NEWTON'S LAWS OF MOTION.

By PROF. OLIVER LODGE.

IT is very singular how persistently that little difficulty in understanding what is meant by the third law of motion crops up. It only arises from confusion in the use of terms, and to see the matter clearly needs no hyperphysical penetration as to whether stress is in its essence motion, nor mathematical subtlety of analysing a horse and cart into infinitesimal elements. If it were really difficult to understand so simple a matter as the propulsion of one body by means of another, poor chance should we have of grasping really complex problems. It is perfectly true that some of the present teaching of dynamics perpetuates, and, indeed, originates, the confusion; but a person is not limited to what he may find in books, and if we take the terms involved and observe where the ambiguity arises, I can assure anyone who will take the trouble to think and read carefully, and who has ordinary acquaintance with mechanical facts, that the term-generated confusion will vanish.

The difficulty commonly arises under one of two heads, sometimes under both. I shall call them respectively source of confusion No. 1, and source of confusion No. 2. Shortly stated, source No. 1 consists in carelessly using the term "motion" instead of "change of motion," and source No. 2 consists in thinking of *resistance* when the word *reaction* is employed—in other words, of foisting upon the term "reaction" the meaning of "resistance." These two sources of confusion will be traced home and laid bare in the sequel; and to this end let us consider some of the common terms in order, using no subtlety, drawing no fine distinctions but such as are forced upon us by facts, and giving to every non-technical word its simple ordinary meaning.

(1) *Force.*—It is impossible for an engineer, or indeed any one else, not to be thoroughly acquainted with the thing called force. We have a direct sense for force just as we have for sound and light, and force goes by the popular names push, pull, effort, &c. Authorities may dispute as to the best mode of defining the way to *measure* force scientifically, but such disputes have no real reference to the thing itself. However, as a matter of fact, confusion in the use of the term Force is not responsible for the misapprehension of the third law; the term does not even enter into the customary statement of that law.

(2) *Motion.*—Here is source of confusion No. 1; the term "motion" is perpetually being used instead of "change of motion" or "acceleration." Thus one may find it stated that a body on which no force acts cannot move—this is, briefly speaking, a simple lie. What is true is that it cannot change its motion; it can neither hurry, nor slacken, nor deviate from its course. It cannot start from rest, of course, but it can go on moving steadily for as long as it likes; in fact, it cannot stop. And conversely, whenever a body is moving steadily the resultant force acting on it is necessarily *nil*. This is simple, important, and often forgotten. If a cage is ascending a coal pit at a uniform speed it does so because the pull of the rope is exactly equal to the weight of the cage, plus any small friction of the air. Neglecting the latter for simplicity, if the pull exceeds the weight of the cage its motion changes; *i.e.*, it begins to go faster. If the pull is less than the weight, its motion also changes; it begins to go slower, it does not at once begin to go down. Of course, if the upward pull is less than the weight of the cage *for a long time* it will slacken, stop, and reverse; but it is quite a mistake to suppose that when a cage is going up, the pull on the rope is necessarily greater than its weight, and when it is going down, necessarily less. The mistake arises simply from confusing motion with change of motion or acceleration. First let the pull of the rope be made greater than the weight of the cage, the resultant force acting on that cage is upward: very well, then, its change of motion is upward; if it had been at rest, it begins to ascend; if it had been ascending, it begins to ascend quicker; if it had been descending, it begins to descend slower. What its *actual motion* is, is not told us at all by the statement, "the resultant force acting on the cage is upward." Again, let the pull on the rope be suddenly made less than the weight of the cage, then the resultant force is a downward one, and the acceleration is therefore downward also; *i.e.*, if the cage had been going down it would begin to go down quicker; if it had been going up, it would begin to go down slower; if it had been standing still, it would begin to descend. Finally, let the pull of the rope be exactly equal to the weight of the cage; the resultant force, and consequently the changing of motion, is now *nil:* the cage may be moving up or down or standing still—that is quite immaterial; all we can be sure of is, that its speed is not changing.

Now all this is simple matter of fact, which can be verified if necessary by attaching a dynamometer to the winding drum. When the cage begins to be wound up the pit shaft the dynamometer will first indicate a force *greater* than the weight of the cage, presently a force *equal* to that weight as the motion becomes steady, and finally one *less* as the cage is slackened near the top, increasing quickly up to the exact weight again when the cage has quite stopped. Similarly on lowering, the dynamometer will first indicate a force less than the weight, then equal, and finally greater, as the cage is being stopped near the bottom. This is not a subject for discussion or difference of opinion at all. If anyone refuses to admit its truth it is useless to discuss the laws of motion any further with him just yet, because he is wrong in the fundamental facts of the subject, and it is premature to enter into minute and exact statements of law until the elementary facts are correctly appreciated.

As to the little point about the possibility of unequal tensions at the two ends of a rope: it depends entirely on whether the inertia of the rope itself is negligible or not. If it be a hypothetical rope without mass, its tension is necessarily the same at all points whatever is being done with it. If it be an actual rope, its tension is also uniform whenever its motion is steady, but it is greater at one end than that at the other whenever its motion is being either accelerated or retarded. The inertia of a rope, however, is usually so small, compared with what it is commonly used to pull, that for practical purposes it is customary to neglect it altogether. It is not well, however, to import practical approximation into a discussion on principles, and a complete statement about a rope, as about any other body, is simple enough, viz., *the difference between the pulls applied to its two ends is equal to its mass-acceleration.* [See below.]

(3) *Action.*—In the statement of the third law the word "action" may be, and has been, held to have a very general signification, including "work" for instance, as well as force, but there is no need to strain it thus; it may be taken to mean simply the whole force applied to the body considered, and this is commonly done.

But a body when being moved is commonly acted on by two sets of agents—one set pulling it forward, the other set pulling it back or resisting its motion. There is some question then whether the resultant of the two sets of forces should be considered as the "action" on the body, or whether the propelling forces only should be called *action* and the retarding forces *resistance*. The former plan is really the simpler of the two, provided it be thoroughly understood, but the latter plan has its advantages also. It is merely a question of usage and will be mentioned again later: possibly ambiguity may be avoided by noting the two alternatives here.

In modern parlance the word "action" is never really used, "reaction" is still used sometimes and is convenient, but for most serious purposes the idea of the pair of forces or *stress* is all-sufficient and satisfactory.

(4) *Reaction.*—Here is the central point of misapprehension, or confusion No. 2, more vital than even the "change of motion"—confusion No. 1, already discussed. The two words "reaction" and "resistance" are often used as if synonymous. They are not; they involve distinct ideas. Consider resistance first as the simpler of the two.

(5) *Resistance.*—The resistance experienced by a body is simply the opposing force applied by external bodies to it. It is the obvious drag-back which an engineer must think of automatically. Thus with a sledge it is the friction of the ground; with a coal-pit cage it is mainly gravity; with a rifle bullet it is the viscosity of the air, and so on. There can be no difficulty whatever in perceiving what the resistance to any given motion is; but now, if we proceed to assert that "resistance is equal and opposite to action" —that the force resisting the motion of a body is always equal and opposite to the force assisting that motion—we shall talk unmitigated nonsense. Yet this is what those who affect to deny the third law of motion think is asserted by it. Well may they consider Newton a nincompoop to lay down such "laws" as that. Let it, then, be thoroughly and completely understood that the third law says nothing of the kind. It is absurd to suppose that while an arrow is being shot the resistance of the air to the arrow is exactly equal to the force exerted on it by the string. If it were, it may well be asked, why on earth should the arrow fly forward?

Even in the statement of this obvious objection, however, confusion No. 1 is commonly perpetrated. You find it said, "if the cart pulls the horse back as hard as the horse the cart forward, how can it be drawing the cart at all? how can they be moving?" No reason whatever against their *moving*, if they were moving to begin with; every reason against their *starting* to move; every reason against their moving *faster*, or slower. When the direct force is equalled by the resistance the motion is not necessarily *nil*, it is necessarily *steady;* the *change* of motion is nil. (No doubt it is frequently intended to suppose them originally at rest, and to ask how can they move from rest; and of course so long as the pull of the horse is no more than equal to the pull of the cart, they can't; they are stuck in a rut.) But if it is *intended* to consider them originally at rest when the question is asked how can they move, it should be so stated. When we see anything moving at a uniform pace in a straight line (say a railway train) we can be sure that the resultant force is nothing. The forward pull on every truck is then exactly balanced by the friction at its bearings, the resistance of the air &c., and the pull of those behind. If the forward pull were greater than the total resistance the speed would be increasing, if the forward pull were less than the resistance the speed would be decreasing; precisely as has been explained at length for the case of a coal pit cage. One might then formularise a statement, if it were worth while, of this sort. "The resistance experienced by a body is equal to the force urging it to move *provided its motion is steady.*" (The simplest case of perfectly steady motion is of course no motion at all, and all stationary bodies are stationary *because* the forces acting on them exactly balance each other—the resultant force is *nil.* The same, however, is the case with all bodies which are moving with constant velocity in a straight line.) But such a statement is not the third law of motion, nor anything like it—it is not an absolute statement at all, it is a conditional statement, being accompanied with a proviso. The laws of motion are all absolute and unconditional statements, true under every conceivable variety of circumstance.

Now what is it that the third law really asserts? It asserts equality between the total or resultant force urging the body to move, and the *reaction* of the body. What is this thing reaction? Return to its consideration.

(4) *Reaction.*—The reaction of a body depends on its inertia or mass, and on the acceleration which is being generated in it; and it can be, and is, defined as equal to the product of the two. It may be called, therefore, mass-acceleration. If a body be imagined without inertia it can offer no reaction. If a body is not accelerated (or retarded, or diverted from its course), it can offer no reaction. But when a body with inertia is accelerated, it *must* offer reaction, and this reaction is defined to be the product of the inertia and the acceleration; that is to say, it is proportional to the amount of matter in the body—number of pounds or grammes—and to the rate of change of its velocity.

