of telephone and other wires. He quite felt that it would be better and safer to have all these wires underground, but he feared the difficulty of enormous cost would render that plan quite impossible. But, looking to the different condition and action of telegraph and telephone wires, it might be found desirable to lay the former below ground and the latter overhead. Supposing the heavy cost of putting wires underground to be incurred, it would, he feared, be too heavy for the company at the outset, and he thought the Public Works Loan Commissioners might advance the money for that purpose and recoup themselves by means of rentals. Certainly charges such as this ought not to be imposed on ratepayers. In regard to the control of wires, Mr. Johnson advised that it should be entrusted to the street authorities, but he would not give them too much discretion, deeming it better that Parliament should define somewhat closely the method in which, and the conditions under which, wires should be carried underground. The local authorities could then see that the Act was obeyed; and they could also make bye-laws appropriate to their respective localities, these bye-laws being subject to the approval of the Board of Trade. It would be desirable that as far as possible there should be uniformity of bye-laws. Referring specially to the City, Mr. Johnson deprecated the construction of subways, chiefly because of the immense cost; and he suggested that telephone wires, like telegraph wires, should be laid down under the kerb stones. At the present time the overhead wires were so numerous and close in the City that serious danger might arise in the event of a heavy storm of wind or snow, but there were scientific reasons for keeping telephone wires above ground. That being so, he suggested that to diminish the danger from a great accumulation of wires overhead, the telegraph wires might be placed underground. Great as the danger might be from these wires, he was not, so far, aware of any serious accident having occurred.

Lieutenant-Colonel Heywood, the engineer of the Commissioners of Sewers, followed on the same side, but in some respects he differed from the Chairman of the Commission. He, too, regarded with alarm the increase in the number of wires overhead, which he declared had already become a public nuisance. In illustration of this view he stated that there were 320 wires crossing Moorgate-street, 312 over Coleman-street, 240 over Leadenhall-street, in a distance of only 1414ft.; 160 over Fenchurch-street, in a length of 1700ft.; eight cables and 408 wires over a length of 2000ft. of Queen Victoria-street; while at Ludgate-circus there were two cables and 142 wires. Again, there were six cables and seventy-four wires across King-street, Cheapside, seven cables and 360 wires over Cannon-street; and in many other streets in the City there were as many as 1200 to 1500 wires to the mile, the mean average for the City being about 1000 wires to the mile. In fact, they were so numerous that in some places they seemed to diminish the light. As the population and business grew so these wires would be apt to increase, and he contended that the public ought not to be exposed to the danger and other disadvantages arising from these wires. It was true that hitherto there had practically been no accidents, but it was to be remembered that most of these wires had not been up long enough to have deteriorated much from the action of the atmosphere. Putting all these wires under the ground would no doubt be an enormously costly undertaking, but that was a matter for the companies to settle for themselves, and he did not anticipate that that would be fatal to the development of the telephone. But be that as it might, the public interest demanded that the wires should be placed underground, and the expense must be put up with in this matter as in other enterprises. By-and-bye it was probable, he thought, that roomy subways would have to be constructed in which to place telephone, telegraph, and electric lighting wires, pipes for various purposes, pneumatic despatch and pneumatic clocks, tubes. Should that become necessary, perhaps the local authorities would build the subways, and repay themselves by a rental for the use of the subways. Such subways, he apprehended, would cost something like £40,000 a mile. On this point, Sir James McGarel Hogg, a member of the Committee, stated incidentally that the Metropolitan Board of Works were in favour of subways wherever they could be made, and intended to construct such a subway under the new street from Charing Cross to Tottenham-court-road. It would not be worth while, the witness added, to go to that great expense simply for the sake of telephone wires, but it would be if all wires, pipes, and tubes were laid in the subways, and such subways would be practicable enough even in the crowded streets of the City, if the cost and inconvenience of making them were submitted to. Finally, Lieut.-Colonel Heywood recommended that the general regulation of these undertakings should be left to the Board of Trade, the several local authorities supervising the actual execution of the work; and that, as a safeguard for the public, the heaviest penalties should be provided, and the companies be made liable for damage through accidents.

Mr. Francis Hayman Fowler next came forward on the same branch of the inquiry, in his capacity as Deputy Chairman of the Metropolitan Board of Works. He explained that that body had no statutory powers regarding the erection of wires, and they felt that as telephone companies were now seeking further powers, the whole matter ought to be put under some general law with a view to control by central authorities. The telephone had now become a public necessity, and therefore should be encouraged, under certain conditions and restrictions. To the central authorities he would give the power of making bye-laws, and of granting licences, after the proposals had been examined and reported upon. In London such central authority should apply to the whole metropolitan area equally. The bulk of the overhead wires in London belonged to the Telephone Companies, and their great and rapid increase had been a cause of much anxiety to the road authorities in regard to the public safety. Therefore it was necessary to create some more effective means of public control, and to make the law on the subject clear. He believed that the danger from these overhead wires had been exaggerated, and proper supervision would make it almost unappreciable. Therefore he did not consider it necessary to insist on the wires being laid underground; and although, no doubt, that would be the best system, the great expense would make it commercially impossible.

Following up the consideration of the subject from the point of view of local authorities and public interests generally, the Committee examined at their next sitting Sir Arthur Hobhouse, a member of St. George's Vestry. He explained that he came forward at the request of this vestry, and informed the Committee that the vestry had no jurisdiction over wires unless and until they formed a public nuisance. Some of the metropolitan vestries desired that they should have the control of these wires, but his vestry had not aimed at that power. They felt that there ought to be some method of public authority over the wires, but as to what sort of control there should be considerable difference of opinion existed. They did not propose that the vestries should have a power of veto upon the erection of wires, but they still thought that the laying and maintenance of wires should come under local control. They had passed resolutions recommending the creation of some central authority who should decide whether wires should be laid down; that such central authority should be the Metropolitan Board of Works, or the Board of Trade. By the Electric Lighting Act of 1882, it was provided that no line along, over or across, a street should be erected without the consent of the local authority; and the Act also gave an absolute veto to the vestries, but they had no jurisdiction until the wires became a public nuisance or annoyance. He advocated power being given to central authorities to make bye-laws, but advised that the vestries should have control in regard to construction and maintenance and supervision. At the same time he believed it might be impossible to attain uniformity of bye-laws and regulations, because of the varying circumstances that might exist as to whether wires should be overhead or underground, and as to other considerations. To illustrate the differing powers to be conferred, Sir A. Hobhouse suggested that while a telephone company might have power to lay wires from Westminster Bridge to Paddington Station, the central authority should be empowered to prohibit wires being erected in overcrowded places. Such wires as there were in the St. George's district had not caused any damage, but if they did threaten such danger, the vestry could not interfere unless the wires became a public nuisance.

Mr. Charles Mossop, chairman of the Electric Lighting Committee of the Chelsea Vestry, next gave evidence, urging that power and authority over these wires should be given to district boards and vestries. He declared that the present dual authority of the metropolitan vestries and the Metropolitan Board of Works was inefficient, and caused difficulty and delay. His vestry had passed a resolution declaring "that the authorities to sanction the laying of telephone wires in the metropolis should be the vestries and district boards, and not the Metropolitan Board of Works, and that the dual authority suggested by the Metropolitan Board of Works has already proved inefficient, and that it leads to great difficulties and causes delay." That resolution was sent to all the vestries and district boards, and up to that morning they had received fifteen replies, and thirteen were in favour of this resolution. The local boards must necessarily know a great deal more than the Metropolitan Board of Works, because they had so many local officers and inspectors, while the Board of Works had only one; and, as a matter of fact, the Electric Lighting Act of 1882 had laid it down that under no circumstances should the Metropolitan Board of Works be the local authority. Another consideration was that the large cities and towns in the provinces would be very unlikely to consent to be placed under, and have to appeal to, the Metropolitan Board of Works. Upon this point some observations were made by members of the Committee, and eventually the chairman said it was clear that there would have to be different courts of appeal for London and the provincial towns.

Mr. Mossop, continuing his evidence, said he should object to the Metropolitan Board as the appeal tribunal, because that would be in opposition to the principle laid down by the Electric Lighting Act, and because that system would involve arbitration, which, in the case of a dispute between two vestries such as St. George's and Chelsea, would lead to a partial tribunal through their not having an equal representation on the arbitration. In a report he had drawn up—as chairman of the Electric Lighting Committee—upon the Bill of the United Telephone Company, he had pointed out that as that measure provided ample powers for examining and testing wires, these wires could be erected overhead without danger to the public. Therefore, and considering also that the cost of underground wires was about £350 per mile as against £10 for overhead wires, he thought the local authorities might sanction overhead wires under such restrictions as might be necessary for the public safety.

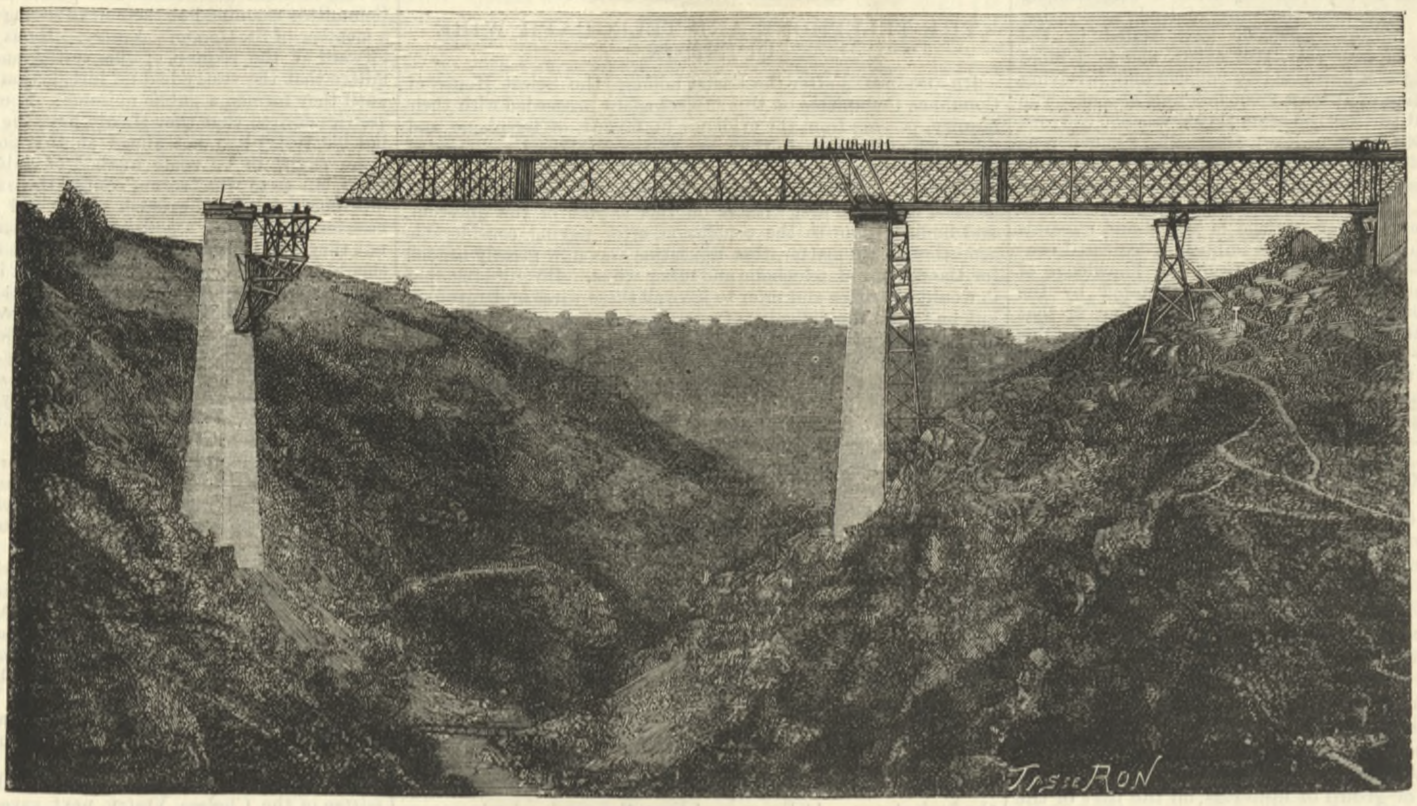
Mr. Greenwell, a member of the Marylebone Vestry, described a report which had been submitted by the vestry to other vestries and accepted in principle, and which declared that no existing authority that could be created would be better qualified to govern and control wires than the existing authorities, because they were the only authorities by whom the streets were governed; and, further, that the Board of Works should be the Court of Appeal in the event of any dispute between the telephone companies and the local authorities. If, however, Parliament should object to the Board of Works for appeal purposes, then the vestry would favour the Board of Trade as the alternative; and whichever it was, the decision of the Court of Appeal should be final.

Mr. Bird, on behalf of the Fulham District Board, expressed himself in favour of placing the control of the wires in the district boards, the central authority being the Board of Trade. If overhead wires were allowed, then they should be tested and inspected by the officers of that department, and should not be used until such inspection had taken place. The companies would, of course, bear the expense, as the undertakings were for their profit and advantage.

Mr. Adams, a member of the Islington Vestry, gave preference to the Board of Trade rather than the Metropolitan Board as the court of appeal.

The Royal Scottish Corporation—William Templeton.— Most engineers remember the name of William Templeton, and feel indebted to that author for help obtained from "The Millwright's and Engineer's Pocket Companion," and "The Engineer's Commonplace Book." We regret to learn that the daughter of this well-known engineering writer is, in her sixty-sixth year, in impaired health and circumstances, and thus unable to support the very aged mother who is dependent upon her. The favour of the votes of the governors and subscribers of the Royal Scottish Association is therefore earnestly sought on behalf of Miss Templeton, as a candidate for the £12 pension at the election on the 28th inst. The case is very strongly recommended by several well-known engineers.

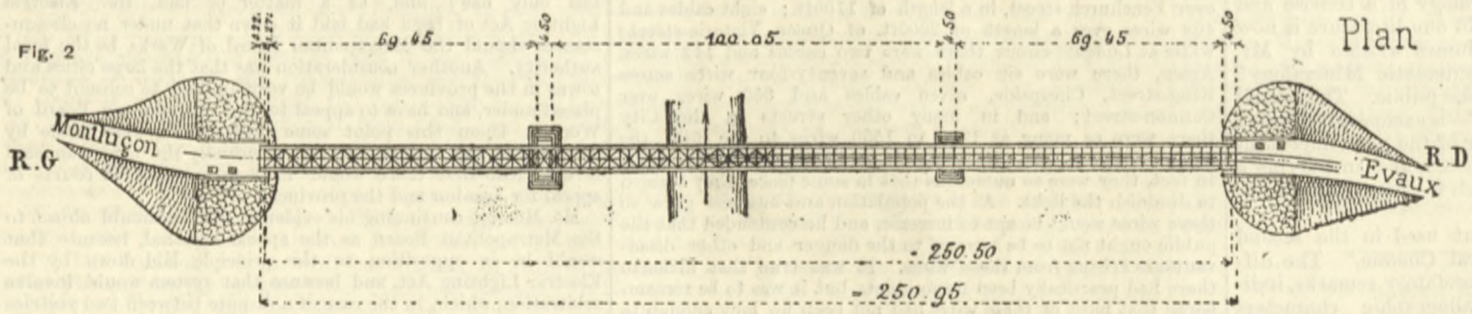
THE LA TARDES VIADUCT, MONTLUCON AND EYGURANDE RAILWAY.



THE VIADUCT DE LA TARDES.

The chronicles of failures or accidents are not less instructive in engineering matters than in others, as the following account will show:—The railway from Montluçon to Eygurande, constructed by the State engineers, crosses the valley of La Tardes near d'Evaux (Creuse). At the place chosen for crossing it by means of a viaduct the gorge is deep and steep. The line passes at a level of 91·3 m. (299·46ft.) above the river, and the viaduct is 250·5 m.—Figs. 1 and 2, p. 318—in length. To support the viaduct girders, advantage was taken of the form of the valley sides, and on the right bank of the river a pier of only 48·02 m. at a distance of 69·45 m. from the abutment

Fig. 2

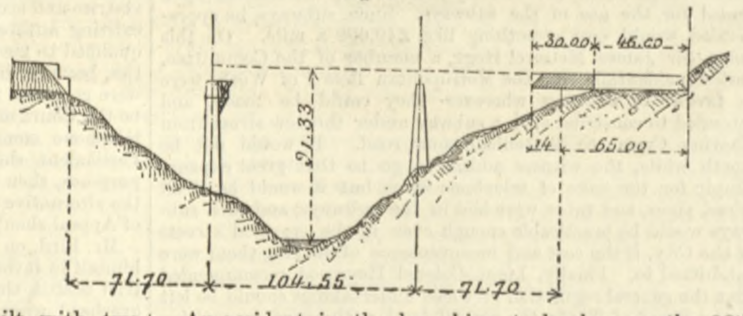


was built, and on the left bank a pier of 59·95 m. in height was built at the same distance from the abutment on its side. These two piers are 104·55 m. from centre to centre. Piers and abutments are of the hard granite which constitutes the valley of La Tardes. The facings are in hammer-dressed work—*moellon à bassage*—and the caps in free-dressed stone. Some service bridges supported by simple scaffolding connected the piers in construction to the sides of the gorge. As the piers progressed these bridges were raised so as always to bring the materials to the work. At the top the piers measure 4·5 m. by 8 m., the batter being 1 in 10. The abutments are in form a rectangular mass 14·5 m. by 9·4 m. and 17·3 m. in height, and with a projection 1·5 m. wide to carry the girder ends.

The road is supported on two large girders of light lattice construction, with vertical connections between top and bottom members—Fig. 3. The central span is 100·05 m., and each side span 69·45 m. The two girders are 5·5 m. centre to centre, and are 8·3 m in. depth, the depth being thus about one-twelfth the central span. The top and bottom flanges or members are built with two widths of plates 0·4 m. wide and of varying thicknesses, and with two vertical plates each ·800 m. wide, as shown at Fig. 3, and 0·42 m. apart, connected to the flange plates with angles 0·1 × 0·1 × 0·012. The trellis consists of two series of bars at an angle of 45 deg. They are chiefly of single-backed angle irons, and are fixed to the inside and outside of the vertical plates of the top and bottom members. They are at frequent intervals tied together by short plates. The two girders are tied together by double-backed angle struts, as seen in Fig. 3, page 318. The girders rest on the left bank abutments, with the rolling supports seen in Fig. 4, and on the right bank abutments by means of fixed supports, two of these being used under each girder, with a view to reducing the length of the bearing, but it was not found advisable to do this, as it seemed that only the one or the other came fairly into play.

Owing to the height of the bridge it was decided to launch the girders from the right bank. The viaduct being situated at the intersection of two valleys, the line is built on a sharp curve at the ends of the viaduct, and this made either the construction of staging or launching of the complete structure difficult. For the latter method, a cutting had to be made in the rock of the bank long enough to build 40 metres at a time. The central span being 100·05 m. in length—329ft.—was longer than had ever been launched in this way. To diminish the overhang as much as possible, an advance part was constructed of 30 m. in length—see Fig. 5 above—and a stage projecting was built on the left pier, as also shown above. The opening was thus reduced to 60 m. The advance section was made up of parts which afterwards formed the right abutment end of the girders. It was temporarily put together with part only of the members, so as to be light, and was stiffened by means of wood. The apparatus for launching, as used by MM. Eiffel et Cie., usually consists of a strong frame resting on pivots. On the frame are two rollers 0·5 m. in diameter, one of which can be turned by means of a ratchet wheel. In this case, however, six pairs of rollers were used under each girder, to increase the number of points of support for the girders, which were of unusual weight. Each pair of rollers was separately mounted, so that the whole on the pivotted frame received an equal weight and gave equal support, and to make this adjustable one pair was mounted so as to be adjusted by a weight at the end of a lever.

Fig. 9



An accident in the launching took place on the 26th January, 1884. Part of the structure had already been launched—the position of the girder approaching that shown in Fig. 5—when a hurricane occurred. A projecting part, 53 m. in length, overhung the pier, and but 37 m. had to be crossed to reach the projecting stage on the side of the other pier. The wind in this valley is often very violent, and had in February, 1879, blown wagons off the line between Montluçon and Gannat. The viaduct had withstood very heavy gales during the 24th and 25th, but on the night of the 26th and 27th the hurricane precipitated the whole superstructure into the ravine. No one was hurt, and the workmen living 200 m. from the work heard nothing of it. In the morning they found that a length of 132 m., and weighing 142 tons, had gone into the ravine from a height of 60 m. Various explanations of the accident were offered, but the more likely one seems to be that, under the action of the heavy wind varying in force, the overhanging part acquired some pendulous motion and gradually moved, so that instead of the rollers being directly under the vertical plates forming the sides of the box-shaped bottom flange or member, they reached the outer part of the bottom plate, when, owing to the great weight of the overhanging part, the bottom plate was deformed, and that movement was initiated which the force of the wind completed.

(*To be continued.*)

The London Association of Foremen Engineers and Draughtsmen.—The thirty-second anniversary festival was celebrated by a banquet on Saturday, the 18th inst., at the Cannon-street Hotel. Sir Philip Cunliffe Owen presided, and he was supported by Viscount Enfield, Sir Andrew Clarke, Admiral Arthur, Mr. Woodall, M.P., Mr. John R. Ravenhill, C.E., and other distinguished gentlemen. The gathering was remarkable for its comparative smallness, and the total absence from it of engineering employers. It was matter of comment that of the fourteen honorary stewards named on the programme only two were present, and that the name of Mr. Joseph Newton, who was for nearly a quarter of a century President of the Association, and who sat at the table on Saturday, was not included in the list of toast-proposers or responders.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Thomas Williams, engineer, to the Iron Duke; William Lennox, engineer, to the Indus, additional; William H. Pippett and Frank R. Stuttaford, assistant engineers to the Iron Duke; J. H. Brettell, chief engineer, to the Northampton; and D E. Smith, chief engineer, to the President, additional; Charles M. B. Dyer, engineer, to the Asia, as supernumerary; Albert E. Cox, engineer—acting—to the Himalaya; John Johnson, chief engineeer, to the Conquest; J. J. Finch, chief engineer, to the Orion; James Jessup, chief engineer, to the Thunderer; O. G. Egan and James Sherivell, engineers, to the Thunderer; J. J. Frost, engineer, to the Conquest; William Irwin, engineer, to the Jackal; R. S. G. Norgate, engineer, to the Orion; H. B. Clatworthy, engineer, to the Alexandra, additional, for the Orion; Richard Phillips, assistant engineer, and H. J. Coad, acting assist. eng., to the Alexandra, additional, for the Thunderer.

New Electric Illuminated Clock Dials.—Considerable additions are about to be made to the General Post-office, Melbourne Victoria, and amongst other items we note the following:—The upper portion of the clock tower will be taken down, and it will then be raised till its total height reaches 188ft. The present illuminated dials, which are much too small to be of any practical use, will be dispensed with, and four new skeleton dials, each about 13½ft. diameter, will be provided, the centre of the dials being about 132ft. from the ground. A new feature will be introduced in connection with these dials. They will be made of cast iron, and will have hemispherical recesses so spaced as to mark the hours in place of the usual figures. These will be nickel-plated inside so as to reflect the sunlight and form bright points in the day time, and in these cups incandescent electric lights will be placed, whilst similar lights of smaller size will be arranged in a close row along each of the hands. It is anticipated that this arrangement will make it possible at night to tell the time by this clock at a great distance. The work will be carried out by the Department of Public Works, under the direction of Mr. Peter Kerr, architect of that Department.

Liverpool Engineering Society.—A meeting of this Society was held on the 15th inst. at the Royal Institution, Colquitt-street, Mr. W. E. Mills, president, in the chair. A paper by Mr. Charles H. Darbishire, A.M.I.C.E., on "Quarrying and the Preparation of Setts," was read by the author. The paper commenced by pointing out that the term "quarry" meant, primarily, the place where the stone was hewn and squared, whereas now it means the place where it is won from the rock, and not necessarily where it is squared. Attention was called to the fact that the dressing of stone, as far as is known at present, was probably one of the first accomplishments man possessed when the race became distinctly human, and that in every age quarrying stone and working it up to serve a useful, or even merely an ornamental purpose, has always been one of the leading industries. At the present day, when traffic has become concentrated into comparatively narrow streets of cities and towns to the extent it has done, exceeding frequently 200,000 tons per yard width of street per annum, the preparation of stone for paving to meet the exigencies of the case is of the greatest importance. The quarry described is situated at Penmaenmawr. The system adopted was fully dealt with, the various duties of the different sets of men being carefully gone into. Examples of the tools in use were exhibited, and they appeared simple enough in themselves, but it was explained that the art lay in using them skilfully. The paper concluded with a brief comparison of the system practically in force throughout North Wales with that under which quarrying as carried on in the large quarries of England.

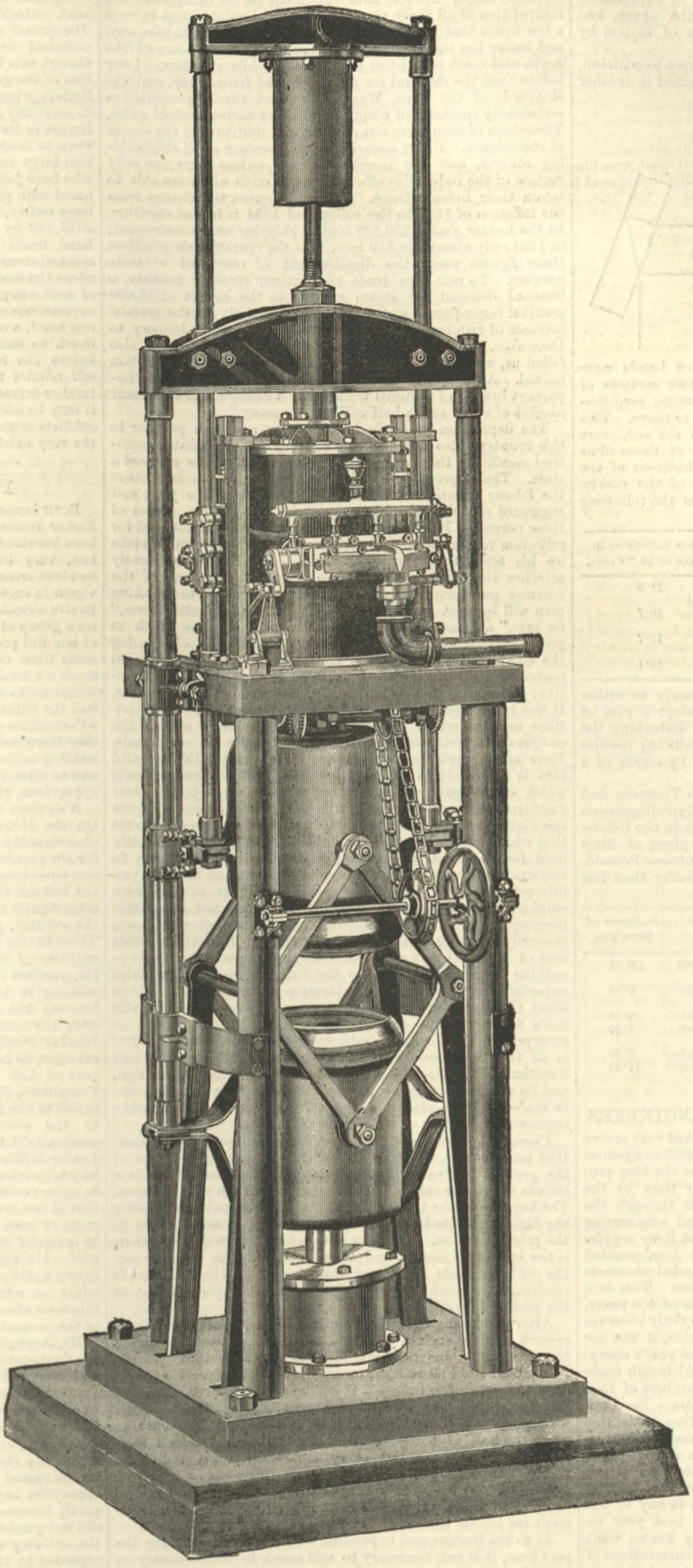
THE EQUITABLE DUPLEX HAMMER.

WE illustrate by the accompanying engraving an American hammer, the invention of Mr. Ed. B. Meatyard, C.E., Lake Glenna, Wis., U.S.A. The object is to off-set the weight and velocity of one ram with the momentum of the other, to graduate equitably a series of blows on a die forging, as the nature of the metal requires. "In other words," says Mr. Meatyard, "as the impact on one side of a forging varies in intensity, I provide for it to vary in like ratio on the other side. To this end the density and elasticity is the same in both rams, so they will vibrate in the same rhythm as they meet to strike the interposed mass of metal. Neither ram can move in either direction without a corresponding movement of the other ram in an opposite direction.

"For the working of any die forging where a high degree of toughness is sought with elasticity, it seems necessary to hold the first blow well in hand, and to augment successive ones as the metal under treatment gets harder. To accomplish this I provide a differential cut-off to vary the influx of steam, as well as to obtain any degree of cushion from the exhaust. It has two pistons in its cylinder, one for each ram, and to secure a better control of the tool, the steam cylinder has independent steam and exhaust valves, with suitable gear to operate them separately.

"This hammer is particularly intended for trueing up the parts of steel car wheels without the aid of lathework. The parts must first be liquid forged or otherwise roughed out to approximate form. It will not work irregular masses. An air cushion on the bed-plate meets the recoil; a second one over all meets the *vis inertia* of the upper piston trappings as each blow is made.

"It must be obvious that the reason why the well-known drop hammer, or the better known Nasmyth steam hammer, cannot do the class of work for which this hammer is designed, so as to produce a homogeneous and uniform output, lies in the fact that a die forging cannot always be turned over to get the effort of the dynamic inertia of the moving ram on both sides alike. For my hammer the lower ram carries the forging, and, for that reason, should be slightly the lightest. It provides the only means for producing light, braced, tough, hard, and elastic car wheels at reasonable cost." Has Mr. Meatyard ever heard of Mr. Ramsbottom?



THE ROYAL INSTITUTION.

LAST Friday night Professor S. P. Langley, of the Allegheny Observatory, lectured at the Royal Institution on "Sunlight and the Earth's Atmosphere," Sir William Bowman, F.R.S., presided. Professors Tyndall, Frankland, Dewar, and others were present, and the attendance was large.

Professor Langley explained that his experiments at the top and bottom of a high mountain had proved that the ultra-red end of the solar spectrum is much longer than previously supposed, that the colour of the sun is probably blue or bluish-white, and the colour of the earth's atmosphere somewhat orange; that the power of the solar radiation has been hitherto underestimated, and that the absorption of the atmosphere is nearly double that previously supposed. These results of his were generally known before his arrival in this country. He exhibited his celebrated bolometer for measuring extremely feeble variations in heat, but performed no experiments with it, on the ground that they would take up too much time. He also projected on the screen a sectional diagram of the apparatus he used, but did not describe it, on the ground that a description would not interest the listeners. In fact, he altogether underestimated the culture of the auditory before him, told them almost nothing they did not know before he began to speak, but gave some entertaining descriptions of mountain and desert scenery, forming a lively, popular lecture which much amused those present, and left them about as scientifically wise as they were before.

On Friday, March 20th, Professor A. W. Rücker, M.A., F.R.S., lectured at the Royal Institution on "Liquid Films—a Soap Bubble." Sir Frederick Bramwell, C.E., F.R.S., presided.

Professor Rücker said that the ordinary molecular theory leads us to think of a liquid as consisting of many particles held together by forces between them; the particles on the surface of the liquid having these forces acting on one side only, consequently are under the influence of an attractive force dragging them towards the rest of the liquid. These outside particles seem to be less tightly packed than the remainder. That such is the molecular condition of liquids is generally admitted. There was some difference of opinion as to the cause of the facts he intended to bring forward. There are physicists who hold that the surface films are due to the formation of a thin pellicle produced by impurities settling upon it from the air, or even by the direct action of the air itself; he, however, did not think these objections to be very serious.

When saponine is dissolved in water to the extent of 2 per cent., the bulk of the liquid seems to be little affected, but the viscosity of the surface is enormously increased. He proved this by placing a balanced magnetic needle on the surface of the solution, when a magnet held near would scarcely move it. When, however, more saponine solution was poured in, until the needle was ¼in. below the surface of the liquid, the needle would readily turn under the attractive force of the magnet. He also blew a bubble of saponine solution, afterward partially withdrawing the interior air by suction; the bubble then shrivelled up like a purse, instead of contracting equally in its entire bulk, as a soap bubble would have done. To perform an experiment of this kind, he said, a common tobacco pipe previously soaked in the solution, is the best instrument to use. Two of his assistants, Messrs. Staples and Wilson, adopted the plan of causing a disc to oscillate in liquids at the surface, and at various distances beneath to test the viscosity at different depths. They found that with saponine the resistance increased enormously at or very near the surface, as shown by the following table, in which the figures from the bottom upwards show the increase in the resistance:—

Logarithmic Decrement of Disc Oscillating in a 2 per cent. solution of Saponine.

Depth of upper edge in terms of 0·1 mm.	$\lambda \times 10^{4}$
0	25:0
1	67
2	45
3	39
4	34
10	25
24	20
36·5	19

Any physical properties which the surface of a liquid possesses are lost at a very small distance below that surface, so that an oscillating disc when descending soon acquires the same motion as if it were deeply immersed; there is, therefore, an interior mass, having a thin skin or surface layer. Bubbles exert pressure on the air within them; he proved this by means of two bubbles on the ends of a U-tube inverted—∩. One bubble was larger than the other, and there was a closed tap in the bend of the tube; when he turned this tap, so that the air within the two bubbles and tube became continuous, the pressure of the small bubble caused it to shrink to nothing, and to squeeze its air into the large bubble, which thereby increased in size; the skin of the small bubble therefore exerted most pressure.