This, so far, is mainly a matter of definition, not a statement of fact. Now comes the third law with its statement of fact; and it asserts that the reaction of a body, so defined, is always precisely equal to the resultant force applied to the body. That is what it says; whether it be true or not is a matter for discussion and observation. There is not the least doubt in the mind of any one who understands the statement, and has any experience of force and motion, that it is perfectly true. The people who think they don't believe the third law have got hold of some ridiculous statement of their own, which they quite rightly don't believe—they are not thinking of the true third law at all.

The law is so simple that it is not really an independent statement; it, like the "first law," follows from the second. The "second law" is the one great axiomatic or experiential statement: of it the first law is a special case, and the third law a convenient restatement in another form. There is only one law of motion, viz., in symbols

$$m\,d\,v = \mathrm{F}\,d\,t;$$

or in short words,

change of momentum = impulse;

or more explicitly, the momentum generated in a body is precisely equal—in magnitude and direction—to the impulse which produces it. The necessary definition of the terms "momentum" and "impulse" being supplied, say, thus:

The momentum of a body means its velocity multiplied by its inertia or mass.

The impulse of a force means the force multiplied by its duration—the time during which it is applied.

The meaning of the symbols, then, in the shorthand formula $\mathrm{F}\,d\,t = m\,d\,v$ is as follows:—

F, the resultant force applied to the body, or the propelling force minus the resisting force, or the resultant in magnitude and direction of all the forces acting, no matter how numerous they are;

m, the mass or inertia of the body on which F acts, the quantity of matter in the body irrespective of its nature or physical condition;

$d\,v$, the change in the speed of the body—both in magnitude and direction—which is produced by the action of the force F during the time $d\,t$.

Given the law, $m\,d\,v = \mathrm{F}\,d\,t$, the so-called "first law" follows instantly and obviously thus:—

If $\mathrm{F} = o$, $d\,v$ must equal o;

i.e., if no force acts, or if the resultant force is *nil*, no change of motion can occur; or the motion of the body will be perfectly steady and uniform both in amount and in direction.

And the third law also follows, by the simplest algebraic transformation and by the necessary definition, thus—

$$\mathrm{F} = m\frac{d\,v}{d\,t}$$

Now, $\frac{d\,v}{d\,t}$ is the rate of change of velocity, and is commonly called acceleration, so in the right-hand of this equation we have mass × acceleration, which we have already agreed to call the "reaction" of the body. And on the left-hand side of the equation appears the "action" or resultant force applied—the total impressed force. Thus, then, action = reaction.

Admit or deny the "second law" according as experimental facts seem to you to support or to contradict it; but having admitted it, do not pretend to deny its direct consequences. Find fault with the definition and meaning of the term "reaction" also if it amuses you, but do not dignify this quibbling about words with the appellation of an examination into, and criticism of, a law of nature.

Note a special case of the above statement, $\mathrm{F} = m\frac{d\,v}{d\,t}$.

Suppose $\frac{d\,v}{d\,t}$ is nothing, F must be nothing; or in words:—the resultant force acting on a body is zero, or the resisting forces are equal to the propelling forces, provided there is no acceleration; *i.e.*, provided the motion is perfectly steady. We have said this before; it is just the statement which, *without* the proviso, some persons seem to think is the third law itself. *With* the proviso, we now see that it is the merest special case of the true third law.

But it may now be asked, have I not, in the above definition of reaction, artificially simplified the statement of the third law beyond the point contemplated by Newton? Is not the whole reaction of a body really made up of two parts—first, its mass-acceleration above spoken of; and secondly, the resistance or drag back exerted on it by other bodies? Well, it is merely a matter of convenience whether we consider this resistance as part of the resultant force or part of the reaction. I have preferred to consider it as part of the resultant force, and not to abstract the propelling or forward forces from the resisting or backward forces. I have taken their difference, and called *that* the resultant force F. This is really the simpler method, but the other will do if it be preferred. This other and more common method is to consider the propelling or forward force as "the force applied," and to say that the reaction of the body is equal to this; meaning by "the reaction" the sum of two distinct things, viz., first, the mass-acceleration or true reaction, secondly, the drag back exerted by outward agents—friction, gravity, &c.

If P is the propelling force and R is the resisting force, my way of stating the third law is—

$$\mathrm{P} - \mathrm{R} = m\frac{d\,v}{d\,t};$$

the more common way is—

$$\mathrm{P} = m\frac{d\,v}{d\,t} + \mathrm{R}.$$

There is no question of fact, or difference of opinion, involved. I call P − R the total impressed force F, and $m\frac{d\,v}{d\,t}$ the reaction; but I might call P the impressed force, and $m\frac{d\,v}{d\,t}+\mathrm{R}$ the reaction. It is necessary just to point out and seize the slight difference of statement. The latter may be regarded as the more Newtonian. The thing is the merest question of taste; but it is no question of taste, but a certainty of very ill taste, to say that the third law asserts that P = R, and then to exhaust oneself in denying it.

The history of Newton's third law has been a curious one. Never really grasped in all its generality by his contemporaries or successors, they lost themselves in overgreat complexity, and rigid dynamics was impossible till D'Alembert rediscovered Newton's third law as a sort of empirical rule. It is, in fact, still called by most writers on rigid dynamics "D'Alembert's principle." But even then it was not really understood in all its simplicity, and accordingly it became the fashion with Cambridge text-book writers throughout the early half of the century to replace both it and the second law by a couple of bald and inadequate statements. And this and other errors, in spite of the clarifying labours of Tait and Thomson, still cling about a great number of Cambridge-trained teachers, as I know from personal knowledge.

Much of the teaching of mechanics has been radically bad in many respects,* but there is no need for it any longer to be so, and even this little matter which I now call attention to, of limiting the name reaction to $m\frac{dv}{dt}$, may be a help. For a name is distinctly wanted for this quantity. It is not a force, though it is the equivalent of a force; it is not inertia, though it is often so called, and inertia is one of its factors; when one wants to be accurate one calls it mass-acceleration, but this is an awkward and unwieldy name; it is sometimes, with fatal effects, called resistance; its right and simple name is reaction. Resistance exerted by other bodies cannot really be part of the reaction of a body to the forces exerted on it; its reaction is due to its own inertia and to the acceleration which is being generated in it. Any resistance experienced by a body from outside agents is part of the whole number of forces acting on it, not part of its true reaction to those forces.

There is no mystery about the third law at all. The reaction or mass-acceleration of a body is equal and opposite to the resultant of all the forces acting on it. That is the whole thing. It is neither more nor less than the second law over again in another guise.

University College, Liverpool, O. L.
March 14th.

* I am by no means inclined to believe that it has been any worse than the teaching of Physics, but its subject matter is much more simple, and so defects in statement are more easily detected and appreciated in mechanics than in Physics.

EXPERIMENTS WITH A CORLISS ENGINE AT CREUSOT.

(*Continued from page* 180.)

M. DELAFOND, engineer-in-chief of the mines at Creusot, draws numerous deductions from the experiments, the principal numerical results of which we have set before our readers. We do not propose to reproduce all that he has written on the subject, but we give four diagrams, and we have selected from M. Delafond's summary those particulars which seem most valuable and interesting.

To begin with, the diagrams, Figs. 1 and 2, show the kilogrammes of steam used per horse-power per hour. We reproduce these diagrams from our contemporary, *Annales Industriel*, just as they stand. We have not considered it necessary to translate the legend, or to convert the French measures into English. Fig. 1 shows how the consumption of steam varied with the pressures and points of cut-off; Fig. 2 shows how the consumption varied with the pressure and the effective horse-power. M. Delafond warns his readers not to attach too much importance to certain erratic flexures of the curves. The experiments, as he says, were very difficult to make, and absolute mathematical accuracy must not be assumed to have been obtained. The results of experiments Nos. 23, 45, 56, and 67 were not plotted, because steam followed the piston throughout its stroke, and the boiler pressure was too variable, owing to the difficulty of keeping up steam, to permit any deduction to be drawn based on a relation between pressure and work done. The curves showing the results of the compression experiments are also to be taken with reserve, because the experiments were too few to permit of general deductions being drawn from them.

The examination of the diagrams leads to the following conclusions:—(1) Contrary to theory, the consumption of steam does not diminish as the pressure and expansion are augmented. (2) When the pressure remains constant and the expansion is increased, the consumption at first diminishes, and then increases. For each pressure there exists a point of minimum consumption corresponding to a certain amount of expansion, and any departure up or down from this particular cut-off is attended with loss. Fig. 2 shows that the radii of curvature in the regions of minima are generally very large, so that the work done may vary between wide limits without much affecting the weight of steam used per horse-power per hour. These minima represented a larger exertion of power when the engine worked without a condenser than when it worked with it. (3) When the point of cut-off was fixed, and the pressure varied, we have the following results:—

When the engine worked condensing, without the jacket, the consumption of steam attained a maximum when the pressure was 7·75 kilos. per square centimetre, or 110 lb. per square inch, and it diminished as the pressure fell, and attained its minimum either with 64 lb. on the square inch, or 50 lb., according as the work done was greater or less than 100-horse power. The consumption augmented again with each further fall in pressure.

When steam was admitted to the jacket the consumption, so long as the power exceeded about 120-horses, always diminished as the pressure was increased, but the difference in economy between pressures of 110 lb., 89 lb., and 64 lb. was very small. When the power fell below 120-horse power, the consumption tended to become constant, no matter what the pressure; but the best result was obtained with a pressure of 64 lb. per square inch.