If a thinning film be watched for experimental purposes, care must be taken that no other changes are going on than the approach of two surface skins, and that but one phenomenon is being dealt with throughout, more especially because any change from other causes becomes prominent in very thin films. To analyse the amount of the thinning of a film, the plan adopted was to measure its varying electrical resistance. The resistances vary inversely with the thickness, and if this law be obeyed during the experiments, it furnishes presumptive evidence for supposing that the composition of the film is not altered; if there were variations, there would be reason to suppose that other changes were going on. The liquids used are such as are liable to changes of composition. Bubbles blown from soap and water and glycerine alter with the humidity of the atmosphere, with the temperature, and with light. The film has therefore to be put in an enclosed space, surrounded by water, to keep the temperature even, and the glass case must not be opened during the experiment. The inside of the case must be well drenched with the liquid, to keep the humidity of the air in an equable condition. In his apparatus, after the bubble was blown, it was connected above and below with the rims of platinum cups, and each film drawn out into cylindrical form. Two wetted gold needles were then introduced into the film, and the electrical current passed between them.

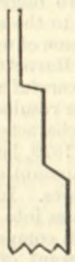
A method of measuring all but the black part of the film was the well-known one of observing the colours, but they had to revise Newton's scale of colours, and to form one for themselves, as follows:—

Table of Air Thicknesses corresponding to the Middle of the Greens of the Orders of Newton's Scale in terms of 10^{-6} *mm.*

Order.	Newton.	R. and R.
2	378	409
3	629	656
4	900	964
5	1150	1188
6	1468	1479
7	1775	1787
8	—	2115

At first they tried to measure the current by the Wheatstone's bridge method, but it did not answer well; the films would develope irregularly, and it was necessary to be able to use the part of the film ready for experiment. The device of the two gold needles was therefore adopted, and the current measured by means of a quadrant electrometer and a set of resistance coils. The results at first seemed to be very irregular, but this was found to be due to variations in moisture and temperature. On picking out the results obtained under fixed conditions, they were found to agree within the limits of 137 to 146, instead of varying from 137 to 200. They finally succeeded in keeping the films practically in the same state as the mass of the liquid from which they were formed, to such an extent that by the indications of their instruments they could tell the composition of the particular liquid in use; the instruments, indeed, would indicate the variation in the atmosphere produced by the insertion of a piece of wet blotting paper into the case. Most elaborate precautions, in short, were taken to secure uniform conditions.

FIG. 1



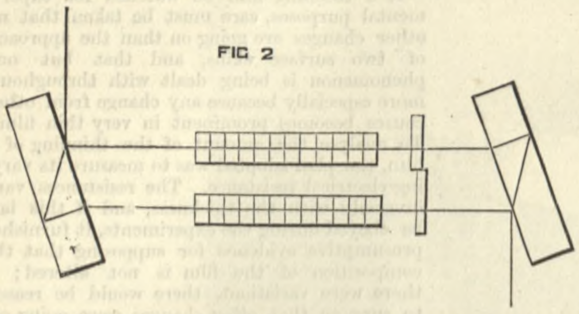
When the film begins to get very thin it turns black; then it is impossible to estimate its thickness by the colour scale, nor to tell thereby how it goes on thinning, so the electrical method has to be brought into play. A great band of black forms at the top of the cylinder; the coloured film does not gradually fade into the black film. The change is sudden, with a hard and fast line of demarcation, at least when diagrammatically indicated as on Fig. 1, upon any scale not of enormous dimensions. Under the microscope the missing colours can be seen, but there is, nevertheless, a very rapid change. The coloured part is sometimes sixty-five times thicker than the black part. The thickness of the black part remains the same, whatever the magnitude of the particular film; of this there had been many proofs, as set forth, for instance, in the following table:—

Length of black part of film.	Mean value of resistance.
> 0 and < 2	1·761
> 2 ,, < 4	1·764
> 4 ,, < 6	1·734
> 6 ,, < 8	1·760
> 8 ,, < 10	1·756
> 10 ,, < 12	1·760
Colour next black part of film.	
Blue of the second order	1·826
Green ,, ,,	1·748
Yellow ,, ,,	1·719
Orange ,, ,,	1·756
Red ,, ,,	1·716
Green of third order	1·738

The films were observed for a long time; one film lasted for one and a-half hours, and the last resistance measured differed but little from the first; in going from one film to another the thickness varied considerably, some having much thicker black parts than others. They could measure with accuracy to about one-sixtieth part of a wave of red light. On sending currents through the whole film, it thinned more quickly when the current passed downwards than when it passed upwards; the upward flow of the current retarded the thinning. He proved this before the observers by experiment, throwing an image of a film-cylinder upon the screen, and causing the colours to change their direction of motion by reversing the current.

The electrical method of measurement being open to criticism, the thickness of the black films had been ascertained in another way—by the plan represented in Fig. 2.

FIG 2



In this differential refractometer interference bands were produced by the reflection of light from the two surfaces of the two inclined sheets of glass, and by introducing modifications the interference bands could be caused to move. Two tubes containing soap films, as represented in the cut, were placed in the path of the rays; and a number of these films affected the position of the bands, so that the thickness of the films was arrived at thus by calculation. Some of the results obtained by the two methods are represented in the following table:—

Liquid.	Method.	Mean thickness in terms of 10^{-6} mm.
Liquid glycerique	electrical	11·9
Liquid glycerique	optical	10·7
Soap solution	electrical	11·7
Soap solution	optical	12·1

He believed that they could measure accurately to within one-millionth of a millimetre. They had to adopt a plan of breaking the soap films when desired, without disturbing the rest of the apparatus. They did this by introducing needles into each tube, and making them pass along it by means of a magnet drawn over it outside.

As regards the size of molecules, Sir William Thomson and others had given what they calculated to be their dimensions in terms of millionths of a millimetre, as set forth in the following table, in which also the thicknesses are given of films measured by himself—Professor Rücker—and Professor Reinold. It would seem therefore that molecules are smaller than has hitherto been supposed.

Magnitude.	Observer or computer.	In terms of 10^{-6} mm.
Diameter of molecule (inferior limit) ..	Sir W. Thomson	0·01
Diameter of molecules forming the atmosphere	Van der Waals	0·28
Radius of molecular attraction (inferior limit)	Van der Waals	0·23
Diameter of molecule (superior limit) ..	Sir W. Thomson	2·00
Thickness of black film (smallest observed)	Reinold and Rücker	7·20
Mean	Reinold and Rücker	11·69

THE AMALGAMATED SOCIETY OF ENGINEERS.

The past twelve months or so has been a period of very severe strain upon the resources of nearly all the trades union organisations of this country, and probably by none has the long-protracted depression in trade been felt more keenly than by the societies the scope of whose operations extends through the various industries connected with the iron and engineering branches of trade. It will therefore be of interest if we supplement the brief notice given last week of the Amalgamated Society of Engineers by one or two more extended abstracts from the annual report just issued to the members. This is a bulky and elaborately compiled volume of upwards of 400 pages, and the general secretary, Mr. John Burnett, very truly observes that it will "afford much food for careful reflection, if not for heartfelt congratulation, some of the results of the year's operations being very striking in their character." Although trade was not nearly so bad in 1884 as in 1879, large numbers of men have been unemployed, and a vast amount of distress has been experienced by the labouring classes. In dealing with this depression, Mr. Burnett, as usual, goes into statistics of foreign trade to show that, so far as foreign competition is concerned, this has not been the cause of the want of employment which has prevailed. In support of this, he points out that we sent abroad more engines and machinery in 1884 than in any of the previous ten years, except 1883, which was the best year we ever had. That, however, they had suffered, they knew; want of employment for their members had been the characteristic of the year, and the retrogression from moderate to very bad trade is clearly shown in the following tabulated return of the number of members receiving out-of-work support each month during the year:—

January, 1884	1893
February "	1955
March "	1931
April "	2025
May "	2073
June "	2318
July "	2637
August "	2667
September "	3091
October "	3162
November "	3255
December "	4090

As the reason for this continuous and large increase in the number of unemployed members was not to be found in the foreign trade returns, Mr. Burnett proceeds to look elsewhere, and he has no difficulty in tracing it to the complete collapse of the shipbuilding industry. His conclusions upon this point it will be as well to give in his own words:—"Of late years," he writes, "the shipbuilding trade of the country has assumed gigantic proportions, and production has been upon a scale never before imagined, much less realised. Steam shipping had become a most profitable method of investing capital, and, as a consequence, people with money and no other qualification for the business rushed into the trade. Inflation and over production naturally ensued; hence in 1883 we had a production in this country of over one and a-quarter million of tons. That this was vastly in excess of the needs of the world has been since amply illustrated. The craze for shipping shares had been such that in several inland towns shipping companies were started and had their business managed for them there. As was anticipated, the period came when the competition of all these vessels for freight brought rates to such a low figure that the weakest or least fortunate had to give way, and before the middle of 1884 was reached the harbours of the north-east coast were filled with fleets of idle steamers. Long before then the demand for new boats had fallen away, and the shipyards of the Tees, Wear, Tyne, and Clyde, presented a melancholy spectacle of empty berths and barren scaffold poles. Thousands of men were out of work and destitute of the means of subsistence. Relief agencies were necessary in all shipbuilding centres, and the members of our unions were the only section of the industries affected by the crisis who were able to retain their independence. Put into figures, the change from the inflation of 1883 to the collapse of 1884 is indeed startling. In the former year 1,256,829 tons of shipping were constructed; in 1884 only about 730,819 tons. To the operative shipbuilders these figures mean the displacement of one-third of their number. To our own trade they mean, speaking roughly, a lessened demand for steam engines to the extent of 50,000 nominal horse-power, and they account entirely for the gradual increase of numbers on our unemployed list from January to December. If in this emergency our foreign trade had also failed us, we should have been in a most deplorable condition indeed. At a moderate computation the collapse in this important branch of national trade made a difference to the labour market of seven and a-half millions of money."

The depression in trade had, however, not been peculiar to this country. No single foreign country was in a better industrial condition than our own; none, in fact, was in so good a state. The depression had been universal; as a consequence the labour question had been the question of the year, and suggested remedies had been numerous and diverse. Some of these remedies, Mr. Burnett urges, may offer abundant food for reflection to the thoughtful artisan, who would do well to make up his mind as to some of them. Mr. Burnett evidently attaches the most importance to co-operation, as one of the schemes put forward by which the prosperity of the working man will be most readily secured. "In its distributive form," he says," co-operation has undoubtedly already done much to promote household comfort, encouraging thrift, and cheapening the commodities of everyday consumption. But co-operation cannot be complete unless it is both productive and distributive; the one branch is indeed the complement of the other. It was hoped years ago that the surplus funds of such organisations as ours might be judiciously and profitably used in the co-operative production of the manufactures of our trade. Time and experience have shown, however, that this hopeful idea is not likely to be readily fulfilled. We have no funds which can so safely be considered surplus as to justify their employment in any enterprise which is in the slightest degree speculative or uncertain. Apart from this, however, it seems that while our Society and its funds cannot wisely be directly used for co-operative purposes, it may indirectly do much to encourage a system which is bound to spread, and in which our interests must be greatly bound up, whether as our own employers or as mere labourers. Our branch and committee meetings bring into close companionship our members who are, generally speaking, the 'pick of the trade.' Half the possible uses of such intimate association are thrown away if it leads to nothing higher or better for the future. In many localities opportunities arise for the combination of individual means to affect the establishment of a co-operative workshop. A little more self-confidence and mutual trust, a sufficient spirit of enterprise, and an earnest desire to make labour its own master, is all that is necessary to achieve some practical good in this direction. The Society in itself is a co-operative association, and its usefulness may be largely increased if its meetings can be made the birth-place of co-operative undertakings destined to improve the position of its members."

Passing on to consider the somewhat allied project of industrial partnerships, allotting to each worker some percentage of the profits he creates, Mr. Burnett considers that "this is a reform which lies rather with the employer than with the man. The keynote of the theory is that the best method of obtaining the highest results from labour is to give it an actual share in the profit it makes. We have always held that well-paid labour is the best of all labour, and if such partnerships as these pay the ordinary trade rates and work under all the usual trade conditions, no workman will object to a fair apportionment of the profit realised."

After dismissing the projects of the State Socialists with the remark that for such a system the British workman is as yet too robust and independent, Mr. Burnett adds that "in the past labour has had to fight for all it has gained, and will yet have to fight in the future. It is," he says, "the recognition of this fact which has called our unions into existence. Their main purpose is one of assertion or resistance. They have to make the best of things as they are, and to this mission their rules confine them; but every member has his individual rights, and within the limits of our rules, and as a private citizen, he may devote his energies to such of the social reform agencies as he may think the most likely to secure better treatment for labour than it has ever yet enjoyed."

As to the income and expenditure of the Society during the past year, it is not necessary to add much to the summary we published last week, except that there are two matters brought into prominence by the report which are deserving of further notice. One of these is the expenditure on superannuation, which has continued the upward tendency of the past ten years. The demand upon the resources of the Society for this benefit, which last year required £30,519, has been steadily enlarging year after year to the extent of about £2000 per annum, and as this increase will continue for many years to come, a prospect so alarming is opened out that Mr. Burnett emphasises the very obvious fact that "it is now the duty of the branches to take serious thought on the subject, and give to their representatives at the delegate meeting to be held at Whitsuntide such instructions as in their opinion will enable that assembly to put this benefit on a sound and substantial footing in the future. This," he adds, "is undoubtedly the point of all others which needs most careful handling. It is becoming rapidly evident either that there must be retrenchment of expenditure, greater stringency of the conditions of entitlement, or increased special payments for this benefit; or, possibly, a method of reform which shall include the whole of these alternatives. Last year's outlay for this benefit was at the rate of 12s. 0½d. per member. The proportion of superannuated members was 2·8 per cent., or twenty-eight per thousand. The proportion of cost of superannuation to the total income of the Society for the year, less the proceeds of special levy, was £23 9s. 6d. per cent., as against £8 15s. 10½d. per cent. ten years ago."

The out-of-work and the sick benefits have also been heavy items, the one taking £59,056, and the other £27,977, but it is more especially the expenditure of £23,480 on disputes connected with trade that calls for remark. This special strike expenditure comes second only to that in 1874, and is only £77 less than was spent in that year. This large outlay is nearly all chargeable on account of the disastrous conflict at Sunderland, which has ended in complete failure and defeat. The actual cost of this fruitless struggle cannot, however, be reckoned simply by the expenditure it has entailed, heavy though this has been. The persistence in the conflict, in the face of the generally depressed state of trade, has compelled the Society, when its members have seldom been in a worse position to meet any extra strain, to raise an income which has been the largest in its history. To do this the members have been called upon to make extra weekly payments, with the natural result that large numbers have abandoned the Society, whilst those who have joined it have shown a considerable falling off as compared with previous years. It is true that notwithstanding the large outlay, which has exceeded even its exceptional income of £157,484 by £15,357, the Society has still in hand accumulated funds amounting to £162,768. This is, however, in marked contrast with its position some five or six years back, when the Society was possessed of funds amounting to upwards of £275,000; and with an increasing drain upon its resources to support unemployed, sick, and superannuated members on the one hand, a continued general depression in trade and a serious check to increase of membership on the other, the prospect before the Society is not encouraging. Mr. Burnett himself admits that whether the year before them is to make a further inroad upon their funds it is impossible to foretell; but, it may be added, one thing is certain, that further reckless trade conflicts cannot be entered upon without seriously jeopardising the very existence of the Society.

PRIVATE BILL LEGISLATION.

Both branches of the Legislature are again in session after the Easter recess, and the work of legislation by Committees has been resumed, but as no Committee met before Tuesday week last, very little has yet been accomplished, and a curious incident arose on Tuesday week in illustration of the want of vigour in regard to private Bills immediately after a holiday. At twelve o'clock three members met in a Committee-room to take up a group of Bills, and the learned counsel for the promoters of one Bill proceeded to open his case. After he had spoken for some time, one of the three members discovered that he had made a mistake and got into the wrong room. He accordingly withdrew to search for his proper destination, but his doing so had the effect of rendering the proceedings null and void, for in a Committee of four members three make a quorum, and in this case there were only two present, the third, of course, having nothing to do with the group. The other two had not arrived, and as after the lapse of an hour or more they did not put in an appearance, the two present gave them up and adjourned.

A distinct advance has been made with the Ship Canals Bill. On the House of Lords Committee reassembling, under the chairmanship of Earl Cowper, Mr. Pember, the leading counsel for the promoters, mentioned that during the brief recess some correspondence had taken place between the solicitor for the Bill and the solicitor to the Mersey Docks Board respecting some figures relating to the probable extraction of water from the estuary, given by Mr. Lyster, the engineer to the Board. These having differed from those of Mr. Leader Williams, the engineer of the Bill, Mr. Lyster challenged an examination of the question by the surveyors on each side. But since then the solicitor to the Board had declined to arrange an interview between the surveyors, as Mr. Lyster was perfectly satisfied with the accuracy of his figures, and adhered to them. Mr. Pember asked that the correspondence should be put in as evidence, as he intended to make use of it. The engineering part of this subject being still the only matter before the Committee, Mr. Bidder addressed the Committee on that on behalf of the Mersey Docks and Harbour Board. He referred to the circumstance that in each succeeding year the promoters had changed their plan, and intimated that Mr. Leader Williams having failed now to offer a scheme that would be unobjectionable to all parties, the Dock Board were obliged to again resist the Bill, and on the same ground as before, viz., that it involved the construction of works which, in the judgment of men whose life had been devoted to the Mersey, would be attended with disastrous consequences to the port of Liverpool. He enlarged upon this contention, pointing out the injury anticipated to the estuary and the bar especially; and while he admitted that as the dredging was reduced the injurious effects might be diminished, he objected to the offer of the promoters to do that, as bidding for the Bill.

Mr. Aspinall, Q.C., and Mr. Pope, Q.C., followed on behalf of the Corporations of Liverpool and Birkenhead and the London and North-Western Railway Company respectively, and Mr. Pember having replied, the Committee announced their decision to allow the Bill to proceed. Then, with a view to shortening the inquiry they suggested that, the commercial question being next taken, and the commercial evidence being before them, the opponents should begin that part of the case by taking the initiative and proving a negative. To this the counsel for the opposition objected, partly because they were not ready, and partly because this was an unusual course, and as the Committee did not persist, the promoters proceeded with their evidence in the ordinary way. The decision to allow the Bill to go on is regarded by the promoters as virtually tantamount to a decision in favour of the Bill—at least in regard to the engineering question—and the suggestion as to the commercial case is regarded as having very much the same signification.

Since the last sitting of the Select Committee on the Regulation of Water Companies Bill, the eight metropolitan water companies have sent to the members of the Select Committee on Lord Camperdown's Bill the terms of an amendment which, if accepted by the Committee, will reconcile the companies to the provisions of the Bill. The nature of the amendment is that the companies shall not have power to cut off water in order to enforce payment of rates until a period of twenty-one days shall have elapsed after the delivery of full particulars to the consumer, and if within that period he applies to a magistrate to fix the amount of the claim, then the companies' powers are not to be exercised until the magistrate has decided the dispute between the parties. The metropolitan companies offer no objection to the provision of the Bill requiring them to furnish the particulars of their charge, unless it be that they do not think this need be done every quarter. A large body of provincial companies have also laid before the Committee the provincial case; but from the great number of parties interested, and from the peculiar circumstances of many towns, an agreement among them has been more difficult to be arrived at. They are generally willing, however, to agree to the amendment as to twenty-one days' notice, with full particulars of the claim, and the decision of a magistrate being necessary before a consumer's water can be cut off. Both the metropolitan and the provincial companies would like a modification in the Bill which would leave them the power of cutting off water to prevent contamination or waste, and a number of provincial companies are more interested in this than in preserving intact their power of cutting off to enforce payment of the rate. The Bill, we may again mention, enacts that hereafter the water-rate shall not become payable until the company has furnished to the consumer a demand note containing or accompanied by full particulars of the charge; and that, in the event of non-payment, the supply shall not be cut off until the company has obtained an order granted on summons.

The Committee met again on Tuesday week, Lord Camperdown presiding. Mr. Hollams appeared on behalf of the eight metropolitan companies, and Mr. Blakelock and Mr. Coates for the provincial water companies. The suggested amendments of the metropolitan companies were the subject of considerable discussion. Lord Camperdown said that he had drafted and printed certain amendments, which he now submitted to the consideration of the water companies. The Committee felt, with regard to the proposals of the metropolitan companies as to the service of the demand note, that those proposals were very fair and unobjectionable. A long discussion took place as to the details in connection with the service of the demand note and particulars, and a basis for settlement was arrived at. With regard to the cutting off of the supply, Lord Camperdown suggested that the Bill should be amended so as to allow the consumer, within twenty-one days, to lay his objection before the justices, and if the consumer did not avail himself of this opportunity, it would be assumed that the demand was admitted. The Committee were of opinion that for sanitary reasons the supply ought in no case to be cut off from small tenements paying 2d. or 3d. a week. In connection with this subject it may be worth while to give the following extract from a letter to the *Standard*, signed "Texas," a few days ago:—"The revaluation of the whole of the metropolis is now proceeding, and there can be no better time to call attention to the necessary reassessment of the water companies. The income of these companies supplying London was, for the year 1856, about £518,000; and for the year 1883, £1,600,000; and the assessment to rates in 1856 was £118,199, and in 1883 £119,944. These figures need no comment, save that the rates paid should, in fairness to the ratepayers, bear some proportion to the increase of income, and I venture to trust that all the parochial authorities interested will now direct their attention to this matter, and so reassess these companies that they will henceforth bear a just and proper share of the burdens thrown on the ratepayers of London."

Two or three other Select Committees have sat during the week, but no noticeable results have yet been arrived at, and in the two Houses a few Bills not of general interest have advanced a stage.

In the House of Commons on Monday week an interesting discussion took place upon the second reading of the North British Railway Bill. Mr. Waddy, one of the members for Edinburgh, resisted the motion not so far as the Bill was a railway Bill, but because it proposed to give the company power to improve and extend a building in their possession and use it as an hotel. This would enable the company to become hotel keepers on a large scale, and he protested against this as disadvantageous to real and proper hotel keepers, especially as railway companies were not fitted for such an undertaking. Mr. Orr Ewing explained that the company did not propose to become hotel-keepers themselves, but simply wished to enlarge this building with a view to letting it as an hotel.

Sir Arthur Otway supported the Bill, and eventually Mr. Waddy's opposition was defeated, and the Bill read a second time. It will now go to a Select Committee, where no doubt the hotel-keeper question will be kept well in mind.

Of the 248 Private Bills presented to Parliament this session, twenty have already become dead. Among them are Bexley Heath Railway (Nos. 1 and 2), the Islington (Angel) and City Subway, the Marble Arch, Regent's Circus, and City Subway, the Thames Deep Water Dock, the Tower Floating Bridge, the Westminster (Parliament-street) Improvements, and the Bill for making a railway from Oxted to Westerham.

Since the reassembling of Parliament after the Easter recess the Select Committees have at least been in active operation, if no heroic results have followed upon their labours. Several Committees have taken up the groups of Bills allotted to them, and a number of these private schemes have been dealt with; but on the whole the issues involved have been slight and local, and at the same time some of the Bills which at the beginning of the Session appeared to possess a good deal of vitality, have vanished from the list for one reason or another. For example, there was a Bill advanced with the object of giving the South-Eastern Railway Company access to the Crystal Palace. It was promoted conjointly by the Crystal Palace Company and the Railway Company named, together with the Metropolitan Railway Company, and its scheme was the construction of a line of railway nearly five miles in length, commencing by a junction with the South-Eastern Railway at New Cross, and terminating in the grounds of the Palace, near the north tower. At the opening of the Session there were three Bills put forward for forming new lines to the Crystal Palace, but two of them collapsed early, and now the third, referred to above, has been withdrawn. The same fate has befallen the Bexhill Direct Railway Bill, which proposed to construct a line of nearly four miles in length from a junction with the South-Eastern system at Crowhurst to Bexhill, with running powers over certain portions of the South-Eastern line; and also power to make agreements with the South-Eastern and London, Brighton, and South Coast Railway Companies for the working of the new line; and in like manner two of the remaining five Bills for constructing subways in the metropolis have been abandoned, leaving only the Clapham and City, the King's Cross, Charing Cross and Waterloo, and the London Central Subway Bills to be dealt with. These three have now been grouped, and will come before a House of Commons Committee on April 29th. In this connection it is to be noted that the Metropolitan Railway Company has been refused a *locus standi* against the King's Cross and Waterloo Subway Bill. A Select Committee, presided over by Admiral Egerton, has also rejected that portion of the East London Railway Bill which proposed to sanction a scheme for the consolidation and rearrangement of the capital of the company by the conversion of various stocks, with provisions for capitalising the arrears of interest. On the other hand, a House of Commons Committee has passed the preamble of the London and South-Western Railway (various powers) Bill, which, as amended, authorises that company to acquire certain lands and carry out certain bridge widenings for the purpose of laying down additional lines between Clapham Junction and Waterloo. It also extends for two years from August 10th, 1885, the time originally granted in 1882 for taking the lands required for the authorised railway and new station at South Kensington, and extends for three years from August 10th, 1887, the time required for completing the railway and the new street, and widening of Pelham-place connected therewith. A similar period of extension is also granted for making the bridge and railway across the Thames at Putney in connection with the Kingston and London Railway, sanctioned in 1882. The Bill also vests in the company 3 roods 33 perches of Barnes Common which the company has acquired by agreement from the Conservators in exchange for other lands which are now to be thrown into the common. When first introduced this Bill also sought powers to extend the Thames Valley Railway to Shepperton, but all clauses relating to this new line were struck out before the Bill came before the Committee. Under this Bill the company are authorised to raise £400,000 additional capital and to borrow any sum not exceeding £136,000. A number of commonplace Bills—for gas and water supply and other ordinary purposes—have been passed by Committees, but none of them call for special notice. As a matter of fact, the ordinary measures this session are very ordinary indeed, and anything like substantial interest is found after all to be confined to three or four special schemes which are still in progress. There is a considerable number of Bills introduced by municipal or other local authorities for police, sanitary, and general municipal purposes; but they raise no special feature except where, in a few of them, power is proposed to be taken to enable the respective authorities to make bye-laws for the regulation of telephone and telegraph wires. That point will doubtless depend very much on the decision of the Select Committee on Telegraph and Telephone Wires—whose proceedings will be found on another page—but so far no less than eleven of these Bills have been referred to Select Committees.

Among the really private, though *quasi* public, Bills, that for the construction of the Manchester Ship Canal still stands in the foremost place, and is yet some distance from a conclusion even before the House of Lords Committee. The Committee having a week ago decided, after the engineering branch of the subject had been thoroughly examined, that the Bill should proceed, and having in vain invited the opponents to take up the lead on commercial and other points and to prove a negative, settled down to a patient hearing of evidence which had been already twice put forward, and remained practically unaltered. They have accordingly spent the last few sittings in receiving the evidence of the promoters as to the benefits which the commerce not only of Lancashire, but of the whole of Northern England, will derive from this scheme. It is needless to enter into this part of the case at any length, but a few of the statements made in support of the Bill are worth recording. For example, Mr. Adamson—chairman of the Provisional Committee and, indeed, one of the prime movers in the whole project—stated that at least five million people were anxious that the Bill should pass this year, while no less than 500 public bodies, such as municipal authorities and chambers of commerce, had petitioned Parliament last year in favour of the Bill; and that up to the present time the promoters had spent £130,000 in prosecuting the scheme. He described the sole object of the Bill as being to cheapen transit and to take goods direct to Manchester without breaking bulk, and he estimated that there would be a saving of 50 per cent. by the canal in the rates of carriage for goods of all classes. As to the prospect of raising the required capital, he had no doubt whatever on that point, and he mentioned that one of the benefits expected from the canal being the prevention of floods and the removal of sewage by means of a culvert running by the side of the canal, the Corporation of Manchester were prepared to pay the promoters £1000 per mile way-leave for so disposing of the sewage. In support of his opinion respecting the capital, Mr. Adamson stated, without giving names, that several gentlemen had promised to subscribe £50,000, £20,000, £5000, and lesser sums each. In connection with the examination of this witness, the London and North-Western Railway Company incurred the expressed displeasure of the Committee. The leading counsel for that company not having been present during the examination of Mr. Adamson, an adjournment of the cross-examination was proposed. Thereupon the Earl of Milltown observed that the London and North-Western Company had treated the Committee with disrespect in not having counsel present during this evidence; and the Committee declining to defer the cross-examination, it was intimated by Mr. Sutton that the London and North-Western Company would be satisfied if the Committee took last year's cross-examination of Mr. Adamson for the purpose of the present inquiry. On the following day, Mr. Pope, Q.C., representing the London and North-Western Railway Company, asked for an intimation from the Committee as to whether they were likely to feel bound by the decision of last year's Committee on the branches of the subject other than that of the estuary. The Chairman replied, that while the Committee would not feel bound by the decision of last year's Committee, it was obvious that the evidence that satisfied that Committee would be very likely to satisfy this Committee; and he suggested that the whole of last year's evidence should not be repeated now. Subsequently the Committee made an attempt to curtail the proceedings; but, this failing, the inquiry has dragged its slow length along from day to day, reviving evidence now many times repeated. The opponents have still to present their case, and at the present rate of progress the Bill is likely to occupy two or three more weeks in the House of Lords alone.

After a protracted and most careful investigation, the Select Committee on the question of restoring Westminster Hall has arrived at a decision, which in due course will be submitted to the House of Commons. Two schemes were before the Committee, viz., one by Mr. Pearson, to finish St. Stephen's Porch as proposed by Sir Charles Barry, to erect a cloister, and to raise the tower; and one by Mr. Peddie, M.P., to do simply sufficient to protect the Hall from the effects of weather. Mr. Pearson's plan was rejected last year, but the Committee this year have accepted it, and will recommend Parliament to grant the vote necessary to carry it out in its main features. The Select Committee on the Water Companies (Regulation of Powers) Bill are still pursuing their inquiry, but they are nearing the termination; for at the last sitting something in the nature of a compromise was arrived at respecting the knotty question of notice of cutting off supply and the furnishing of particulars relating thereto. An absolute decision and result cannot yet, however, be given. A somewhat curious point has been raised by the Bill promoted by the Caledonian Railway Company. In 1883, and again last year, this company entered into an agreement with the North British Railway Company that neither should promote any aggressive scheme against the other. Now, however, the first-named company desire to contribute £150,000 to the Lanarkshire and Ayrshire Railway Company for certain purposes, and the object of their Bill is to obtain Parliamentary sanction of that proposal. On the strength of the agreement the North British Railway Company oppose the Bill as a breach of faith, and this delicate question is awaiting settlement at the hands of a Select Committee.

The Channel Tunnel (Experimental Works) Bill was to have been discussed, with a view to its second reading, in the House on Tuesday, but Sir E. Watkin proposed, at the request he said of the President of the Board of Trade, a week's postponement. In making this motion Sir E. Watkin said he understood from the papers that Lord Richard Grosvenor had stated that the Prime Minister was in favour of a tunnel between England and France, and he invited Mr. Gladstone to say whether that was correct or not, as such a declaration, one way or the other, would be of great advantage in dealing with this Bill. The Premier did not make any announcement on the subject, and in the end the second reading was deferred for a fortnight.

In the preamble of a Bill introduced by Mr. Norwood, M.P., it is recited that questions have from time to time arisen as to how far machinery and plant are to be taken into consideration in estimating for the purposes of the poor-rate the value of the premises in which a business is carried on. The Bill accordingly proceeds to define the machinery the annual value of which is to be estimated. It includes, first, fixed motive powers, such as water-wheels and steam engines, and the steam boilers, donkey engines, and other fixed appurtenances of these motive powers; second, fixed power machinery, such as shafts, wheels, drums, and their fixed appurtenances, which transmit the action of the motive powers to the other machinery fixed and loose; and third, pipes for steam, gas, and water. But all other machinery and plant, whether attached to the premises or not, are to be exempt from rating. It is proposed that the measure be temporary only, the limit of its operation being fixed at the end of the year 1887.

LAUNCHES AND TRIAL TRIPS.

On the 13th inst. Messrs. Raylton Dixon and Co. launched another small steam vessel which has been built as carrier for the fishing trade, to bring the take of the trawling fleet from the fishing stations into the Billingsgate Market. She is built for the Great Yarmouth Steam Carrying Company, the other four having proved so very successful. Her principal dimensions are 128ft. over all, 21ft. beam, and 11ft. 7in. depth of hold, and she will be fitted with engines of 50-horse power by Messrs. Blair and Co., of Stockton. She will also be provided with steam winch and derrick gear for trawling, and her holds are specially arranged for carrying ice out to the fleet and in stowing fish boxes on the return, the sides and below deck being protected by double lining of non-conducting material, so as to exclude heat and preserve the fish. On leaving the ways she was christened the Courage.

The screw steamer Haiphong, which has been built and engined by Messrs. Wigham, Richardson, and Co., Neptune Works, Low Walker, for the Douglas Steamship Company, of Hong Kong, proceeded to sea on her trial trip a few days ago. She is a spar deck vessel, built to Lloyd's highest class. Her 'tween decks are fitted up for about 330 emigrants, and accommodation for first-class passengers is provided in a large house on deck. The engines have cylinders 31in. and 62in. respectively by 42in. stroke, working at 90 lb. pressure; and the steamer is fitted with steam steering gear, winches, and all the latest improvements for rapid loading and discharging. After adjusting compasses, the vessel was taken for a series of runs over the measured mile off Whitley, when a mean speed of 12¼ knots was obtained.

On Saturday, the 18th inst., Messrs. Edward Finch and Co. launched from their shipbuilding yard at Chepstow a very powerful and handsomely modelled screw tug, built to the order of Messrs. Gibbs and Lee, of Cardiff. Her principal dimensions are: Length over all, 93ft. 6in.; breadth, 18ft. 1½in.; depth, 9ft. 8½in. She will be fitted with compound surface condensing engines, having cylinders 18in. and 36in. by 24in. stroke, and a boiler 9ft. 6in. by 11ft. 6in., designed for a working pressure of 85 lb. She has accommodation aft for the captain and forward for crew, together with one spare state room, large cross bunker between engines and boiler, and will be fitted with all the most modern appliances. As she left the ways she was christened Royal Briton by Miss Gibbs.