When the engine worked without condensation, and with steam excluded from the jacket, the diagrams show that the best results were obtained with a pressure of 78 lb. on the square inch.

The jacket reduced the consumption of steam more and more as—the point of cut-off remaining fixed—the pressure was augmented. Its effect was very important when the pressure was 110 lb.; it was of no importance when the pressure fell to 36 lb. The economic efficiency of the jacket is less and less as the point of cut-off becomes later and later, the pressure remaining constant. Thus the diagrams show that it is practically useless when, the pressure being 36 lb., the cut-off took place at 55 per cent. of the stroke, and the power exceeded 150 horses.

Working with a condenser promotes economy, other things being equal. Thus, when the engine worked up to 150-horse power, with the condenser, steam being admitted to the jacket, it required $20\frac{1}{2}$ lb. of steam per horse per hour, the pressure being 110 lb.; while without the condenser it used nearly 25 lb. of steam at 79 lb. per square inch. But the gain due to condensation diminishes as the work done augments, and it will be seen from the diagrams that for 175-H.P. the difference is only about $1\frac{1}{2}$ lb. in favour of the condenser. In two experiments, the one made with 110 lb. with the jacket and condenser, the other with 78 lb. compression, and the jacket, but without the condenser, "The advantage of having a condenser was, under the circumstances, scarcely discernible," writes M. Delafond.

The Corliss engine experimented with gave the best results when the work done varied between 120 and 170 horse-power. Above or below these powers the consumption of fuel increased because it became necessary to cut off too late or too early in the stroke.

The utmost economy is realised when the engine is worked at the proper power, with a pressure of 110 lb. per square inch, steam being admitted to the jacket. But the difference in economy between steam of 110 lb. and steam of 64 lb. is very small. M. Delafond points out, that if we take the generation of steam into consideration as well as its use, the lower pressure is the more economical; because a pound of steam at 110 lb. demands more heat for its production than a pound of steam at 64 lb. Again, other things being equal, the boiler will cost more as the pressure is higher. Furthermore, there is reason to believe that by raising the temperature of the feed-water by means of the exhaust steam, which can be done much more effectually without than with a condenser, it might be found to be as economical to work without as with a condenser.

(*To be continued.*)

Fig. 1

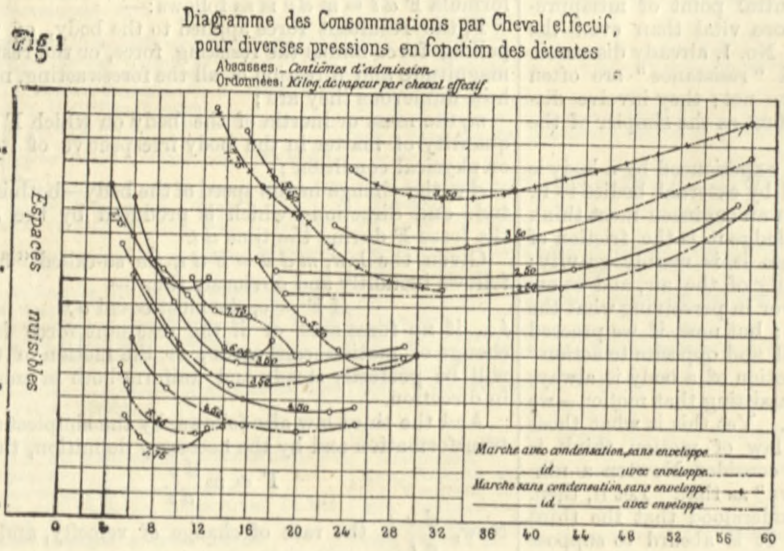


Fig. 2.

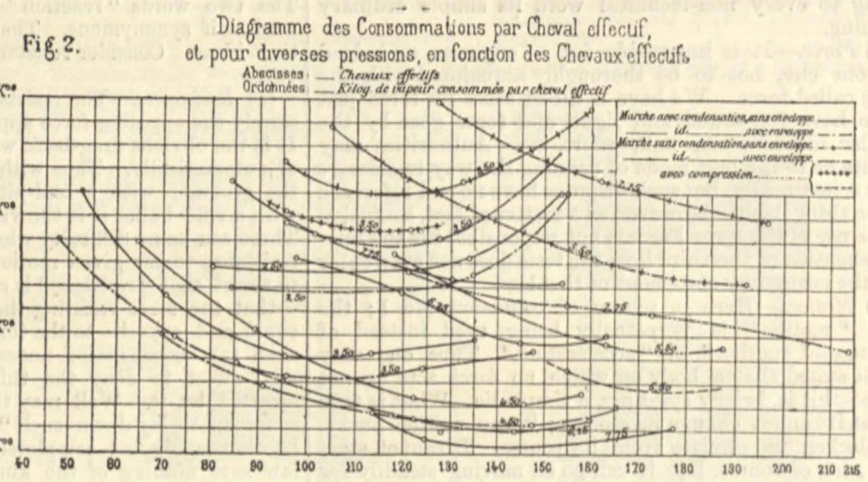


Fig. 3.

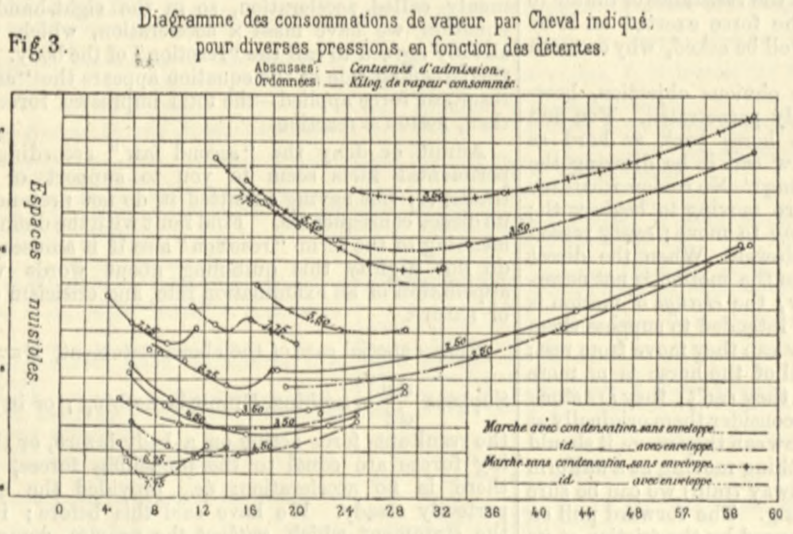
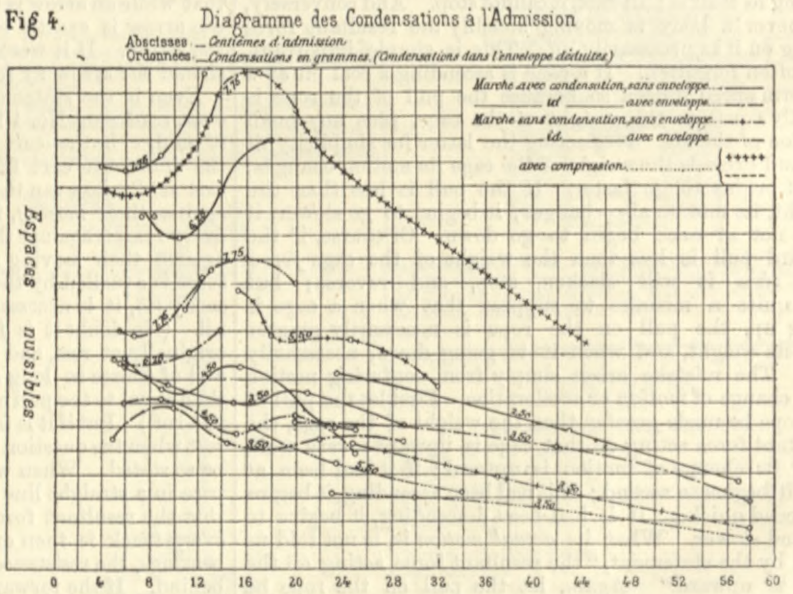


Fig 4.



DIAGRAMS SHOWING THE RESULTS OF EXPERIMENTS WITH A CORLISS ENGINE.

TENDERS.

WELLINGTON, SOMERSET, WATERWORKS.

CONTRACT No. 2.—For the manufacture and erection in Wellington of gas engines, pumps, and gas-making apparatus. Mr. E. Pritchard, M.I.C.E., engineer, London and Birmingham.