On Saturday last, the 18th inst., there was launched from the yard of the Barrow Shipbuilding Company a fine paddle steamer for the Isle of Man Steampacket Company, of Douglas. The vessel is built of Siemens-Martin mild steel. Her dimensions are:—320ft. by 38ft. by 14ft. 6in. depth of hold, with a gross tonnage of about 1458 tons, and will be provided with accommodation for carrying about 1500 passengers. Her fittings and appointments are of the most elaborate and elegant description, and will probably not be surpassed by any vessel afloat. Her saloons are very commodious; her upper saloon, measuring 75ft. in length and 34½ft. in breadth, is panelled very handsomely in satinwood and walnut, decorated with gold, the entrance to it being 13ft. by 14ft. This saloon, together with the captain's room and state-room, is upholstered in peacock blue velvet. The design of the ladies' saloon, which measures 17½ft. by 36ft., is carried out in very fine sycamore and walnut, with gold moulding and capitols, and is upholstered in bronze green velvet. The lower saloon, which is 82ft. in length and 35ft. in breadth, is upholstered in crimson velvet. The sofas in this saloon, ladies' rooms, and state-rooms are so arranged as to be easily converted into sleeping accommodation. The smoke-room, 24ft. by 34½ft., is panelled in ash with oak framing and teakwood moulding and upholstered in buffalo hide. Instead of the usual deck-house, as in other steamers belonging to the company, she has been fitted with a poop extending to the bridge, well lighted by unusually large side lights. The promenade deck, an advantage always appreciated by passengers, extends from side to side, and practically the whole length of the ship. The vessel will be steered by Messrs. Muir and Caldwell's steam steering gear amidships, and Hastir and Co.'s screw gear aft. The anchors will be worked by Messrs. Matthew, Paul, and Co.'s steam windlass, and she will also have a steam capstan fitted aft for warping purposes, supplied by the same makers. The boats will be four in number, and for the additional safety of passengers she will be provided with eight of Williams' patent double lifeboat seats on deck. The vessel will be propelled by double compound oscillating surface-condensing engines of about 5000 indicated horse-power. The diameter of the high-pressure cylinders is 50in., and that of the low-pressure cylinders 88in., the length of stroke in each case being 72in. The frames and other important parts are made of steel for the purpose of securing lightness and great strength. The paddle-wheels are on the feathering principle, and are fitted with carved steel floats. The circulating water for the surface condensers is supplied by two powerful centrifugal pumps of the Barrow Shipbuilding Company's usual pattern, and powerful double donkey pumps and fire-engines are fitted in the engine-room for the purpose of feeding the boilers, pumping out the holds, washing decks, and extinguishing fire in case of need. For this latter purpose a complete system of pipes is led the whole length of the ship, so that water can be supplied to any part. Steam is generated by four large double-ended boilers, constructed wholly of Siemens-Martin mild steel, and each having six furnaces. They will work at a pressure of 85 lb. Powerful fans, driven by independent engines, are fitted in the stokeholes, so that in case of need the boilers can be worked with forced draught, under which circumstances the power (and consequently the speed) will be greatly increased. The speed expected from the vessel is about twenty knots, and she will be the fastest of the Isle of Man Steam Packet Company's already fine fleet. The ship and engines have been designed by the Barrow Shipbuilding Company. The hull has been constructed under the superintendence of Mr. George Hughes, and the engines under the superintendence of Mr. Lewin, the company's engineer. The launch, which was very successful, was witnessed by a large number of spectators.

On the 29th inst. will be launched a splendid paddle steamer for the City of Dublin Steampacket Company, intended for the passenger and mail service between Holyhead and Kingstown. This vessel, constructed, with her engines, by Messrs. Laird, Birkenhead, is 380ft. long and 38ft. beam; she will be a paddle boat of 6000-horse power, and will have a speed of 20 knots; she will be the fastest paddle steamer in the world.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, April 10th.

PRIVATE advices during the past two or three weeks from iron manufacturers throughout the country show a rapidly growing preference for steel, and an announcement is made of the projection of the construction of several steel works to make steel rails and steel plate. The managers of the rail mills are turning their attention to steel ingots and slabs, and their production is increasing every week. The merchant iron demand is very backward, and prices are low. The iron trade is not improving, yet there is evidence of large requirements held back for more favourable conditions. Tin is unsettled and weak at 17.30 dols.; tin-plate is dull at 4.30 to 4.40 dols.; copper steady at 10.45 dols. The production of copper is still largely in excess of apparent requirements.

The strong evidences of a foreign war threaten the prices of wool, because of the dependence of American manufacturers on foreign sources of supply for about 35,000,000 dols., which will be cut off in the event of a blockade of Russian ports. The confirmation of rumoured engagements has already advanced the price of oil, and the speculative tendency has seized the market. The grain markets of the interior have been stirred by war rumours, and prices have leaped from 0.95 to 1 dol. for wheat in St. Louis, with corresponding advances in Detroit, Chicago, and all western markets. It is impossible at this early date to predict the possible effects of an actual war. All markets are more or less excited.

The iron trade will keenly watch the developments of the situation. Iron buyers are not very heavily supplied, and brokers here to-day were unable to obtain tonnage or to make contracts because of their inability to name prices. Stocks of merchandise and material of all kinds throughout the country are light, because of the conservative policy of manufacturing which has been so readily adhered to for eighteen months past. The markets are in a condition to advance, provided an impetus is given to demand.

Some twenty strikes have taken place among workmen throughout the country, mostly against reduction. Labour organisation is being pushed, and any upward tendency in prices will likely be still further stimulated by the organised effort of labourers to obtain more satisfactory compensation.

There will be no attempted increase in production in crude iron. The production of nails is at the rate of 7,000,000 kegs per year, and is equal to all requirements. Building operations are being vigorously pursued, and more work will be done this season than in any former season. The dry goods merchants have won a substantial victory in their contest with the New York Central, in reference to freight diversions of railroad companies claiming the right to select its own line for delivery.

Advices from all parts of the South indicate that the full acreage of cotton will be planted. The distribution of merchandise from this centre increases very slowly. Advices from Western and Southern distributing centres indicate a moderate demand.

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

(*From our own Correspondent.*)

SHEET mills at date remain idle in numbers of instances, lacking sufficient orders, and though the majority are running, it is upon hand-to-mouth contracts, and the outlook is not hopeful. Local consumers, such as the galvanisers, no less than merchants, are curtailing their orders, in the expectation that prices will yet still more tend in their favour. Merchant singles are £6 5s. up to £6 15s.; galvanising doubles, £7 to £7 5s.; and lattens, £8 to £8 5s.

Quotations of black sheets of the Woodford brand remain at £8 for sheets up to 20 gauge, £9 10s. up to 24 g., £11 up to 26 g., and £11 10s. up to 28 g. Close annealed "Woodford Crown" sheets are £9 10s. for 20 g., £11 for 24 g., £12 10s. for 26 g., and £13 for 28 g. Best sheets are 30s. per ton additional, and double best 60s. per ton additional. Siemens-Martin close annealed steel sheets are £13, £14 10s., £16, and £16 10s., according to gauge; and charcoal qualities are quoted £16, £17 10s., up to £19 and £19 10s.

The continued strength in North of England manufactured iron prices, notwithstanding the drop of 3d. per ton in pigs, has again a slightly beneficial effect in some circles upon our markets this week. Common bar makers to-day—Thursday—in Birmingham were hardly open to so much negotiation by merchants. They quoted £5 10s. Ordinary bars were £6, while a few houses obtained £6 5s. to £6 10s. for iron of a reliable quality. Marked bars still command the official figure of £7 10s.

Horseshoe bars were quoted £6 for ordinary sizes; hinge strip, £6 10s.; hoops and strips, £5 15s. to £6 5s.; steel hoops and strips, £6 15s.; and gas strips, £5 10s., £6, and £6 10s., according to sizes. Sash iron was quoted £6 15s.

Contracts entered into for pig iron are in too many cases for small supplies. The representatives of pig iron smelters in the Northampton, Derbyshire, and Lincolnshire districts are not booking orders to the extent they had hoped for; neither is hematite iron so saleable as a few months ago. Best all-mine pig iron is quoted at £3; part mine, £2 5s.; and common or cinder iron, £1 17s. 6d. per ton. But these quotations cannot be obtained in other than rare instances by between 2s. 6d. and 5s. per ton. Midland pigs are unaltered upon the basis of recent quotations.

Railway orders for bridge and girder work and station roofing have been fairly abundant of late for home and export, and if competition were less keen and prices stronger there would not be great cause for complaint in this branch. Yet the bridge and roofing makers about Darlaston are at present very quietly engaged, except in the case of Messrs. Simeon Carter, who are supplied with orders for twelve months to come. A number of the operatives employed by the Bridge and Roofing Company, Darlaston, have been discharged.

Ironmasters and engineers note with satisfaction that the Scinde, Punjaub, and Delhi Railway Company is inquiring for quantities of Staffordshire plates and bars and supplies of bolts and nuts, galvanised carriage roofing sheets, steel locomotive tires and axles, and brass boiler tubes. For the Nizam's Guaranteed State Railways Company, carriage and wagon wheels and axles and axle boxes are needed at once.

Messrs. Glenfield and Co. have this week secured the contract for supplying, erecting, and setting to work, gas engines, air compressing, and pumping machinery, &c., needed by the local authorities of Wednesbury in connection with the sewerage of the town. Messrs. Glenfield's contract price was £3510. There were four other tenders, as here:—Hughes and Lancaster, £4107; Hartley and Harnox, £3989; Patent Shaft and Axletree Company, £3808; and Renshaw and Co., £3605.

Additional contracts for troop equipment have been booked since last week from the War-office by the japanners, stampers, and others, and further orders are daily anticipated as the result of the recent tendering. The heavier needs of the departments in the way of tanks, tools, railway goods, and some descriptions of engines and machinery are still finding expression at certain of the Birmingham and district works. Large orders for iron padlocks for the India-office, and of locks for the Admiralty, have been received. Certain of the currycomb makers have been busy upon good lines for the War-office. Some of the Government contracts have been cut very fine. Torpedo netting orders now being accepted by some makers furnish a striking illustration in point.

All efforts having failed to induce certain recusant nut and bolt manufacturers and their workmen to join the respective masters' and men's Associations, the majority of the men have this week submitted to a reduction in wages of 5 per cent., instead of the 10 per cent. originally demanded. This drop has been acceded to upon the understanding that the late rate of wages shall be resorted to immediately a satisfactory settlement is made with the outside masters.

The operative brass-workers of Birmingham have resolved that the time has arrived when a determined stand should be made against further attempts to reduce wages. To this end an effort is being made to increase the membership of the men's societies.

The majority of the mills in North Staffordshire are running, on an average, about four turns a week. Manufacturers have to depend on the orders arriving from day to day. Prices are very unreliable. Crown bars are nominally quoted £5 10s. per ton. The plate trade fails to improve, and these mills are running scarcely half-time. Crown plates are quoted £6 15s. delivered Liverpool, but for good lots less is accepted.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business throughout the iron trade of this district remains in much the same unsettled condition as reported last week, and so long as the present suspense continues with regard to the issue of the political complications abroad, it must act as a serious check upon trade. There is no actually quotable change in prices, although the tendency of the market is to bring an increased strain upon weak holders, but there is practically an absence of any inquiry to test what sellers would really be prepared to take if orders were offered. The depression is the most marked in pig iron transactions, which are of the most limited character possible. For manufactured iron there are fair inquiries in the market, and but for the present uncertainty with regard to the future, it is probable they would develope into a moderately good trade being done, but for the moment buyers hesitate to commit themselves to transactions of any great weight.

A generally depressed tone characterised the Manchester iron 'Change meeting on Tuesday, and the market was a reflection, so far as business is concerned, of the prevalent disquietude and uncertainty with regard to the political complications abroad. In pig iron there was only a small hand-to-mouth trade doing, with 40s. to 40s. 6d., less 2½, remaining the quoted prices for good local and district brands delivered equal to Manchester, and one or two second-rate brands offering at about 38s. 6d. to 39s., less 2½, delivered here. For Middlesbrough brands coming into this district, prices, if anything, show rather an easier tone. Hematites continue only in very poor demand, and where offers of any weight are made they are at prices lower than makers care to accept. Some of the finished iron makers are fairly off for orders, and there is a moderate business doing in railway material for India and the colonies; but generally business is very quiet, and prices continue on the low basis of £5 7s. 6d. for good qualities of Lancashire and North Staffordshire bars; £5 17s. 6d. to £6 for hoops, and £6 17s. 6d. to £7 per ton for sheets.

Where activity is being maintained in the engineering trades, it is chiefly in connection with locomotive and railway carriage building, both of which branches are still well supplied with work, in some cases for a long time forward. In most other branches, as I have previously reported, a slackness generally appears to be coming over trade.

The absence of activity in engineering is necessarily reflected in the brass foundry trade, and for both engineers' and marine fittings there is only a very small inquiry, with prices cut extremely low to secure orders. With regard to manufactured metal goods generally the same may also be said, and for delivery into the Manchester district the quoted prices are about as under:—Solid drawn brass tubes, 5¾d.; copper ditto, 7½d.; brass wire, 5¾d.; copper wire, 7¾d.; rolled brass, 5½d.; and brass sheets, 6¼d. per lb.

A decided novelty in connection with steam pumps has been introduced by Mr. Joseph Bernays, the well-known inventor of the centrifugal pump bearing his name. This consists in making the connecting-rod of the same length only as the crank, and in arranging the parts in such a manner as to lead the rod to change its position during each stroke from above the crank at one end to below the crank at the other. The rod thus adds its own length to the stroke at each end, and in this way causes the piston to move through four times the length of the crank instead of twice only. A simple contrivance keeps all the working parts in their position during the stroke, and at the same time relieves the piston-rod from side strain, in consequence of which crosshead guides are dispensed with, and the wearing of the glands avoided. The pumps take up very little space, so that they are adaptable for being fixed in places where other fly-wheel pumps would be impossible, and the patentee claims for his invention that it combines the advantages of direct-acting pumps with those of the fly-wheel type, as it admits of the long stroke and simple construction of the former, whilst retaining the steadiness and certainty of action, economy of steam, and accessibility of working parts of the latter. I had an opportunity of inspecting at the works of Messrs. Larmuth and Co., Salford, who have been granted the sole licence for the manufacture of these pumps, two of different sizes which they have made for the International Inventions Exhibition. One of these is a ram pump having a steam cylinder 2⅝in. diameter, ram 1½in. diameter, with a stroke of 3in., and delivering at 160 revolutions per minute about 180 gallons per hour; the other is a double-acting pump, with steam cylinder 6in. diameter, water cylinder 4½in. diameter, and stroke 9in., delivering at an average speed about 4800 gallons per hour.

In connection with the visit of the Gas Institute to Manchester in June next, a large and influential reception committee has been formed, the chairman of which is the Mayor of Manchester, the vice chairman the Mayor of Salford, and an executive committee has been elected for carrying out the requisite arrangements for making the meeting a success. A very comprehensive programme of visits to works and other places of interest is being prepared, and exceptional facilities will be offered to the members of the Institute for extending their acquaintance with the Lancashire coal-fields, and the other industries of the neighbourhood.

A generally steady tone is being maintained in the coal trade of this district, and although the strike in the Yorkshire district has not transferred to Lancashire any materially increased demand such as might have been expected, it has helped to strengthen prices. For such orders as have come forward for house fire coals from districts usually supplied by Yorkshire, or for the London market, advanced prices have in most instances been got, but so far as the local trade is concerned prices are not more than firm at full list rates. Common round coals for ironmaking and steam purposes have not been materially affected, and these still meet with only a slow sale at prices no higher than those which have been ruling for some time past. Pits, however, are, as a rule, being kept on pretty near full time, and colliery proprietors in most cases have been able to get rid of the stocks which were lying under load. At the pit mouth prices average about as under: Best coal, 8s. 6d. to 9s.; seconds, 7s. 3d. to 7s. 6d.; common coals, 5s. 6d. to 6s.; burgy, 4s. 6d. to 5s.; ordinary slack, 3s. 3d.; and best qualities, 4s. up to 4s. 3d. per ton.

The shipping trade continues very quiet, and good qualities of steam coal delivered at the high level, Liverpool, or the Garston Docks do not average more than 7s., whilst some sorts are to be got at 6s. 9d. per ton.

Barrow.—I have nothing of much interest to report this week in connection with the iron and steel trades of this district. The demand for both iron and steel is quiet, and there is no improvement to note in any branch of trade. The works throughout the district are not fully employed, and the orders makers and manufacturers have in hand are not such as will maintain or support even a semblance of activity. Prices are unchanged, but are easier in tone. Stocks remain large all round, but do not increase. There is not much hope in the present condition of things of a revival in the demand so far as either the Continent, the colonies, or America are concerned; indeed, the outlook is not cheerful in any department. No new feature can be noted in the iron shipbuilding trade. No new orders are to hand, but builders are busier than they were on the large orders which have been booked lately, and which are likely to keep them fairly employed during the season. Marine engineers are busier on both heavy and important work, but this is the only branch of this trade which is at all lively or active. Boiler-makers and finished iron makers are not doing much trade, and the foundries and engineering works in the district are but indifferently employed. Iron ore and coal are quiet, while shipping is inactive in all its branches. It is expected that during next month steam tramways will be opened at Barrow, where eight miles of tram lines have been laid, connecting the town with the docks on one hand and Furness Abbey on the other. The progress in the building of the new municipal buildings at Barrow—one of the finest edifices, from an architectural point of view, in the North of England—and in the construction of the new high-level bridge at Barrow, has been most marked of late, and it is expected both these great public works, which have been undertaken by the Corporation of the town, will be completed during this year.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

STRANGE as it may seem, the colliers' strike at its highest point—that is, when most men are out—is accompanied by a fall of 1s. 6d. in the London market, and a reduction of prices on the part of a local colliery of some magnitude. The Yorkshire district is now in the second week of the stoppage, and there is no scarcity of coal, while even at the pits where stacks of coal are most freely exhausted the consumers are still being supplied at smaller advances than in winter are brought about by a sharp touch of frost. I had occasion this week to visit or pass a large number of collieries in South Yorkshire, and a few in West Yorkshire. It seemed to me that the stacks at the pits were very little diminished, and the sidings of the railways were still blocked with coal-laden wagons. Those colliery companies upon whom the stoppage came too suddenly have found no difficulty in securing what they want from other pits, and in one instance—the case of a colliery usually employing over 1000 hands—an official in authority told me they had obtained coal from their neighbour at positively less price than they could raise it themselves.