	£	s.	d.
W. R. Renshaw and Co., Kidsgrove	1779	15	0
Sylvester and Co., Newcastle	1638	0	0
Piercy and Co., Birmingham	1600	0	0
Crossley Bros., Manchester	1547	0	0
,, ,, alternative tender	1445	0	0
John Wolstenholme, Radcliffe	1420	0	0
Ball and Horton, Stratford-on-Avon	1270	0	0
Glenfield Co., Kilmarnock—accepted	1261	0	0

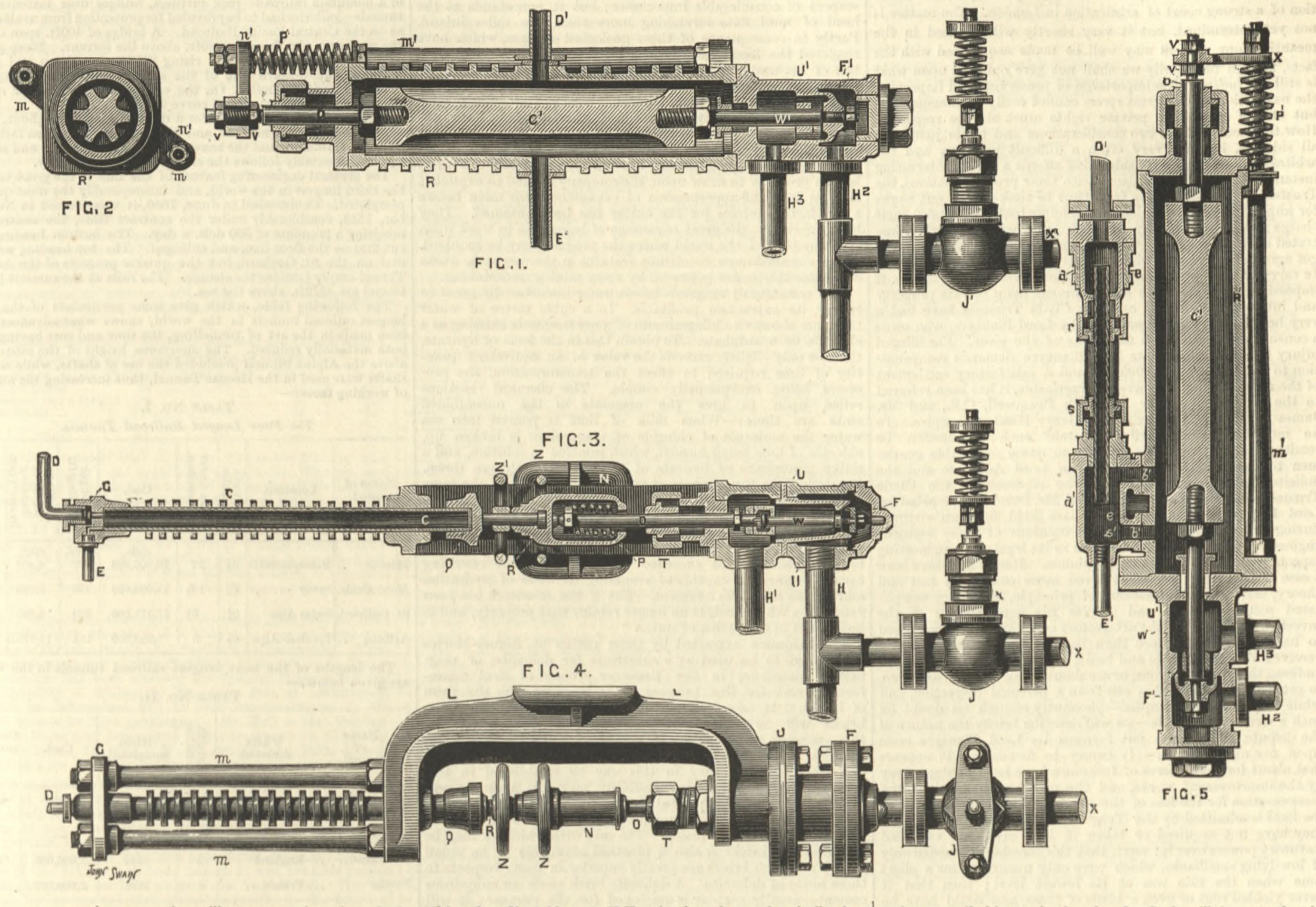
LUTON SEWAGE EXTENSION.

FOR the supply of engine, pump, and boiler power for the Luton sewage extension.

	£	s.	d.
Gimson and Co., Vulcan-street, Leicester	4089	0	0
Sylvester and Co., Castle Hill Foundry, Newcastle	3832	0	0
F. Pearn and Co., West Gorton, Manchester	3250	0	0
Watt and Co., 90, Leadenhall-street, London, E.C.	2986	0	0
Kirk and Co., Etruria Ironworks, Stoke-on-Trent	2980	0	0
Oliver and Co., Broadoaks Ironworks, Chesterfield	2890	0	0
Renshaw and Co., Kidsgrove, Staffordshire	2750	0	0
Hayward Tyler and Co., Luton	2730	0	0
H. Balfour and Co., Finsbury-circus, London	2600	0	0
Hathorn, Davey, and Co., Sun Foundry, Leeds	2500	0	0
Coalbrookdale Company, Shropshire	2425	0	0
A. Cohen, Cozewhoe, Northampton	2360	0	0
Spencer and Co., Melksham, Wilts	2320	0	0
A. Rigg, 42, Old Broad-street, London, E.C.	2033	0	0
Wolstenholme and Co., Albert Works, Radcliffe	1370	0	0

No tender accepted.

THE GROSSMAN FEED WATER REGULATOR.



The accompanying engravings illustrate an ingenious feed-water regulator now being introduced by Mr. Karl J. Mayer, of Barmen. Figs. 1 and 2 show respectively cross and longitudinal sections through one form of the instrument where the expanding metal bar is placed inside a tube communicating with the boiler. Figs. 3 and 4 are respectively longitudinal section and plan of a construction where the expanding metal bar is made in the form of a hollow tube into which the steam or feed-water can enter according to the height of the water in the boiler. Fig. 5 shows a vertical arrangement of the apparatus combined with an additional contrivance for varying the height of the water-line in the boiler. The apparatus shown in Figs. 1 and 5 being the same in its main construction, in explaining this the same figures of reference will be applied to the same pieces. In Figs. 3 and 4, C is the expanding metal bar, here in form of a tube, which communicates with the boiler by means of the tubes D and E. If, now, the water falls in the boiler it will also fall in the tube C, and when steam enters that tube it will get hotter, and consequently lengthen and open the valve F which is fixed at the end of the bar O, forming the continuation of the metal tube C. As soon as the valve F is opened, or opened more fully, more water passes through the same and enters the boiler, and the water-line will rise until the pipe C is again filled with water, when it will contract, close the valve, and so check the feeding. The feed-water is led to the valve F by means of the force pipe H, which is screwed into the casing U which carries the valve F. Tube H comes from the feed-pump, and tube H^1 leads the water to the boiler. To prevent the bursting of a pipe when valve F is closed and the pump is at work, a safety valve T is inserted into a branch of the force pipe, through which the water can escape when F is closed, the pressure on the safety valve T being somewhat higher than the ordinary boiler pressure. The working parts of the apparatus are fitted to a bracket L in the following manner:—On the left-hand side of the bracket the two bars *m* are screwed in the same; at their ends they carry the traverse G, to which one end of the expanding bar or tube is immovably fixed, and which is also bored to allow the connections D and E for the steam and water tubes; the other end of C passes freely through the boring in the bracket, and it is closed here by the nut Q which ends in a screw R. On this screw R is screwed the strap N, which forms the casing for the spring P enclosed in it. The strap P is adjustable on the screw R by means of the screwed wheels Z and Z^1. Through N is passed the bar O, which passes through the stuffing box and gland T into the casing U of valve F. This casing is fixed to the other side of the main bracket L. By a connecting piece W the bar O is connected to the valve F. From the above, and with reference to the figures, it will be understood that the apparatus will act as desired. By means of the hand screws Z and Z^1 the amount of opening of the valve F can be regulated. To prevent any overstraining or breakage, in consequence of a greater contraction of the bar or tube C than is desirable, be it either that the allowance of opening given to the valve is too short, or that the bar C contracts more than is intended, for instance by allowing the water in the boiler and in the bar C respectively to get very cold, the strap N is made to press on the spring P, which, by being compressed, takes up the strain of the contracting bar.

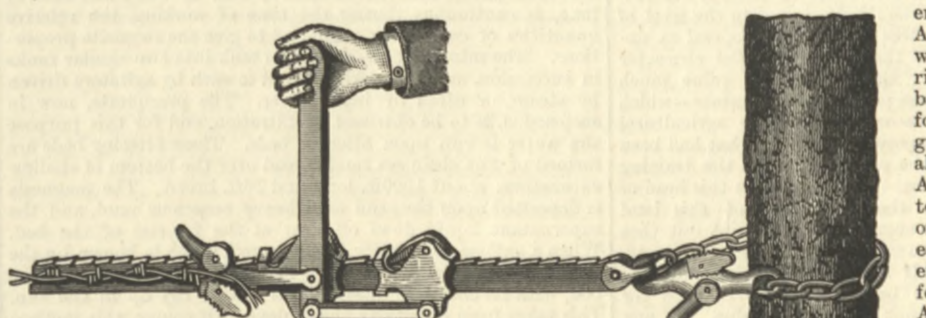
The apparatus shown by Figs. 1 and 2 differs from the preceding one only in its construction. The expanding metal bar C^1 is here of star-shaped cross section enclosed in a tube R, which communicates with the steam and water space of the boiler by means of the tubes D^1 and E^1; at the left hand side a bolt O, which is screwed in the bar, passes through a stuffing-box through the cover of the tube R, and is fastened to a traverse N^1 by the adjustable nuts V V. At the other end a similar bar W^1 passes through the other cover of the tube R into a casing U^1, which contains the valve F^1. This casing is connected to the pump by means of the pipe H^{11} and to the boiler by the pipe H^3 in the same manner as described before. The crosshead N presses against the spring P^1 wound round the bars M^1; spring P^1 having here the same functions as the spring P in strap N (Figs. 3 and 4). The action of this apparatus is the same as that of the one described before. Supposing there be low water in the boiler, steam will enter the tube R^1 by the pipe D^1, the bar C^1 will expand, and being locked-fast in the traverse N^1 between the nuts V V, will open the valve F^1, and the feeding begins or will be increased, and will last so long until the water in the boiler rises so high that it enters through pipe E^1 into the tube R^1, then follows cooling of the bar, contraction, and closing of the valve. Should the contraction be too much, the overstrain will be taken up by the traverse N^1 and springs P^1. Surplus water, when the valve is closed and the pump continues working, passes through safety valve T^1.

Fig. 5 shows an apparatus exactly like the preceding one, but arranged vertically and fitted in addition with a contrivance which allows a variation of the height of the water line. The apparatus itself in its construction and working being exactly the same as before described, except its being arranged vertically instead of horizontally, we need not repeat its description, and we only now describe that part of it which allows changing the height of the water line whilst the boiler and the apparatus are at work. This is effected by making the pipe D^1 which connects the apparatus with the steam space of the boiler, adjustable in a vertical direction, in order to vary the height in which the steam is allowed to enter the tube R^1 containing the metal bar C^1. To that effect pipe D^{11} leads into a separate casing a^1, attached to the tube R^1, and from it the pipe *e* passes through the stuffing-box *r*, and enters also through stuffing-box *s* the casing a^1, so that the pipe *e* can be shifted up and down at pleasure. Now casing a^1 communicates with the tube R^1 by a higher and by a lower passage *b* and b^1, and it will be understood that if tube *e* is set low, the water entering through E^{11} will shut off the passage of the steam through *e*, and no steam will further enter the tube R^1 and heat the bar C^{11}. This will be cooled, and contract, &c., as formerly. If, however, the pipe *e* is set high, steam will still pass through it and the upper passage *b* in casing *a* until this one is also closed. So it will be seen that by making the amount within which the pipe *e* can be shifted up and down large, a great variation in adjusting the water line is possible.

The Grossmann feed-water regulator for steam boilers, especially the two designs shown in Figs. 1 to 4, seems to be well worked out and thought through, and being based on the principle of the contraction and expansion of metals caused by the change of temperature, which cannot change or become untrustworthy for any reason, the apparatus appears to be well worth the attention of boiler owners and makers of boiler fittings, the more so as it can claim, besides the great advantage of having, practically speaking, no wearing parts which can get out of order, that of great simplicity. The feed-water regulator is patented in England and abroad.

THE DEAN WIRE STRETCHER.

The accompanying engraving shows an ingenious device for stretching wire, &c., manufactured by the Bartlett Hardware Company, Freeport, Illinois. This stretcher consists of a wrought iron ratchet bar, on which slide two malleable iron guides, carrying steel dogs which engage with the ratchet teeth. A wrought iron lever connected with the two guides stands at right angles to the ratchet bar, and by working this lever forwards and backwards the guides are moved forward alternately on the ratchet bar. A malleable iron clamp attached to the lever holds the fence wire or strip to be stretched, and each forward movement of either guide moves the clamp forward and tightens the wire. A chain attached to the front end of the ratchet bar, and provided with a malleable clamp and hook, serves either to fasten to a post or to grasp another wire in splicing. The dogs drop into the notches of the ratchet bar by their own weight, and on turning the notched edge of the bar downward the dogs drop out of the notches, and the guides may be instantly moved to the rear end of the bar, when the stretcher is again ready for work. The working of the dogs and guides is purely automatic, and they need never be touched by the operator. The only manipulation required is the working of the lever. The lever moves through a small angle, so that it is at all times very nearly at right angles to the bar, so that the power is applied to the best possible advantage, and at the same time the tendency to twist about the wire, which is an objectionable feature of all crank stretchers, is completely removed.



THE DEAN WIRE STRETCHER.

THE REMSCHEID WATERWORKS.

On page 226 we publish the first of several pages of engravings, by which we shall illustrate an account of the Remscheid Waterworks, constructed under Herr L. Disselhoff, by whom a paper, containing some valuable information, was read on the subject before a German engineering society.

THE IMPROVEMENT OF THE CLYDE NAVIGATION.

A DISPUTE of considerable interest both from an engineering and from a public point of view has lately occupied the attention of a strong court of arbitration in London. The matter is not yet determined, but it very shortly will be, and in the meantime our readers may well be made acquainted with the facts, though necessarily we shall not give opinions upon what is still *sub judice*. The importance of preserving and improving the navigation of our great rivers cannot easily be exaggerated; but at the same time private rights must also be respected. How to reconcile these two considerations and to do justice on all sides is, however, very often a difficult problem, and the arbitration now under consideration affords a highly interesting instance of this. In accordance with their proper functions, the Trustees of the Clyde have from time to time carried out works for improving the navigation of the important river under their charge; and the necessity for such work was strikingly illustrated only a few days ago, when more than one large steamer got aground repeatedly while endeavouring to reach Glasgow. In carrying out improvement operations of this kind it is almost impossible to avoid some encroachment upon private property and interests, and in this case the Clyde Trustees have had a very heavy claim made upon them by Lord Blantyre, who owns a considerable estate upon the banks of the river. For alleged injury to his Erskine estate Lord Blantyre demands compensation to the amount of £100,000; and a satisfactory settlement of the matter being otherwise impracticable, it has been referred to the arbitration of Sir Frederick Bramwell, C.E., and Mr. James Abernethy, C.E., with Sir Henry Hunt as umpire. To no more competent tribunal could such a question be remitted; and it would be difficult to name more able gentlemen to conduct the case than the Lord Advocate and the Solicitor-General for Scotland, who represented the Clyde Trustees, and Mr. Webster, Q.C., and Mr. Dundas, who acted for Lord Blantyre. The arbitrators have held fourteen sittings, during which they have heard the opinions of many eminent engineers, and have sifted the cause in its legal and engineering aspects with keenness and thoroughness. Rarely has there been a case of this class that has involved more conflict of fact and theory, more difficult questions of principle, and more complicated points of law; and despite the completeness of the investigation, thus far the arbitrators can hardly be considered to have done much more than begin their inquiry. Having received all this evidence and heard the learned arguments *pro* and *con.*, they have now gone, or are about to go, to the *locus in quo*, to get what assistance they can from a personal inspection, and while they are thus occupied—pleasantly enough no doubt on such a river as the Clyde—we will describe briefly the nature of the dispute. The claim put forward by Lord Blantyre rests upon five main points:—(1) Injury to foreshore. It appears that about forty-two acres of foreshore have been dredged away by the improvement works, and the owner claims substantial compensation for the loss of these acres. The dredging away of the land is admitted by the Trustees, but they argue, first, that they have not acquired or taken it, but have only exercised statutory powers over it; next, that this foreshore consisted only of low-lying sandbanks, which were only uncovered for a short time when the tide was at its lowest level; then that it never yielded rent or even a blade of grass, and could have no commercial value, and therefore Lord Blantyre was not entitled to compensation; and finally, that so far from harm having been done to the estate by the submersion of the foreshore, increased value had been imparted to the estate by the widening and deepening of the river. (2) Damage to Erskine House and grounds by the disappearance of a natural sandy beach, the loss thereby of access to the deep-water channel, and the deposit of mud and other objectionable matter in front of the estate. To this the Trustees reply that, although the landward part of the foreshore might be clean sand, the actual foreshore was only soft mud, not a little impregnated by sewage matter from Glasgow and other towns on the river; and again, however that might be, the mansion and grounds are improved in value rather than diminished by the substitution of a better and more navigable stream. (3) Damage to land alleged to have been cut off from the river by walls or embankments, leaving an intervening strip of malodorous marshes between the channel and the dry land. On this branch of the claim the Trustees contend that by a half-tide wall this land was formerly cut off from the river, and having been virtually reclaimed by their works, its value has been greatly enhanced, and might be made yet more valuable if Lord Blantyre would complete the work already done by filling up the ground. With respect to this enclosed land, it was proposed by Lord Blantyre that it should be raised to the level of the embankment, but the Trustees resist this proposal as unreasonable, and point out that if that were done, the character of the land would be entirely altered, and its value much increased. (4) Damage to certain portions of the estate—which it was contended might have become valuable for agricultural or building purposes—by the deposit of mud on what had been a good, clean beach, caused by the construction of the training walls and the dredging operations. With regard to this head of the claim, the Trustees deny the probability of this land becoming valuable in the way suggested, and point out that hitherto, although there has been this land available, few, if any, persons had offered to take it. If it were offered for sale, they argue that the prospect of its being taken up as good for agricultural purposes would not raise its value to any appreciable extent, and that in any case its value has not been diminished in any way by the works. (5) Damage through the loss of grazing land, the destruction of an embankment at a place called Bishopton, and the undermining of a river wall at North Barr. To Nature the Trustees attribute the wasting away of this alleged grazing land; they assign the leaking or stopping of a drain, or rabbit holes, as the cause of the failure of the embankment, and they deny that the river wall at North Barr has been undermined. In addition to all these answers, the Trustees assert that much of the damage attributed to the improvement works has really been caused by neglect on the part of Lord Blantyre to keep the banks along his land in proper repair. From this summary of the case it will readily be seen that it affords abundant matter for dispute as between the parties, and more than ordinary difficulties for the arbitrators to determine; but from many points of view it is of the first importance that a clear and decided decision should be arrived at. Many other rivers, besides the Clyde, are being converted into deep navigable channels, and it is matter of urgency that there should be some distinct principle laid down as to the rights that may be claimed on the one hand by riparian owners, and on the other hand, by trustees and others who are concerned with the improvement of our rivers with a view to the promotion of trade and commerce. From this arbitration there is every reason to expect such a result, and the decision will be awaited with deep interest by many persons besides the Clyde Trustees and Lord Blantyre.

A GREAT MAGNESIA MINE.

AIGUES-MORTES, on the Mediterranean, is known to all geologists as a remarkable instance of the slow upheaval which is constantly going on in many places. In former times it was a seaport of considerable importance; but it now stands at the head of mud flats stretching more than two miles inland. Partly in consequence of these geological changes, which have rendered the locality convenient for dealing with large quantities of sea water, Aigues-Mortes possesses at the present time features of interest to the engineer, particularly to the engineer occupied in the production of steel. Works of no great magnitude yet, but of certainly growing importance, have been constructed here for the production of magnesia. The mine from which this mineral is extracted is fairly rich and of no inconsiderable extent, being nothing less than the sea itself. With so large a property to draw upon, the company formed to exploit it are free from the apprehension of exhausting their mine before a satisfactory return for the outlay has been obtained. They have, moreover, the great advantage of being able to work upon it in any part of the world where the produce may be required. These circumstances constitute features in the magnesia works of Aigues-Mortes not possessed by every mining undertaking.