At the Drift and Norfolk pits of the Thorncliffe Collieries some 230 to 250 men have resumed work at the reduction of 10 per cent. This action has given offence to a large number of their fellow men employed at the other pits, and on Monday expression was strongly given to this feeling by a mass meeting held at Chapeltown in the very district where the men had gone to work. It looked, on the face of it, as if the demonstration was really intended to put pressure upon the colliers who had gone back to their employment, and this view seems to have been shared by the authorities, who had a large force of police on the ground. There was no disturbance whatever, the demonstrators contenting themselves with calling their 250 companions "black sheep," and passing resolutions to adhere to the policy of resistance. At Sheffield the Nunnery Colliery men have paraded the town to excite sympathy and solicit assistance. They had five hours of it in the public streets, and as the result they returned to head-quarters with a cartload of loaves, potatoes, and flour; but as was remarked of old, "What are these amongst so many." There was not enough in the cart to give "one square meal" to the twelve hundred whose appetites must have been sharpened by a five hours' march. Empty again, boxes were used for collecting the coppers of the multitude, and although the amount obtained has not been permitted to transpire, it was stated to be considerable, though, of course, it is not likely that the small army of men, with their wives and children suffering in their homes, can be supported by the casual pence of the people, thousands of whom are at present straitened in their own circumstances.

The schedule for the Industrial Exhibition of the Cutlers' Company has been issued, and will shortly be made public. The rules and regulations provide that it shall be purely a workman's exhibition—in other words, a competition between the artisans for excellence in the various handicrafts carried on in the district of Hallamshire, which not only includes the boroughs of Sheffield and Rotherham, but extends as far as Barnsley in one direction and Swinton in the other. This brings the glass trades within the scope of the exhibition. Its interesting character may be gathered from the fact that it includes not only every variety of knife manufactured for every people and every purpose under the sun—and one manufacturer tells us he has over 17,000 patterns alone—but edge tools, joiners' tools, carvers' tools, hay forks, manure and digging forks, garden tools, spades and shovels, steel, files—in endless variety—sickles, hooks, and scythes, saws of all kinds, axes, adzes, and cleavers, electro-plate and Britannia metal ware, surgical instruments, engineers' tools, fenders, fire-irons, stove-grates, and general ironfounding, brass castings, &c. A subscription fund by way of guarantee has been formed to the amount of £2000, and £750 will be divided into 330 prizes, each prize-taker receiving in addition a certificate of the Cutlers' Company which will be treasured as evidence of his skill. The object of the exhibition is to show the progress made by the Sheffield artisans in the past, and to stimulate greater excellence in the future. The master cutler—Mr. J. E. Bingham—is the originator of the enterprise.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE iron market held at Middlesbrough on Tuesday last was but thinly attended, and the tone was less cheerful than on the previous Tuesday. Merchants have reduced their price for No. 3 G.M.B. to 33s. 9d. per ton, and even makers are now to be found who were willing to take 34s. Still consumers do not buy in quantity; they take only small lots and for immediate delivery. The leading makers, who seem to be fairly well supplied with orders, have not lowered their quotations. They continue to quote 34s. 3d. to 34s. 6d. per ton for No. 3 G.M.B., and in a few cases the former figure was obtained on Tuesday. The demand for forge iron is steady, and the price is well maintained at 33s. 3d. per ton.

Warrants are offered at 33s. 6d. per ton, but there are no buyers.

The stock of Cleveland pig iron in Messrs. Connal and Co.'s store in Middlesbrough has undergone no change. It amounted on Monday last to 50,833 tons.

April shipments of pig iron from the Tees amounted on Monday last to 44,683 tons, which is much less than in the corresponding period of previous years. Scotland is taking large quantities, but very little is being sent abroad.

The demand for finished iron is improving, and the prices asked by makers are now more freely given. Ship plates are £4 17s. 6d. to £5 per ton, according to specification. Angles are £4 12s. 6d. to £4 15s., and common bars about £5, all free on trucks at makers' works, less 2½ per cent. discount. The steel plate trade continues active. The price asked is £7 per ton free on trucks. Steel rail makers are fairly well employed, and prices remain at £4 15s. per ton.

It is stated that Messrs. Gray and Gladstone are about to make extensive alterations to the Hartlepool Rolling Mills, in order to adapt them to the manufacture of steel.

The shipping trade at the northern ports shows a decided improvement. Steamers which have been laid idle at Hartlepool and in the Tyne for many months have recently found employment, and others are being prepared for sea. Freights are advancing in several directions.

The accountant's certificate as regards the Cumberland coal trade has just been issued. The average net selling price of coal for the three months ending March 31st was 4s. 11·39d. per ton, and miners' wages will, in consequence, be reduced 1¼ per cent.

The salt industry continues to attract considerable attention at Middlesbrough. There are, however, only two bore holes actually in operation at the moment, and both of these belong to Messrs. Bell Brothers, of Port Clarence. Another, which was the first successful one put down, is inoperative, owing, it is supposed, to the tube lining it, or to the internal concentric tube up which the brine passes, having broken short off at a considerable depth. Hopes are entertained that the difficulty will be overcome eventually; but how, or when, is not at present apparent. Meanwhile, other bore holes are being proceeded with by various companies, and by the end of the year it is expected that at least a dozen will be in beneficial use.

Mr. Worsdell has just been appointed locomotive superintendent of the North-Eastern Railway, in succession to Mr. Macdonell, and previously Mr. Fletcher. Mr. Worsdell will find a wide field for usefulness and for the exercise of his well-known talents as an engineer. He has had, among other things, experience on the Great Eastern Railway in the lighting of trains by electricity. The means there employed are a "Tower" engine coupled direct with a Crompton dynamo, both being mounted on the locomotive, and having the various train lights connected direct without the intervention of an accumulator. As soon as Mr. Worsdell's appointment was announced, habitual passengers on the North-Eastern began at once to promise themselves at no distant date substantial improvement in the above direction. The lighting, as well as the warming, of the Northern carriages has hitherto been as bad as it could possibly be.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been considerable activity in the iron market this week, the transactions being largely, however, of a speculative nature. Prices advanced in the warrant market last week mainly in the belief that the Monkland Iron Company might go into liquidation, and that its blast furnaces would, therefore, be extinguished. The effort to accomplish this purpose has been defeated, and the consequence has been large sales of warrants and a depression of prices. Shipments are larger than for a series of weeks, amounting to 10,820 tons as compared with 5090 in the preceding week and 9403 tons in the corresponding week of last year. The stocks in Messrs. Connal and Co.'s stores show a decrease of 560 tons on the week. There are ninety furnaces in blast against ninety-two twelve months ago.

Business was done in the warrant market on Friday at 42s. to 41s. 11½d. cash. The tone was easier on Monday with transactions from 41s. 11d. to 41s. 6d. cash. On Tuesday the quotations were 41s. 7d. to 41s. 8d. cash. Business was done on Wednesday at 41s. 6d. to 41s. 7½d. cash. To-day—Thursday—transactions occurred at 41s. 8½d. to 41s. 8d., closing at the latter price.

The values of makers' iron are steady as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s.; No. 3, 46s. 6d.; Coltness, 53s. and 50s.; Langloan, 53s. and 50s.; Summerlee, 50s. 6d. and 46s.; Calder, 51s. 6d. and 46s.; Carnbroe, 48s. and 45s. 6d.; Clyde, 46s. 9d. and 42s. 9d.; Monkland, 42s. and 40s.; Quarter, 41s. 9d. and 39s. 6d.; Govan, at Broomielaw, 42s. and 40s. 6d.; Shotts, at Leith, 50s. 6d. and 50s.; Carron, at Grangemouth, 52s. 6d. and 47s.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 48s. and 42s. 3d.; Eglinton, 43s. and 39s. 6d.; Dalmellington, 46s. and 42s. 6d.

Two of the new belted cruisers to be built for the Admiralty have come to the Clyde, Messrs. Robert Napier and Sons having obtained the contract. The time allowed for their construction is two years and nine months.

Locomotive engineers have been very busy, and they are despatching valuable lots of engines and tenders to India and other countries. Founders have also been turning out considerable supplies of sleepers and chairs, also for railways abroad. The malleable iron trade is quiet, and prices continue low.

In the past week the shipments of iron and steel manufactures from Glasgow have embraced the hull of a steamer, valued at £3050, for Rangoon, £1100 locomotive fittings for Bombay, £3200 machinery for different places, £1094 sewing machines, £1650 steel goods, and £23,520 iron manufactures, of which £7650 were pipes, plates, &c., for Melbourne, £5650 railway sleepers, &c., for Calcutta, and £5170 ditto for Bombay.

Although certain departments of the coal trade have been much hampered by the difficulties with Russia, there has been a fairly satisfactory business in the course of the week, the requirements of the timber fleet now leaving the Clyde for Canada helping to keep up the amount of the shipments. From Glasgow the shipments have been good; at Greenock 3728 tons were despatched; Irvine, 2049; Ayr, 4478; Troon, 7484; and Grangemouth, 9958. Notwithstanding the unfavourable inquiry during March, the total shipments at all the ports to date are about 70,000 tons ahead of what they were twelve months ago. Offers are now being received for gas coal, and it is expected that contracts will be fixed at good prices, because the demand for good cannels on the part of England has recently been increasing. With milder weather the domestic inquiry is slackening, but there is a fair business in steam and manufacturing sorts. Prices are still very moderate.

The Admiralty Coaling Commission, consisting of Admiral Grant, C.B., Captain R. B. Batt, R.N., Mr. Berneys, superintending civil engineer, Chatham Dockyard; Mr. Gilbert, naval storekeeper, Portsmouth; and Mr. Richards, Paymaster-in-Chief, Royal Navy—have visited Glasgow and Greenock within the past few days, with the object of collecting information in order to determine the best type of collier suited for coaling vessels of the Navy. They were cordially received by the different shipowners and builders whose premises and appliances they inspected.

The miners of Mid and East Lothian have this week held a meeting at Dalkeith, to consider what course they ought to pursue with reference to the reduction of 10 per cent. just made in their wages. As the men have no proper organisation, it is not expected they will be able to do more than formally protest against the reduction.

Messrs. Andrew and James Stewart, of the Clyde Tube Works, Glasgow, have now completed their contract for fifty miles of 4in. malleable iron water pipes, to be laid down alongside the Suakim and Berber Railway.

Eleven of the thirteen stern-wheel steamers built by Messrs. Elder and Co., of Glasgow, for the Nile have now been despatched, and the remaining two will be ready immediately. Messrs. Barclay, Curle, and Co. have received an Admiralty order to construct a dozen life cutters for the ships of the Navy. A series of private orders have also been booked by Clyde shipbuilders within the past few days, but there are still many shipyard artisans unable to find employment.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

COAL contracts continue to be made, and this week I hear that the Western Railway Company of France has placed important ones with some of the leading firms. Algiers, too, is coming to the front, and if one could get rid of the fear that hostilities are about to break out, spring prospects would wear a better aspect than they did a few weeks ago. Now, it must be admitted that there is a grave feeling of concern about, and in the face of increased Mediterranean freights, trade is anything but buoyant. The coal clearances from Cardiff show a total of 129,768 tons; those of Newport, 33,421 tons; and those of Swansea, 40,781 tons for the week. Swansea at present exhibits more excitement than is shown at the other Welsh ports, and this is due to its greater trade with Russia. Last year, for instance, there was exported from Swansea to Russia 1,500,000 tons coal and patent fuel and 206,107 tons of metal. This represented in cash something like £748,335, and materially justifies an interest in the continuation of peace.

Complaints are rife at Swansea of a lessened patent fuel trade, and some speculative movements in the iron trade have been deferred temporarily. In imports there has been a good deal of briskness, and during the week 119 vessels came in with 22,104 tons register.

In the Rhondda Valley all that can be said is that prices for 4 feet No. 2 and 3 are moderately firm, but that little comparatively is being done. If the present condition of things had existed when Barry projects were to the fore, it would have had a great effect on that speculation. I fear there is more zeal and energy shown in the contracts than is felt by promoters.

The coal traffic to London from South Wales has shown a falling off last month; there was a better trade than this, and it was thought that the strike in the north would have improved our position, but this has not been realised. Last month the Midland took 1500 tons from the Aberdare pits; the London and North-Western, about 8000 tons; the Great Northern, 3000 tons principally from Aberdare; and the Great Western Railway, 5500 tons from the Aberdare Iron Company, and 2400 tons from Aberdare-Merthyr.

House coal is very stagnant. Shippers are getting in larger quantities of iron ore than I recorded last week, but trade is quiet and prices show less animation.

In pitwood receipts of stocks have been fewer, and the result is a better tone in the market, and prices are firm at 17s. 6d. Mr. Crawshay is cutting down a large extent of pitwood timber, and will be practically independent of the trade for years to come, though the requirements at Gethin and at Castle Pit, without naming Cwm, where a brittle 6ft. coal is worked, are considerable.

No improvement has taken place in any branch of the iron trade, and but for rails for Canada and some home business things would be duller than ever. There are fears of partial stoppage at Pentyrea furnaces near Cardiff, and I should not be surprised, though there and at Melingriffith business has been carried on—principally with Holland—for some time, when other works, such as Treforest, have had to close.

In the managerial changes at ironworks which have taken place of late, it is pleasant to note the good feeling between the agents. In taking the position at Rhymney Steel Works, held until lately by Mr. D. Evans, Mr. B. Jones was *fêted* and presented with a valuable testimonial of the respect in which he is held by Dowlais agents; and now Mr. Evans himself, who has accepted an important post at Barrow-in-Furness, is on the eve of being presented with silver plate of the value of £300. Such a presentation, subscribed to by leading agents and firms all over the country, well attest the esteem in which he is held.

Advices from Liverpool have imparted more activity to our tin-plate works during the last few days. For the ordinary brands of coke-plate the demand has not improved, but there is an improvement in Bessemer and Siemens best steel plates.

Prices continue to rule very reasonably, and should tempt to increased briskness. Bessemer remain at from 13s. 9d. to 14s. I.C., and best steel 14s. 6d. for carefully assorted specifications. Ordinary cokes keep at 13s. 6d., and buyers are doing their best to force these prices lower; but the fact of this only leaving a thin margin of profit, if any, gives every stimulus to resistance. Forward sales are few at Llanelly and Swansea.

A meeting was held at Swansea last Saturday amongst the tin-plate men, when it was resolved that the general secretary make an effort to clear off the Association debt. The meeting condemned the action of the Vernon and Rhiwderin men for remitting two days' wages to their employer, and agreed to subscribe towards the support of those who objected.

One point, and an important one, was in the meeting denouncing certain new patents, which the men regarded as highly injurious to health. These patents require the use of glycerine, sal ammoniac, and muriatic acid, or spirits of salts, which they voted to be "obnoxious stuff," and to be condemned.

There has been a successful inauguration of telephonic facilities at Newport between the shipping offices of Dock-street and the Alexandra Dock, and in celebration of the event the officials of Newport and Cardiff, between whom there is the most friendly feeling, exchanged hearty congratulations.

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 number of the Specification.*

Applications for Letters Patent.

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

14th April, 1885.

4562. MEASURE TAP, W. Edwin and C. Bailey, Wolverhampton.
4563. UTILISING BLAST FURNACE SLAG, F. W. Gerhard, Wolverhampton.
4564. SHAPING SOLID SUBSTANCES, J., C., and P. Corcoran, and W. P. Scott, Manchester.
4565. RAPIDLY PRINTING NEWS, W. Curthoys, Wolverhampton.
4566. CHEAP CEILING VENTILATOR, J. E. Barwick, St. Peter's.
4567. AIR MOTORS, W. S. Sutherland, Liverpool.
4568. REVOLVING FRAMED CURTAIN, G. A. Labottiere, Lewisham.
4569. BOILERS, &c., A. McDougall, Penrith.
4570. ROTARY ENGINES and PUMPS, W. B. Sayers, Birmingham.
4571. MACHINERY for PRODUCING SCARFED or BEVELLED STRIP, J. H. Bullock, Pelsall, and T. Brown, Walsall.
4572. FIRE-ESCAPES, T. H. Ward, Tipton.
4573. FASTENER for HAMPERS, CASES, &c., J. Rowlatt, Leicester.
4574. EXTRACTING PHOSPHATES, W. P. Thompson.—(*G. Hoyermann, Germany.*)
4575. PERMANENT COFFIN FITTINGS, S. A. Harris, Wolverhampton.
4576. DRY SAND CORES, H. J. Allison.—(*J. H. Blessing, U.S.*)
4577. SILOS, J. S. Robertson, Glasgow.
4578. CORKS, &c., H. G. Jacobsen, Glasgow.
4579. LOCKING-UP PRINTERS' FORMES, J. Beall, Newcastle-on-Tyne.
4580. TRANSMITTING AIR UNDER PRESSURE, J. McInnes, Glasgow.
4581. STEAM ENGINES, E. G. Colton.—(*G. Schuhmann, U.S.*)
4582. DESCRIBING ELLIPSES, G. P. Grace, London.
4583. PROTECTED SEAM LAWN TENNIS BALL, J. Neville, London.
4584. GALVANISING BATHS, T. Minnis, London.
4585. REGULATOR of CARBON POINTS, L. Eidlitz, New York.
4586. WASHING WOOL, A. Deletombe, London.
4587. PADS for COUNTERACTING the END THRUST and the WEIGHT of SHAFTS, A. H. Reed.—(*V. H. Hallock and F. D. Newton, U.S.*)
4588. COMBING MACHINES, G. Wilkinson, London.
4589. ALARM CLOCKS, A. W. L. Reddie.—(*The Ansonia Clock Company, U.S.*)
4590. NON-METALLIC RECEPTACLES, F. Braden, London.
4591. PIPES for SMOKING TOBACCO, &c., F. Braden, London.
4592. RESERVOIR HOLDERS for LAMPS, &c., A. J. Boult.—(*M. Matthews, Canada.*)
4593. FINISHING of COTTON FABRICS, G. W. C. Kirkham, London.
4594. END GATES for WAGONS, T. S. Stewart and H. R. Josselyn, London.
4595. BOTTLE STOPPERS, A. J. Boult.—(*C. de Quillfeldt and J. Mersereau, U.S.*)
4596. AUTOMATIC BILL or INVOICE DISTRIBUTOR, W. A. Rees, London.
4597. GAS BAGS, C. K. Farquharson and R. R. Gubbins, London.
4598. CUTTING GRAIN, F. Lange, Germany.
4599. CLEANING DOMESTIC UTENSILS, &c., T. Warwick, London.
4600. LAMP GLASS or GLOBE HOLDERS, G. L. Holloway and H. Stanning, London.
4601. LEGGING and GAITER FASTENERS, G. L. Holloway and H. Stanning, London.
4602. BALL CARTRIDGES, J. H. Johnson.—(*R. Selebam, France.*)
4603. FASTENING for SECURING RAILS to SLEEPERS, J. Kerr, London.
4604. IRONING MACHINES, J. Ritchie, Glasgow.
4605. BREAKING PIG IRON, F. Sharpe and M. H. Simpson, London.
4606. PERMANENT WAY of RAILWAYS, C. D. Abel.—(*J. B. Caramin and Co., Belgium.*)
4607. BANDS for SECURING BOXES, &c., W. R. Lake.—(*G. Nicholsen, United States.*)
4608. INDIA-RUBBER TIRES, I. B. Harris, Fountainbridge.
4609. PLASTERS for the SKIN, H. J. Haddan.—(*T. A. Abbott, United States.*)
4610. SPINDLES, H. J. Haddan.—(*E. Eggeling, Germany.*)
4611. GAS PRESSURE REGULATORS, H. J. Haddan.—(*E. Derval, France.*)
4612. GUARDS and RESTS for FORKS, H. Harrison, London.
4613. FURNACES, R. McQ. Weir, United States.
4614. FASTENINGS for SHUTTERS, &c., A. M. Clark.—(*J. Von Hollen, U.S.*)
4615. NUT MAKING MACHINES, A. M. Clark.—(*T. Neely, United States.*)
4616. FURNACES, A. M. Clark.—(*F. Egner, U.S.*)
4617. THIMBLES, A. M. Clark.—(*W. P. Slensby, U.S.*)
4618. AERIAL TRANSPORTATION of EXPLOSIVES, &c., A. M. Clark.—(*M. L. S. Buckner, U.S.*)
4619. STONE and ORE CRUSHERS, A. M. Clark.—(*D. Brennan, jun., and G. G. Young, United States.*)

15th April, 1885.

4620. FEEDING STEAM BOILERS with WATER, J. Gresham, Manchester.
4621. SEATING, T. Griffith, Manchester.
4622. STOP MOTION for DOUBLING FRAMES, S. Crabtree, Bedford.
4623. FIRE-LIGHTERS, J. H. Crosby, Liverpool.
4624. POCKET CUTLERY, A. Pilley and A. B. Ball, Sheffield.
4625. TRANSPARENT LUBRICATORS, A. Bradshaw, Halifax.
4626. DYEING and RINSING WOOL, &c., H. Webster, Halifax.
4627. DOOR SPRINGS, J. Watt, Glasgow.
4628. TRAVELLING by ROAD, E. Francis, Z. J. Francis, and F. D. Barritt, Nottingham.
4629. VENTILATORS, J. Miller, Edinburgh.
4630. OPENING DOORS from the INSIDE, R. Roberts, Manchester.
4631. GALVANIC BATTERIES, R. F. Yorke, Derby.
4632. STEEL PENHOLDERS, W. Wilson, Newcastle-on-Tyne.
4633. DAMPING APPLIANCE, W. Wilson, Newcastle-on-Tyne.
4634. PERMANENT WAY of RAILWAYS, W. Stobbs, London.
4635. EMERY WHEELS, W. Stobbs, London.
4636. DISINFECTING APPARATUS, R. Heneberg, London.
4637. COUPLINGS, T. H. Wilkinson and H. Whittingham, Hanley.
4638. BILLETLESS DRIVING REINS, E. W. Gough, Bloxwich.
4639. COAL VASES, W. Sames, Birmingham.
4640. AUTOMATIC GOVERNOR, J. Bird, Liverpool.
4641. TREATMENT of CIGARS, A. T. Booth, London.
4642. LUBRICATOR, J. Tennant, London.
4643. PORTABLE DRY-EARTH CLOSET, G. H. Ellis, South Devon.
4644. COMPENSATING APPARATUS for RAILWAY SIGNAL WIRES C. Wise, Bermondsey.
4645. SHEARING and CUTTING MACHINE, H. H. Leigh.—(*J. M. Mary, France.*)
4646. SASH FASTENINGS, E. Showell, London.
4647. ELECTRIC ARC LAMP, H. Pieper and Sons, London.
4648. DIRECT-ACTING STEAM PUMPS, J. H. Johnson.—(*E. Körting, Hanover.*)
4649. STEERING GEAR for FISHING BOATS, J. D. Jack, Glasgow.
4650. SOCKET, W. Hamilton, Glasgow.
4651. DRESSING MILLING CUTTERS, &c., H. J. Haddan.—(*J. E. Reinecker, Saxony.*)
5652. CUTTING and SHAPING METALS, H. Greenwood, London.
4653. HOLDING and STRETCHING TROUSERS, E. Newton, London.
4654. TRUSSES, A. J. Boult.—(*J. Hec, France.*)
4655. LUBRICATING CERTAIN PARTS of MACHINERY, J. Paton, London.
4656. NEEDLE, G. H. Hughes, London.
4657. HARVESTER BINDERS, A. J. Boult.—(*H. S. Blackburn, Canada.*)
4658. GAFFING or LANDING SALMON, &c., E. L. Berthon, London.
4659. PRESSES for LAWN TENNIS RACKETS, &c., F. Bryan, London.
4660. ROTARY FANS, H. Aland, London.
4661. MECHANISM of FLUTES, &c., C. A. Drake, London.
4662. STIRRUP IRONS, R. Wright, London.
4663. AUTOMATIC OPENING, &c., of VENTILATORS, B. Boothroyd, London.
4664. GEARING for TRANSMITTING MOTIVE POWER, J. Robertson, Glasgow.
4665. STOKING, &c., BOILER FURNACES, J. N. Wilson, Glasgow.
4666. BOILER and other FURNACES, J. S. Booth, London.
4667. TYPE-WRITERS, A. M. Clark.—(*S. S. Burt and A. B. Wood, U.S.*)
4668. ORNAMENTING WALL, &c., PAPER, W. V. Wilson, London.
4669. ACETATE of AMYL, W. V. Wilson, London.
4670. LOADING, &c., COAL and other CARGOES, G. Taylor, London.
4671. ELEMENTS for VOLTAIC BATTERIES, D. G. Fitz-Gerald, London.
4672. SEATS and DESKS, S. Pitt.—(*H. G. C. Holscher, Saxony.*)

16th April, 1885.

4673. ADJUSTABLE CLIP HOOK or EYE, F. H. White and H. Chantler, Liverpool.
4674. OPENING INTERNALLY STOPPERED BOTTLES, W. Vaughan, Birmingham.
4675. RIMS of WHEELS for BICYCLES, &c., J. Hudson, Birmingham.
4676. STEERING of VELOCIPEDES, J. T. Anyon, Manchester.
4677. COMBINED DISINFECTING and FUMIGATING COMPOUND, T. Stoner and J. Turton, Bradford.
4678. STEAM BOILERS, R. Dalgliesh and T. Claridge, Asfordby.
4679. HORSE CLIPPER, J. T. Parslow and T. Emmett, Kingston-on-Thames.
4680. PRODUCING MOTIVE POWER by a BLAST MACHINE, T. Stockley, Southsea.
4681. VENTILATING PIPE and CAP, J. E. Barwick, St. Peter's, Kent.
4682. TOPS of BOTTLES and FLASKS, J. Meeson, Sheffield.
4683. HOLDERS for BALLS of THREAD, A. Barr, Glasgow.
4684. MOTORS WORKED by COMBUSTIBLE GAS, G. H. Garrett, Glasgow.
4685. LADIES' STAYS and CORSETS, M. Bentham, Birmingham.
4686. BRONZING and DUSTING PAPER, D. and A. Dodds, Manchester.
4687. SHAFTS for TRANSMITTING POWER, T. H Arrowsmith, Manchester.
4688. SUPPORT for INCANDESCENT LAMP SHADES, A. Swan, Gateshead-on-Tyne.
4689. WOVEN BAGS, F. Baynes and J. Whalley, Manchester.
4690. PISTONS and STUFFING-BOXES, A. T. Allen and H. Cavill, London.
4691. SELF-ADJUSTING CANDLE PROTECTOR, W. Wigfield, London.
4692. DRILLING HOLES in COAL, R. Hudson, Blyth.
4693. STOPPERS for BOTTLES, O. E. Pohl, Liverpool.
4694. FASTENING BOOTS, J. Smith, Stoke-upon-Trent.
4695. RIFLE SIGHT ELEVATORS, F. Osborne, Sutton Coldfield.
4696. ADJUSTABLE PROP for MINES, S. Morgan, Birmingham.
4697. FUR BLOWERS or PICKERS, T. and S. Buckley, London.
4698. CARDBOARD RESTERS, &c., for PACKING HATS, G. Downs, London.
4699. PREVENTING ACCIDENTS to MACHINERY, &c., R. Hitchen, J. T. Pearson, and T. Richmond, Burnley.—*5th January*, 1885.
4700. CLOSING GATES, G. G. Blane, near Windsor.
4701. CHECKING of FRAUD in CARRIAGE FARES, P. L. le Duc, London.
4702. GRAND PIANOFORTES, &c., W. H. Beck.—(*H. Wolffram, Germany.*)
4703. SELF-ACTING TAP HOLE PROTECTOR for CASKS, J. McKinless, Manchester.
4704. BUTTONS, A. S. Mumford, London.
4705. AUTOMATIC TIDAL SEALING VALVE and FLOAT, J. Horne, London.
4706. METALLIC LEAD, W. E. Gedge.—(*S. Trayner, Spain.*)
4707. REVOLVING SAFETY GEAR, F. Sikes, London.
4708. METALLIC BUTTON FASTENER for BOOTS, J. J. Perkins, London.
4709. BROOCHES, I. Greenbury, Glasgow.
4710. NON-CONDUCTING COMPOSITION for PROTECTING BOILERS, &c., M. Keenan, London.
4711. PROTECTING BOILERS, CYLINDERS, &c., M. Keenan, London.
4712. METALLIC SLEEPERS, &c., for RAILWAYS, H. Bankart, London.
4713. SEWING MACHINES, H. J. Haddan.—(*The Nähmaschinenfabrik vorm. Frister and Rossmann, Germany.*)
4714. DISINFECTING, H. J. Haddan.—(*G. Langbein, Saxony.*)
4715. SCREW PROPELLERS, J. H. Johnson.—(*N. Yagn, Russia.*)
4716. CRICKET BATS, W. Sykes, London.
4717. COMMUTATING CIRCUITS, H. P. Holt and A. I. Jones, London.
4718. FEEDING SHEETS of PAPER to PRINTING, &c., MACHINES, W. R. Lake.—(*The Sedgwick Manufacturing Company, U.S.*)
4719. STEAM VACUUM PUMPS, W. R. Lake.—(*G. H. Nye, U.S.*)
4720. WALL BRACKETS and SUSPENSIONS, J. G. Stapleton, London.
4721. PNEUMATIC DOOR CHECK SPRING, J. C. Fell.—(*F. I. Gazaix, France.*)
4722. CUTTING PILE FABRICS, T. Millward, London.
4723. AERIAL ELECTRIC SIGNALLING, F. J. Micklewright, London.
4724. FRAMES for BAGS, &c., E. Pfeiffer.—(*MM. Hupp and Bender, Germany.*)
4725. COMPOUND ENGINES, H. Dansey and O. Robinson, London.

17th April, 1885.

4726. WINDOW SASH FASTENER, R. Jones, Birmingham.
4727. TRELLISED FIRE FRONT for RANGES, &c., M. Bousfield, York.
4728. FLEXIBLE STAY for FIRE-BOXES, W. Leach, East India.
4729. MINERS' SAFETY LAMP, W. Hemingway and H. Joyner, Barnsley.
4730. CENTRE PIECE of SWIVELS, J. Warner, Redditch.
4731. DRIVING BELT, J. H. Butterworth, A. Peverley, and R. Binnall, Rochdale.

4732. Connecting Hames, H. C. Lory, Liverpool.
4733. Pulping Knives, M. Prior, Sheffield.
4734. Obtaining Multiple Copies of Writing and Designs, A. Paget, Loughborough.
4735. Biscuit Sandwiches, W. Wright, London.
4736. Venetian Blinds, A. Squire, London.
4737. Stoppers for Bottles, E. Woodham and P. Ockenden, London.
4738. Getting or Mining Clay, J. H. Key, London.
4739. Safety Attachments for Lifts, &c., J. Archer, London.
4740. Stoppers for Aerated Water Bottles, C. McDonald, London.
4741. Rotary Engines, J. Hick and F. Phillips, London.
4742. Heels of Boots and Shoes, T. P. Millett, London.
4743. Beaters for Blowers, &c., W. Allday, jun., E. Allday, and J. Watkins, Birmingham.
4744. Iron and Steel, F. J. P. Cheesbrough, Liverpool.—(*A. Hansen, Germany.*)
4745. Galvanic Cells, S. Raudnitz, London.
4746. Metallic Expanding Gas Bags, W. Adkins, Birmingham.
4747. Heat-retaining Jackets for Steam Pipes, &c., F. Schulte, London.
4748. Insect Destroyer and Soil Fertiliser, T. H. Sclater, Orkney.
4749. Self-acting Flushing Apparatus, E. R. Palmer, London.
4750. Paving Blocks, A. T. Elford, San Francisco.
4751. Earth-closet Apparatus, J. D. Garrett, London.
4752. Chilled Castings, T. Cooper, London.
4753. Vessels for Food and Liquids, J. Kendrick and S. B. Depree, London.
4754. Printing on Wall Paper, &c., G. W. Osborn, London.
4755. Pegs for Stringed Musical Instruments, T. E. Gatehouse, London.
4756. Securing Milk-cans to Doors, H. P. Lavender, London.
4757. Balls for Lawn Tennis, &c., C. Malings, London.
4758. Starch, B. H. Remmers.—(*L. von Wagner and A. Gillitzer, Austria.*)
4759. Sash Bars, W. H. Luther, Glasgow.
4760. Rolling, &c., Nails, P. Jensen.—(*J. Berglund, Sweden.*)
4761. Crabs, Capstans, Winches, &c., R. J. Rudd, London.
4762. Ventilators for Railway, &c., Carriages, A. Miller, London.
4763. Exercising the Muscles, J. Carter, London.
4764. Drying and Coating or Varnishing Metal Plates, J. Lysaght, London.
4765. Wicks for Oil Lamps, &c., S. Hallett, London.
4766. Looms for Weaving, W. R. Lake.—(*C. Pearson, United States.*)
4767. Looms for Weaving, W. R. Lake.—(*C. Pearson, United States.*)
4768. Looms for Weaving, W. R. Lake.—(*C. Pearson, United States.*)
4769. Thermometric Apparatus, A. G. Brookes.—(*E. W. Upton, United States.*)
4770. Securing Heels to Boots and Shoes, A. G. Brookes.—(*N. W. Bingham, United States.*)
4771. Wiring Interiors for Electric Light, &c., B. J. B. Mills.—(*L. Stieringer and J. H. Vail, U.S.*)
4772. Brakes, W. J. Vicary, London.
4773. Handles of Cricket and other Bats, W. H. Cook, London.
4774. Fastening for Corsets, &c., A. Combault, London.
4775. Stopper for Bottles, &c., J. C. Schultz, London.
4776. Storing Power, A. M. Clark.—(*M. Honigmann, Germany.*)
4777. Combined Public Tea or Coffee House, W. Muir, London.

18th April, 1885.