The quantity of magnesia in sea water is sufficiently great to render its extraction profitable. In a cubic metre of water there are about two kilogrammes of pure magnesia existing as a chloride or a sulphate. To obtain this in the form of hydrate, the cost only slightly exceeds the value of an equivalent quantity of lime required to effect the transformation, the processes being exceptionally simple. The chemical reactions relied upon to give the magnesia in the uncombined state are these:—When milk of lime is poured into sea water the molecule of chloride of magnesium is broken up, chloride of lime being formed, which remains in solution, and a milky precipitate of hydrate of magnesium is thrown down. Similarly from the sulphate of magnesium, we obtain the same precipitate and sulphate of calcium. But the great bulk of the magnesia exists in sea water as the chloride. The hydrate when calcined assumes two different states, according to the temperature at which the calcination has been effected. If the temperature has not exceeded 900 deg. Fah., the resulting caustic magnesia is capable of resuming its water of hydration and setting hard like a cement. But if the substance has been raised to a white heat, it no longer retains that property, and is indifferent to the action of water.

The magnesia extracted by these means at Aigues-Mortes is intended to be used as a substitute for dolomite, or magnesian limestone, in the Bessemer process of steel manufacture; and for this purpose it is moulded into the form of bricks. It seems highly probable that these magnesia bricks will in a short time come into general use for this purpose; and such works as those at Aigues-Mortes will then be called into existence in many places. A new and important industry may in this way be established in this country. Equal to lime in infusibility, magnesia is a more perfect type of a refractory substance, and is applicable to every use in which it is not brought into contact with an acid substance in a state of fusion. The ease with which it may be moulded into bricks is also a practical advantage of no small value; and such bricks are greatly superior in many respects to those made of dolomite. A dolomite brick needs an anhydrous cement—usually coal-tar is employed for the purpose; it will keep unaltered only a few days, even when every precaution is taken to shield it from atmospheric influences, and it is of too frail a nature to permit of its being handled roughly. But a magnesia brick is similar to one of common clay in all these particulars. In the matter of cost, too, the advantage is on the side of the magnesia brick. Per ton, the latter costs almost exactly twice as much as the dolomite agglomerations; but as 130 lb. of the limestone are required per ton of steel produced, while 40 lb. of magnesia are sufficient for that quantity, the relative cost is as 2 to 3. This is an important merit, and the one that will commend itself most forcibly to the manufacturer of steel. It is, moreover, to be borne in mind, that when magnesia is used in the converters the duration of the linings is increased threefold. Possessed of these numerous and great advantages, magnesia bricks can hardly fail to supplant the dolomite in the use to which the latter are put in the Bessemer processes of steel making. It is hoped that a further use of magnesia may be made by employing it as a reagent, in many cases, in place of lime. In such a case, the scoriæ—phosphate of magnesia instead of phosphate of lime—would be reduced to about one-third.

At Aigues-Mortes the sea water is pumped into a large tank of masonry, and an equivalent quantity of milk of lime is run into the tank along with it. The flow, both of water and milk of lime, is continuous during the time of working, the relative quantities of each being calculated to give the requisite proportions. The mixture flows from this tank into two similar tanks in succession, and is briskly stirred in each by agitators driven by steam, or often by horse-power. The precipitate, now in suspension, is to be obtained by filtration, and for this purpose the water is run upon filtering beds. These filtering beds are formed of fine clean sea sand spread over the bottom of shallow excavations about 1000ft. long and 16ft. broad. The magnesia is deposited upon the sand as a heavy tenacious mud, and the supernatant liquid flows off clear at the far end of the bed. When a sufficient quantity has collected, which is known by the sand ceasing to decant properly, the inflow is stopped, and the bed, with its charge of magnesia, is left to dry up in the sun. This takes from twenty to thirty days. Of course, this method of drying can be adopted only in the summer months, and not even then in every climate. But the drying could be done artificially without adding greatly to the expense. The managers of the works at Aigues-Mortes have now under consideration a plan of this character to enable them to work all through the year. With their present arrangements they are treating 1000 cubic metres of sea water a day; and they obtain from the filtering beds an average of 2 lb. of magnesia per square yard of surface per day. The extent of the beds is being increased to treat a larger quantity of water in the coming summer season. The present output is six tons a week. The dried magnesia slime is stowed away in sheds, to be calcined and moulded into bricks, the manufacture of which is carried on throughout the year.

THE ARLBERG TUNNEL.

AUSTRIA is about celebrating the completion of the Arlberg Railroad, from Innsbruck over, or rather through, the Tyrolear Alps to the Lake of Constance in Switzerland—an enterprise undertaken by the Austrian Government chiefly, doubtless, to give a more direct connection with Switzerland, which is a large consumer of Austrian and Hungarian grain and other produce, but also to give it a connection with France and Western Europe generally, independent of Germany. It will, in connection with the Swiss railroads, form the most direct route between Austria, and indeed all South-Eastern Europe, and Southern France.

The railroad was one of the most difficult to construct that has ever been built, and a great deal of pains were taken in locating and designing it, nearly all the eminent engineers in the Empire, apparently, studying and discussing it, and many submitting plans for it. It passes through some of the most magnificent mountain scenery reached by any railroad, and besides the usual concomitants of a mountain railroad—rock cuttings, bridges over torrents, and tunnels—galleries had to be provided for protection from avalanches, as on the Central Pacific Railroad. A bridge of 400ft. span carries the road over the Trisana, 280ft. above the torrent. Steep grades also were required, the line rising 2152ft. in fifteen and a-half miles on the western side of the summit tunnel, requiring long grades of 160ft. per mile. On the eastern slope 132ft. per mile is the steepest. The maximum curve is 7 deg.

The works are constructed for a double track throughout. The winter lasting seven months, and the temperature often falling to 30 deg. below zero, and the snow storms being frequent and severe, the line invariably follows the sunny slope of the valley.

The greatest engineering feature of the line is the great tunnel, the third longest in the world, and incomparably the most quickly completed. Commenced in June, 1880, it was pierced in November, 1883, considerably under the contract time, the contractors receiving a premium of 330 dols. a day. The bottom heading was cut first on the floor line, and enlarged. The top heading was cut first on the St. Gothard, but the quicker progress of the Arlberg Tunnel amply justifies the change. The rails at the summit in the tunnel are 4372ft. above the sea.

The following table, which give some particulars of the four longest railroad tunnels in the world, shows what advances have been made in the art of tunnelling, the time and cost having been both materially reduced. The enormous height of the mountains above the Alpine tunnels precluded the use of shafts, while several shafts were used in the Hoosac Tunnel, thus increasing the number of working faces:—

TABLE NO. I.

The Four Longest Railroad Tunnels.

Name of tunnel.	Location.	Length in miles.	Years under construction.	Cost.	Cost per running ft.	Maximum advance heading in one year.	Date completed.
				dols.	dols.	feet.	
Hoosac ..	Massachusetts	$4\frac{3}{4}$	22	10,000,000	399	4,456	1876
Mont Cenis.	Savoy	$7\frac{5}{8}$	$14\frac{1}{2}$	15,000,000	356	5,365	1871
St. Gothard.	Swiss Alps ..	$9\frac{1}{4}$	$9\frac{1}{4}$	11,175,000	229	8,235	1881
Arlberg ..	Tyrolese Alps	$6\frac{5}{8}$	5	7,300,000	154	11,775	1884

The lengths of the next longest railroad tunnels in the world are given below:—

TABLE NO. II.

Name of tunnel.	Where situated.	Length in miles.	When completed.	Cost.	Cost per running ft.
				dols.	dols.
Severn	England ..	$4\frac{3}{8}$	Not yet	—	—
Standedge.. ..	England ..	3	1845	—	—
Woodhead.. ..	England ..	3	1845	1,026,000	65
Nerthe	France	3	1847	2,000,000	133

The first-named tunnel passes under a wide tidal estuary, and dips downward towards the centre from the ends. This is always objectionable, and in this case was especially so, large land springs having necessitated an unprecedented amount of pumping. The Severn tunnel has been eleven years under construction, but will probably be completed a few months hence.

The following table gives some particulars of the longest American tunnels. We are indebted to Mr. H. S. Drinker's exhaustive work on tunnelling for most of the figures, which serve by contrast to show the enormous magnitude of the four tunnels given in the first table:—

TABLE NO. III.

Particulars of Longest American Railroad Tunnels.