4778. Finishing Machine for Leather, H. S. Barrow, J. Bostock, and G. A. Hardy, London.
4779. Driving Marine Screw Propellers, G. F. L. Davis, Caversham.
4780. Facilitating the Copying of Designs, W. Rigg, Bradford.
4781. Cabinet for Works of Art, F. J. E. Hine, Birmingham.
4782. Vices, T. Hunt, C. Pegg, and F. Turland, Nuneaton.
4783. Bottling Aerated Waters, W. Fairhurst, Liverpool.
4784. Screw Propellers, J. Belduke ("Bolduc") Liverpool.
4785. Straight Rulers, J. S. Downing, Birmingham.
4786. Photographic Dark Slides, E. Marlow, Birmingham.
4787. Forming a Galvanic Battery, R. F. Yorke, Derby.
4788. Boiler Alarm and Water Indicator, J. T. Robson, Middlesbrough-on-Tees.
4789. Rope Clip, J. Ward, Birmingham.
4790. Grids of Carding Engines, D. Hall and J. H. Kay, Manchester.
4791. Clothing for Animals, R. J. C. Mitchell, Manchester.
4792. Looms, W. Smith, Manchester.
4793. Chasing Tool, T. Bramwell, Manchester.
4794. Expanding Roller, J. B. Horrocks, Manchester.
4795. Grease Traps, S. H. Adams, York.
4796. Delivering Circulars, &c., J. S. Rubinstein, London.
4797. Steam Safety-valves, &c., I. and S. Smith, London.
4798. Artificial Fuel, S. Butler, London.
4799. Brake, I. Marsden, Manchester.
4800. Governing Speed of Engines, J. G. Jones, London.
4801. Scavengers' Carts, R. C. Sayer, Newport.
4802. Disinfecting Powder, J. B. Austin, London.
4803. Low-water Safety Valves for Boilers, J. H. Dewhurst, London.
4804. Drawing Cans for Cotton, &c., J. Whitworth, London.
4805. Taking-up Bands in Spinning, &c., Machinery, D. and S. Ledray and R. C. Hudson, Halifax.
4806. Ironing, &c., Hats, W. E. Gedge.—(*L. Raymond fils, France.*)
4807. Wheels, E. Perrett, London.
4808. Stopping and Starting Tramcars, &c., W. S. Holden, London.
4809. Electrical Storage Batteries, S. Norris.—(*C. P. Orne, United States.*)
4810. Reversing and Expansive Apparatus for Steam Engines, A. L. Daviess, London.
4811. Pressing Apparatus, T. Smith, London.
4812. Elastic Wheel Tires, H. Barrett and J. J. Varley, London.
4813. Bed Plates for Brick Moulds, J. T. Bower, London.
4814. Stamp Affixers, G. W. Schimmel, London.
4815. Electric Thermo-telemetry, J. G. Lorrain, London.
4816. Preparing Metallic Plates for Printing, E. de Pass.—(*C. F. Jos, Germany.*)
4817. Thurming Articles, R. H. Manning, London.
4818. Wire Stand for Eggs, &c., C. Wakeman, Birmingham.
4819. Disinfecting and Deodorising Apparatus, J. M. B. Baker, London.
4820. Travelling Trunks, E. Faithfull, London.
4821. Opening Broughams and Landaulettes, &c., W. J. and R. H. Ridges, London.
4822. Pianos, H. Morris, London.
4823. Preserving Eggs, H. J. Haddan.—(*P. G. Wind and C. C. Lassen, Germany.*)
4824. Portable Fire Extinguishing Apparatus, S. P. Wilding.—(*Count J. A. Masclere, France.*)
4825. Roller Mills, W. R. Lake.—(*H. Seck, Germany.*)
4826. Spreader for Water-cans, E. Newton, London.
4827. Self-cleaning Cisterns or Tanks, E. Newton, London.
4828. Improved Boot, R. G. King, London.
4829. Railway Signalling Apparatus, J. Smith, Glasgow.
4830. Girders, R. A. Stoffert and T. Dykes, Glasgow.
4831. Screens of Purifiers for making Flour, S. Leetham and W. Raine, London.
4832. Stopper for Aerated Bottles, F. C. Roberts, London.
4833. Closing Bottles, J. S. Davison and T. Scott, London.
4834. Heating Vessels, C. Jones, London.
4835. Pumps for Producing Vacuum, P. Jensen.—(*L. A. Riedinger, Germany.*)

20th April, 1885.

4836. Shoe for Beasts of Burden, G. Dunn, London.
4837. Fluid Meter or Motor, J. Mactear, Glasgow.
4838. Silent Sausage and Pie Meat Cutters, W. G. Gregory, sen., Salford.
4839. Ploughs, T. C. Sargeant, Weedon.
4840. Miners' Safety Lamps, T. Marshall, Northampton.
4841. Transmitting Lights and Shadows, W. Gemmill, Drummore.
4842. Rotary Engines, R. E. Dickinson, London.
4843. Reservoir Penholder, E. Hussey, Birkenhead.
4844. Ring Spinning Machinery, B. Cohnen, Manchester.
4845. Reversible Electric Machine, J. Enright, London.
4846. Opening Internally Stoppered Bottles, F. Klouman, Liverpool.
4847. Centreing, &c., Hollow Metal Articles, E. Cope and A. Hollings, Liverpool.
4848. Mules, W. Houghton and E. Knowles, Halifax.
4849. Raising Railway Carriage Windows, C. Eagle, T. R. Keam, and A. Knowles, Birmingham.
4850. Lowering the Shuttle-boxes of Looms, H. Broadbent and W. Holroyd, Halifax.
4851. Locks and Latches, F. Brown and S. Guinery, Luton.
4852. Spinning, &c., R. Turpie, Manchester.—*7th April, 1885.*
4853. Caps, J. Paulus, London.
4854. Holder for Incandescent Lamps, H. Pieper, London.
4855. Excavating Scoop, S. Holmes, London.
4856. Printing, A. S. Rubinstein, London.
4857. Double-acting Pumps, A. Le Grand and R. Sutcliffe, London.
4858. Ruler, S. L. Tomkins, London.
4859. Cartridges, J. Richards, Kingston Hill.
4860. Differential Balance Gear for Tricycles, J. Derry, Birmingham.
4861. Chandelier Lamps, J. Phillips, London.
4862. Desks, G. M. Hammer and E. J. Hammer, London.
4863. Slubbing, &c., Cotton, &c., T. S. Whitworth, Manchester.
4864. Automatic Sight Feed Lubricator, J. Etherington, London.
4865. Boot-cleaning Machine, H. R. Snelgrove, London.
4866. Adjustable Screens, H. Shield and W. N. Crockett, Nottingham.
4867. Utilising Exhaust Steam, C. Oertling, H. Sauber, and G. Ludwig, London.
4868. Net and Rope Hauling Machines, J. McKidd, Glasgow.
4869. Domestic Fire-grates, R. Duncan, Glasgow.
4870. Magazine Guns, W. A. F. Blackeney, Glasgow.
4871. Pickers for Looms, W. Fairweather.—(*C. Rencken, Germany.*)
4872. Applying the Steam Brake to Tramway Engines, &c., W. P. Green, London.
4873. Window, &c., Fastening Bars, W. Leggot, London.
4874. Water Tire for Forge Hearths, L. A. Groth.—(*C. Frémont, France.*)
4875. Nails, W. R. Lake.—(*MM. Russell and Erwin, United States.*)
4876. Umbrellas, A. Löwengard London.
4877. Folding Invalid Board for Bath Chairs, W. H. Brigden, Brighton.
4878. Nails, W. R. Lake.—(*MM. Russell and Erwin, United States.*)
4879. Guns and Gun Barrels, W. R. Lake.—(*W. H. Brown, United States.*)
4880. Type Writers, J. W. Tasker, Balham.
4881. Form of Metal Rods, &c., from Rails, &c., L. Mannstaedt, London.
4882. Air Refrigerating Apparatus, O. J. Ellis, London.
4883. Caulking Tool worked by Fluid Pressure, G. A. P. H. Duncan, London.
4884. Covers for Jars, W. Bartholomew, London.
4885. Joint for Mouthpieces and Stems of Tobacco Pipes, W. H. Sharman, London.
4886. Sashes of Railway, &c., Doors, &c., J. Eaton and F. S. Morris, London.
4887. Toy, J. H. Johnson.—(*G. Hébert, France.*)
4888. Urinal and Drainage Traps, T. M. Lowndes, London.
4889. Crucibles, Muffles, &c., F. Maxwell-Lyte, London.
4890. Implement for Hoeing, &c., J. Le Patourel and T. Le Poidevin, London.

SELECTED AMERICAN PATENTS.

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

313,419. Automatic Fire Kindler, *Peder T. Hamborg, Grand Rapids, Mich.—Filed December 17th, 1883.*

Claim.—(1) In a fire lighter, a device adapted to be placed within a stove, or made as part thereof, consisting of a match holder, a match held therein in an inclined position, and a slide for igniting the same, and connections between said slide and an alarm clock, whereby said slide is drawn from beneath the match

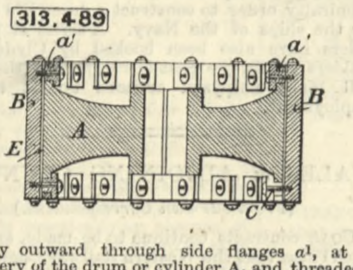
313,419

at stated time, for the purpose set forth. (2) In a fire lighter, a match holder, a slide containing roughened surface beneath the same, and a weighted connection with the hooked or screw-threaded end of the key of an alarm clock, whereby when said key is revolved when an alarm is sounded said weight is made to fall and ignite the match in the holder by the withdrawal of the slide, as described.

313,489. Commutator for Dynamo-electric Machines, *Warren P. Freeman, New York, N.Y.—Filed March 10th, 1884.*

Claim.—(1) A commutator for a dynamo-electric machine, having the commutator strips placed transversely on the periphery of the commutator drum or cylinder, and secured thereto by means of retaining screws passing radially through peripheral flanges at the sides of the said drum, the screws threaded in the said commutator strips, and placed with their heads toward the hub of the said drum or cylinder. (2) A commutator for a dynamo-electric machine, consisting of a drum or cylinder A, peripheral commutator strips B, secured thereto by insulated screws C, passing

313,489

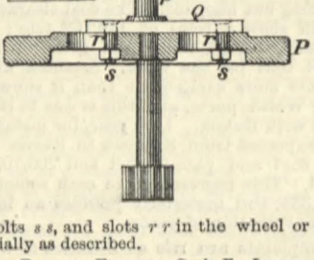


radially outward through side flanges a^1, at the periphery of the drum or cylinder A, and threaded in the said commutator strips, and insulating strip E and F, respectively separating the commutator strips from the drum or cylinder and from each other.

313,481. Crank Pin, *Willis G. Dodd, San Francisco, Cal.—Filed August 19th, 1884.*

Claim.—The combination of the adjustable plate Q,

313,481

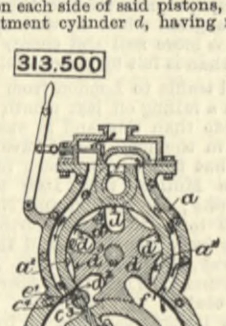


pin *p*, bolts *s s*, and slots *r r* in the wheel or disc P, substantially as described.

313,500. Rotary Engine, *Carl F. Jansson, Manchester, N.H.—Filed November 17th, 1884.*

Claim.—(1) In a rotary engine, the shell *a*, having cylindrical piston chamber a^1 and abutment chamber a^{11} opening into each other, combined with piston cylinder *c*, its piston c^3 c^3, and their cylindrical heads c^4 c^4, the abutment cylinder *d*, with its recesses d^{11}, surface concavities d^3, and intermediate projections d^4, and in and outlet passages e e^1 f f^1, leading to piston chamber a^1, as and for the purpose set forth. (2) The piston cylinder *c*, having pistons c^3 c^3 c^4 c^4 and concave recesses c^7 c^7 on each side of said pistons, in combination with abutment cylinder *d*, having recesses d^{11},

313,500

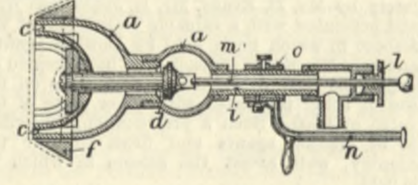


outer concavities d^3, and intermediate projections d^4, for the purpose of preventing escape of steam or water during the revolution of the engine, in a manner as herein set forth and described. (3) In combination with the piston cylinder *c*, its pistons c^3 c^4, and the abutment cylinder *d*, constructed in a manner as described, the inlet and outlet *e* and *f*, with their respective transverse channels e^1 and f^1, as and for the purpose set forth.

313,509. Flue Cleaner, *Fred L. McGahan, Indianapolis, Ind.—Filed May 23rd, 1884.*

Claim.—(1) A flue cleaner consisting of the following elements, namely: A tube having an inlet for steam, a hollow discharge jet secured to one end of said tube, a plate adapted to cover the open end of a flue and to slide over the exterior of said jet, and a valve seated within said discharge jet and connected with said

313,509

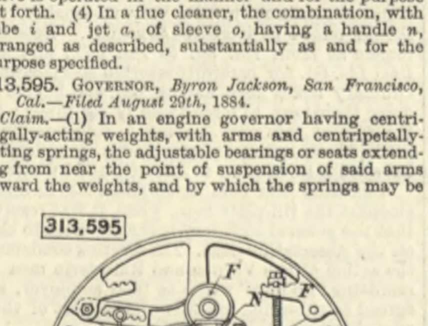


plate, all combined substantially as and for the purpose specified. (2) In a flue cleaner, the combination of discharge jet *a*, having annular openings *c*, valve *d*, and plate *f*, substantially as specified. (3) In a flue cleaner, the combination, with discharge jet *a*, tube *i*, and valve *d*, of stuffing-box *l* and rod *m*, whereby said valve is operated in the manner and for the purpose set forth. (4) In a flue cleaner, the combination, with tube *i* and jet *a*, of sleeve *o*, having a handle *n*, arranged as described, substantially as and for the purpose specified.

313,595. Governor, *Byron Jackson, San Francisco, Cal.—Filed August 29th, 1884.*

Claim.—(1) In an engine governor having centrifugally-acting weights, with arms and centripetally-acting springs, the adjustable bearings or seats extending from near the point of suspension of said arms toward the weights, and by which the springs may be

313,595

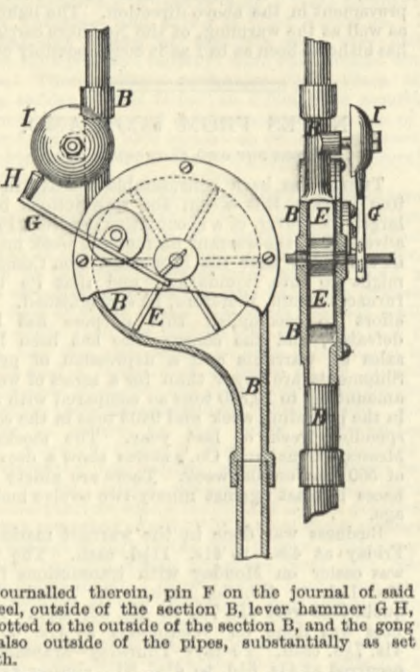


connected with the weight levers, the tension screw connected with the opposite ends of the spring, and the adjustable bearing or seats on the lugs I^1, with which the tension screw is connected, substantially as herein described. (2) In an engine governor having a movable excentric, centrifugally-acting weights, and return springs within the wheel or case secured to the shaft, the elastic buffers N and O, secured in the weight F, and boss J, substantially as herein described. (3) In an engine governor having movable excentrics, centrifugally-acting weights, and return springs within a wheel or case secured to the shaft, and a crank arm with its ends journalled in the exterior excentric, and the projecting boss J, and the elastic buffers O and N, substantially as herein described. (4) In an engine governor, an excentric movable about the engine shaft, the centrifugal-operating weights by which said excentric is moved, a second excentric fitted to and movable about the first, together with a crank or link, one end of which is journalled in the driving disc or wheel and the other end is journalled or loosely connected to a crank pin in the exterior excentric, whereby it is driven directly from the shaft and independently of the adjusting excentric, substantially as herein described.

313,658. Overflow Alarm for Water Tanks, *Frank A. Cushing, New York, N.Y.—Filed April 5th, 1884.*

Claim.—The combination, with the tell-tale pipe of a water tank, of the enlarged section B, with wheel

313,658

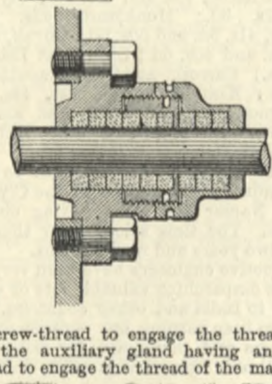


E journalled therein, pin F on the journal of said wheel, outside of the section B, lever hammer G H, pivotted to the outside of the section B, and the gong I, also outside of the pipes, substantially as set forth.

313,703. Stuffing-Box, *Thomas Barber, Flatbush, N.Y.—Filed June 5th 884.*

Claim.—The combination, substantially as hereinbefore described, with the body of the box having an internal screw-thread, of the main gland having an

313,703



external screw-thread to engage the thread of the body and the auxiliary gland having an internal screw-thread to engage the thread of the main gland.

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