Name of tunnel.	Location.	Length. Feet.	Time in building. Months.	Cost.	Cost per running ft.	When completed.
				dols.	dols.	
Baltimore ..	Baltimore & Ohio	6948	25	1,060,000	142	1873
Kingwood ..	Baltimore & Ohio	4100	30	724,000	176	1852
Sand Patch.	Baltimore & Ohio	4725	96	375,000	80	1871
Bergen	N.Y., L. E. & W...	4388	36	800,000	182	1861
Bergen	Del., Lack. & W...	4209	—	—	—	1877
Blue Ridge ..	Col. & Greenville..	5865	—	—	—	1858
Blue Ridge.	Chesapeake and Ohio	4262	—	488,000	114	1857
Great Bend.	Chesapeake and Ohio	6449	—	—	—	1872
Galitzen.. ..	Pennsylvania ..	3612	30	—	—	1854
King's Mo'nt'n	Cincinnati So. ..	4000	—	360,000	90	1876
Musconetcong	Lehigh Valley ..	4879	27	—	—	1875
San Fernando	So. Pacific	6966	—	1,450,000	308	1876

The Arlberg Tunnel is nearly five times as long as the longest of these American tunnels, though only one-third longer than the Hoosac Tunnel.—*U.S. Railroad Gazette.*

SOUDAN EXPEDITION.—The Admiralty and War-office have passed orders to Messrs. Merryweather and Sons, of Greenwich and Long-acre, for five portable steam pumping engines, and several miles of hose, for water supply purposes in the Soudan.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Robert Balcomb, engineer, to the Pembroke, additional, for the Rifleman; G. G. Follett, engineer, to the Jumna; William F. Pamphlett, engineer, to the Alexandra, additional, for transport service at Suakim; James F. Babb, chief engineer, to the Dido; Thomas Morris, engineer, to the Bullfrog; John Pitt, engineer, to the Indus, for service in the Hyacinth.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY. — An ordinary meeting was held on the 11th inst., the president, Mr. Cole, A.M.I.C.E., in the chair, when a paper on "Steel Guns" was read by Lieut. Charles Berthon, R.A. The author strongly advocated the abandonment of all other materials in favour of steel, and argued that it was not only the cheapest but the best material, and in fact would have been the material always employed but for the extreme difficulty of obtaining large masses of reliable quality. The next meeting will be held on the 25th inst., at 7.30 p.m., when Mr. Herbert A. Gribble will read a paper entitled "The Oratory, South Kensington, from a Scientific Point of View."

RAILWAY MATTERS.

THE Buenos Ayres Great Southern Railway Company has received advice that the extension of the line from Tandil to Juarez has just been completed and opened to public traffic.

A RETURN recently laid before the Legislative Assembly of New South Wales gives the cost of first-class American saloon cars on the railways in that colony as £1045 each, and second-class of the same pattern £805 each.

THE Italian Government contemplates connecting Massowah and Kerem by a railway. The latter place would be chosen as summer quarters for the troops. Contractors have been applied to by the Italian War-office respecting the time requisite and the cost of the projected line.

THE companies connected with the Ottoman Railways have appointed arbitrators to decide the points in dispute between them and the Turkish Government. The Construction Company has nominated MM. Jacobs and Brunet, and the Working Company Dr. Holtzendorff and Count Lanezan. The Ottoman delegates are Vahan and Ali Riza Pashas.

ACCORDING to the annual report of the Commissioners of Public Works for the province of Ontario, the total number of miles of railway constructed in the province prior to the confederation was 1464 miles; completed since confederation, 2734 miles; at present under construction or contract, 464 miles. The foregoing figures are exclusive of the Canadian Pacific Railway west of South-East Bay, Lake Nipissing.

THE accidents recorded in America last year are divided according to their nature and the classes of trains as below:—

Accidents.	Collisions.	Derailments.	Other.	Total.
To passenger trains	48	251	33	332
To a passenger and a freight	122	—	—	122
To freight trains	275	430	32	737
Total	445	681	65	1191

AFTER a three months' trial of one of its coaches fitted up with the Pintsch Company's gas apparatus, the Dublin, Wicklow, and Wexford Railway Company has decided to equip all its stock of 183 coaches with the Pintsch gas apparatus, and build a gasworks at Bray to supply them. The oil-gas for the trial was stored in a holder 18ft. by 4ft., and came from the works built by the Pintsch Company some time ago for the City of Dublin Steam Packet Company at Holyhead. It is useful to note that if one coach can be kept going off one holder for three months, a train, or two short local trains, can be kept going for a week by once sending the store supply.

SEVERAL important towns in the Peninsula have been for some years supplied with tramways, but Malaga, the second seaport in Spain, has so far been denied such facilities for locomotion. Now, however, this want will shortly disappear, inasmuch as an important concession has been made by the Spanish Government and the municipality of Malaga to Mr. John Fell, of Leamington, and some ten kilometres will at once be constructed in the principal streets by that gentleman. Mr. Fell is also the contractor for important steam and horse tramways in Germany. Mr. E. Pritchard, M. Inst. C.E., of London, and Señor Manuel Lopes Martin are the engineers for the proposed works in Malaga.

IN reply to a question in the House on the 12th inst., the Under-Secretary of State for India said: "The whole of the earthwork on the Quetta Railway from Hurnai to Gurkai, 65 miles, with the exception of the heavy cutting at Mud Gorge and some other trifling portions, has been completed. More than half of the tunnel headings of the Chappar Rift have been driven through; material for most of the bridges has been collected; and the final portion of the line to Quetta has been planned and marked out. The line will probably be opened throughout for traffic in the course of 1887-8. He was not able to say how far it might be possible to accelerate the communications by means of works of a temporary character. There is no present intention of extending the line beyond Shebo."

EVER desirous of meeting the convenience of its passengers, and of adding as much as possible to the already remarkable facilities and comforts of the Ludgate-hill barn—called station—the Chatham and Dover Company allow their porters—never too civil—to close the exit stair-gate even when wholly unnecessary, and thus people arriving at Ludgate from the Bromley line may have, whether in their evening garb or not, to go outdoors before they can get back to that part of the station whereat cabs are to be had. Ludgate-hill porters are not the least rough and gruff, and the station is not only very bad in itself, but badly or not at all managed. It is rare that a porter opens a carriage door, and ladies may be seen at the last moment, on a wet day, with the rain streaming off the carriage roof, struggling from inside to open a door, while the porters are in knots, or without any regard for other duty than calling out "Ludgit 'ill."

AT the close of the Manchester Coal Exchange on Tuesday, a special meeting of the members was held for the purpose of considering the Railway Rates and Charges Bill now being promoted before Parliament by the principal railway companies, and a resolution was passed to the effect that having regard to the serious issues to trade involved in the additional powers which were being sought to enormously increase existing rates, and having regard also to the present depressed condition of trade and the inability of traders to meet increased charges, that association respectfully invited the Members of Parliament for the City of Manchester and the adjacent town and county divisions to offer an uncompromising opposition to the second reading of these bills, on the ground that it would be too costly to private interests to oppose them before a Select Committee, whilst their general aim and principles admitted of the Bills being dealt with by the whole House.

THE report of the Cornwall Railway Company, which was read last Friday, gives the following figures:—Total train miles, 327,338; coal and coke for locomotives, £1811 9s.; maintenance of way, works, and stations, £12,824 12s.; percentage on receipts, 16·85; per train mile, 10¾d.; per mile open, £195 15s. 11d.; locomotive power, £9650 12s. 2d.; percentage on receipts, 12·68; per train mile, 8d.; per mile open, £147 6s. 9d.; carriage and wagon repairs, £2360 18s. 11d.; percentage on receipts, 3·10; per train mile, 2d.; per mile open, £36 0s. 10¾d.; traffic expenses, £8993 5s. 2d.; percentage on receipts, 11·82; per train mile, 7½d.; per mile open, £137 6s. 0½d.; general charges, £1627 5s. 7d.; percentage on receipts, 2·14; per train mile, 1½d.; per mile open, £24 16s. 10½d.; law charges, £69 12s. 6d.; compensation, £296 6s. 2d.; rates and taxes, £1097 16s. 1d.; Government duty, £1248 13s. 2d.; total working expenses, £38,169 1s. 9d.; percentage on receipts, 50·15; per train mile, 2s. 8d.; per mile open, £582 14s. 8¼d.

IN an interesting letter to the *Times* on the necessity for docks at Calcutta, Mr. C. C. Adley says:—"As regards the question of site, Kidderpore has its advocates, but the Howrah side of the river presents many advantages. Two or three objections to the Howrah side raised some years back have now disappeared, while the material weight of evidence has increased in its favour. In further illustration of this point, one important feature has been overlooked. The bulk of the rail-borne export traffic is brought by the East Indian Railway, and now amounts to about 750,000 tons annually, which will increase in time to a minimum of one million tons. To this must be added—say, half a million tons—the dead-weight of the rolling stock that will be employed backwards and forwards in conveying that traffic from the Howrah to the Kidder pore side of the river over the proposed Cossipore Bridge. The rail level of this bridge must be at least 30ft. above rail level at Howrah, to admit of the free passage at all times of the country boat traffic. We shall, therefore, have annually a weight of at least a million and a-half tons raised up 30ft. high on one side of the river, to be let down again 30ft. on the other side of the river. This unnecessary and amusing engineering feat would be obviated by having the wet docks at Howrah."

NOTES AND MEMORANDA.

IN Greater London 3411 births and 1914 deaths were registered during the week ending the 7th inst., equal to annual rates of 34·2 and 19·2 per 1000 of the population.

THE production of pig iron in France during the first half of 1884 is returned at 954,983 tons, which is a decrease of 64,276 tons on the production of the second half of 1883.

IN London 2623 births and 1495 deaths were registered during the week ending March 7th. The annual death rate per 1000 from all causes, which had been 19·1 and 20·0 in the two preceding weeks, declined to 19·1.

THE deaths registered during the week ending March 7th in twenty-eight great towns of England and Wales corresponded to an annual rate of 20·6 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of this year. The six healthiest places were Brighton, Hull, Wolverhampton, Plymouth, Birkenhead, and Sheffield.

A VERY high death-rate was registered last week at Sunderland. The number of deaths was 116, being at the rate of 48·1 per 1000 inhabitants. In the previous week the number was 101, representing a rate of 41·9. The present excessive rate of mortality is due to a very severe epidemic of measles. In one district alone the number of deaths recorded is 130 since Christmas. The disease has made rapid strides, the number of deaths increasing week by week.

A NEW method of making chlorine has been described by *Le Génie Civil*, as the invention of MM. Pechiney. It consists in the addition of magnesia to a concentrated solution of magnesium chloride, so as to produce a solid mixture, which is then treated with air and heat. Nearly the whole of the chlorine is liberated, a part as free chlorine and a part as hydrochloric acid. The residue consists of magnesia, which is used over again with a fresh charge of magnesium chloride.

A PATENT taken out for a yellow metal, by T. Parker, describes it as of great tensile and compressive strength and hardness, and made by melting copper, 50 parts; spelter dross, 25-30; spelter, 12-17; tin, 2½ parts, with a flux of the following composition made into a paste: Salt cake, 5 parts; coal-dust, 5; silica, 15; bone ash, 20 parts. Manganese or copper sulphate, or the chlorides of these metals, and also common salt, may be used in place of the salt cake. This flux is also applicable to the founding of brass and bronze generally.

THE German Ironmasters' Association has collected facts concerning the financial results of the working of 102 companies engaged in the iron and machine construction industries in each of the years 1879 and 1883. In the former year, the net result of the operations of these companies was a profit of 5,929,000 marks, or 1·6 per cent. on the capital invested; whereas in 1883 the net profits on the same concerns amounted to 24,194,000 marks, being equal to 6·79 per cent. on the invested capital. This shows a gain of 5·19 per cent. in 1883, which gain, however, appears to be all the more remarkable when examined in reference to the ironworking concerns alone. It appears that fifty of the latter companies, with a total capital of 268,764,000 marks, realised only sufficient in 1879 to pay an average dividend of 0·94 per cent.; whereas in 1883 the profits earned allowed of an average dividend of 6·14 per cent. being paid, the net profits amounting to 16½ million marks in the latter year, against rather over 2½ million marks in 1879.

A PAPER on the "Luminosity of Methane" was read on the 19th February, before the Chemical Society, by Lewis T. Wright, Assoc. M.I.C.E. Pure methane was prepared by Gladstone and Tribe's method by the action of the copper-zinc couple on methyl iodide. The gas was obtained free from methyl iodide vapour by passing it through tubes fixed in a horizontal position and packed with copper-zinc, which was kept moistened with alcohol, the alcohol vapour being removed by scrubbing with sulphuric acid. It was burned in a London Argand burner, the chimney of which was fitted with a cap for the purpose of limiting the air supply to the quantity most favourable to the development of luminosity. The methane flame was compared with a Methven standard burner supplied with 18-candle gas, *i.e.*, with a light equal to two sperm parliamentary candles. The results obtained were, with 2·78 cubic feet per hour, 2·9-candle power; with 4·46 cubic feet per hour, 4·6 candles; with 5 cubic feet per hour the calculated light power would thus be from 5·15 to 5·2 candles.

As showing the reduction in mortality after the construction of proper system of sewers in a town, the following figures have been given:—At Münich the entire fever mortality per million inhabitants, for quinquennial periods, was as under:—1854 to 1859, where there were absolutely no regulations for keeping the soil clean, 24·2; 1860 to 1865, when reforms were begun by cementing the sides and bottoms of porous cesspits, 16·8; 1866 to 1873, where there was partial sewerage, 13·3; 1876 to 1884, when sewerage was complete, 8·7. Similarly, at Frankfort-on-the-Main, the deaths from enteric fever per 10,000 were: 1854 to 1879, when there was no sewerage, 8·7; 1875 to 1880, when the sewerage was complete, 2·4. At Dantzic the figures present some more striking characteristics: The deaths from enteric fever per 10,000 living were as follows: 1865 to 1869, when there was no sewerage and no proper water supply, 108; 1871 to 1875, after the introduction of a water supply, 90; 1876 to 1880, after the introduction of sewerage, 18. In Hamburg the deaths from enteric fever per 1000 of total deaths were: From 1838 to 1844, before the commencement of the construction of any sewerage works, 48·5; from 1871 to 1880, after the completion of the works, 13·3. During the time that the works were in progress—viz., from 1872 to 1874—the mortality from enteric fever per 10,000 living was: In the unsewered districts, 40·0; in the districts for the most part sewered, 32·0; and in the fully sewered districts, 26·8. These results illustrate the effect of purifying the air of towns by the rapid abstraction of refuse matter, so as to prevent it from remaining and putrefying in and upon the ground.

"IMPROVEMENTS in the Manufacture of Cement" forms the subject of a good deal of recent patent literature. Mr. R. Stone's improvement in the process of manufacture consists essentially in grinding the materials in a red-hot state, giving a better prepared material with less consumption of power. The burnt clinkers pass red-hot through steel crushing rolls of special construction, and thence to the grinding rollers, the bed plate of which is made concave and adapted to the lower roll, so that the crushed material after passing between the rollers is further ground between the lower roll and the bed-plate. Mr. F. W. Gerhard adds lime to certain impure silicates of alumina and iron, and claims to make cement from the rotch bat or bovin, and what is known as black lime in the Wolverhampton district. Mr. E. W. Harding claims the application of gaseous fuel, in kilns of special construction, to the burning of Portland cement, together with the utilisation of the waste heat, for the carbonisation of coal and the heating of the drying floors; also the mixing of a certain proportion of resin with the cement mixtures to assist the calcination. Messrs. R. W. Lesley and J. M. Willcox seek to mould cement powder into forms suitable for the kilns, as respects size, adaptability to free draught, and the like, while dispensing nearly, if not altogether, with the water ordinarily required to bring it to the pasty condition for this purpose. They compress the powdered materials, damped by heavy pressure between rollers having cells or cavities wherein the powder is moulded into blocks of the requisite size. Messrs. J. W. Matteson, W. J. Chapman, and T. G. Matteson seek to improve the quality of the mixture of chalk, clay, and water in cement making, technically known as slurry, and obtain at a particular stage of the manufacture a more complete admixture and homogeneity of the materials, with perfect disintegration, and free from small particles of chalk hitherto met with in all known processes of manufacture. The apparatus consists of a rotary sieve or tempse, preferably of conical shape, revolving in a well provided with an exit pipe at one end.

MISCELLANEA.

THE Prince of Wales, President of the International Inventions Exhibition, has fixed Monday, the 4th of May, for the opening of the Exhibition.

MESSRS. WALTER T. GLOVER AND CO. have removed from their city offices at 25, Booth-street, Manchester, to new offices in close proximity to their several wire and cable works, Salford, Manchester.

ACCORDING to Dr. Frankland's report to the Registrar-General, the water supplied to the metropolis during the month of February was of a very satisfactory character. "All the samples were clear and bright."

THE lighting of the hoist at Lloyd's is now done electrically by means of E.P.S. accumulators. A set of cells will supply the current for about a fortnight, working ten hours a day, after which the cells are replaced by another set fully charged.

ON Tuesday night a singular accident occurred in Fleet-street. A water main burst below the road, and the water got between the concrete bed and the wood paving, probably through those parts of the concrete where it has been broken into for pipe laying, uplifting it in several places and over considerable areas.

THE Metropolitan Asylums Board have let the contract for lighting, by means of electricity, their hospital ships and buildings at Long Reach, to Mr. James Johnston, 4, Albert-square, Manchester. The plant will be in duplicate throughout, and a considerable saving in the annual cost of lighting will be effected by the substitution of electricity in the place of oil.

THE lighting of ironworks by electricity is gaining additional favour among ironmasters. Messrs. E. T. Wright and Sons, of the Monmoor Ironworks, Wolverhampton, have a portion of their works lighted by electricity, and it is costing less than when they used gas. The firm have determined to further adopt the process in a few months if the results continue as satisfactory.

WE are requested to state that Mr. John Brown, M. Inst. C.E., honorary professor of coal mining at Mason Science College, Birmingham, has resigned his appointment in consequence of the nature of his professional engagements preventing his undertaking to lecture on specified dates in each week of the respective terms, and that the resignation will take effect at the close of the ensuing summer term.

A TELEPHONIC ticket, at half a franc, has been issued, the holder of which is entitled at any of the Paris post-offices to hold five minutes' conversation with persons in any other post-office or at any of the Telephone Company's stations. The system came into operation on Sunday last. The Telephone Company offers, at the same rate, conversations at any of its eleven stations with persons at any other station or at the residence of any of its subscribers.

AT Messrs. Thos. Murphy and Co.'s brewery, Clonmel, Ireland, a 6in. bored tube well, 62ft. deep, has lately been completed by Messrs. C. Isler and Co. It yields a supply of over 10,000 gallons per hour, obtained from the rocks which underlie gravel and sand beds, with springs strongly contaminated; but the contractors have succeeded in safely excluding them from connection with the lower ones. Mr. E. R. Southby, after analysis, reports the water "free from all forms of organic pollution. In fact, it takes rank amongst the very purest waters." At Messrs. Cassidy and Co.'s brewery, Monasterevan, a similar well has just been completed. At Messrs. Brown and Terry's brewery, Burnham Beeches, Berks, a tube well the same size, but 130ft. from the surface, yields 3000 gallons per hour. The discrepancy in the quantity of water yielded is due to the nature of the strata, for in this instance the supply is drawn from the chalk beds.

MESSRS. FRASER AND FRASER, boiler makers, of Bromley-by-Bow, London, E., obtained the order for the supply of nine immense wrought iron tanks to occupy the entire hold of the ss. Woodcock, which is to be stationed at Suakim as a water ship for the use of the troops. The order was received by Messrs. Fraser and Fraser on Saturday, the 28th February. The iron, which had to be specially made for the work in Staffordshire, was delivered to them on the following Saturday, the 7th March, and in one week, viz., on Saturday, the 14th March, Messrs. Fraser and Fraser had the satisfaction of delivering and fixing the whole of the tanks in the hold of the steamer. This is considered to be one of the most expeditious feats performed in the arrangements for sending out the relief expedition to the Soudan. The Woodcock sailed from Woolwich on Thursday morning for Suakim. Messrs. A. B. Fraser and Co., Liverpool, have fitted the s.s. Cyphrenes with their condensers for providing fresh water at Suakim.

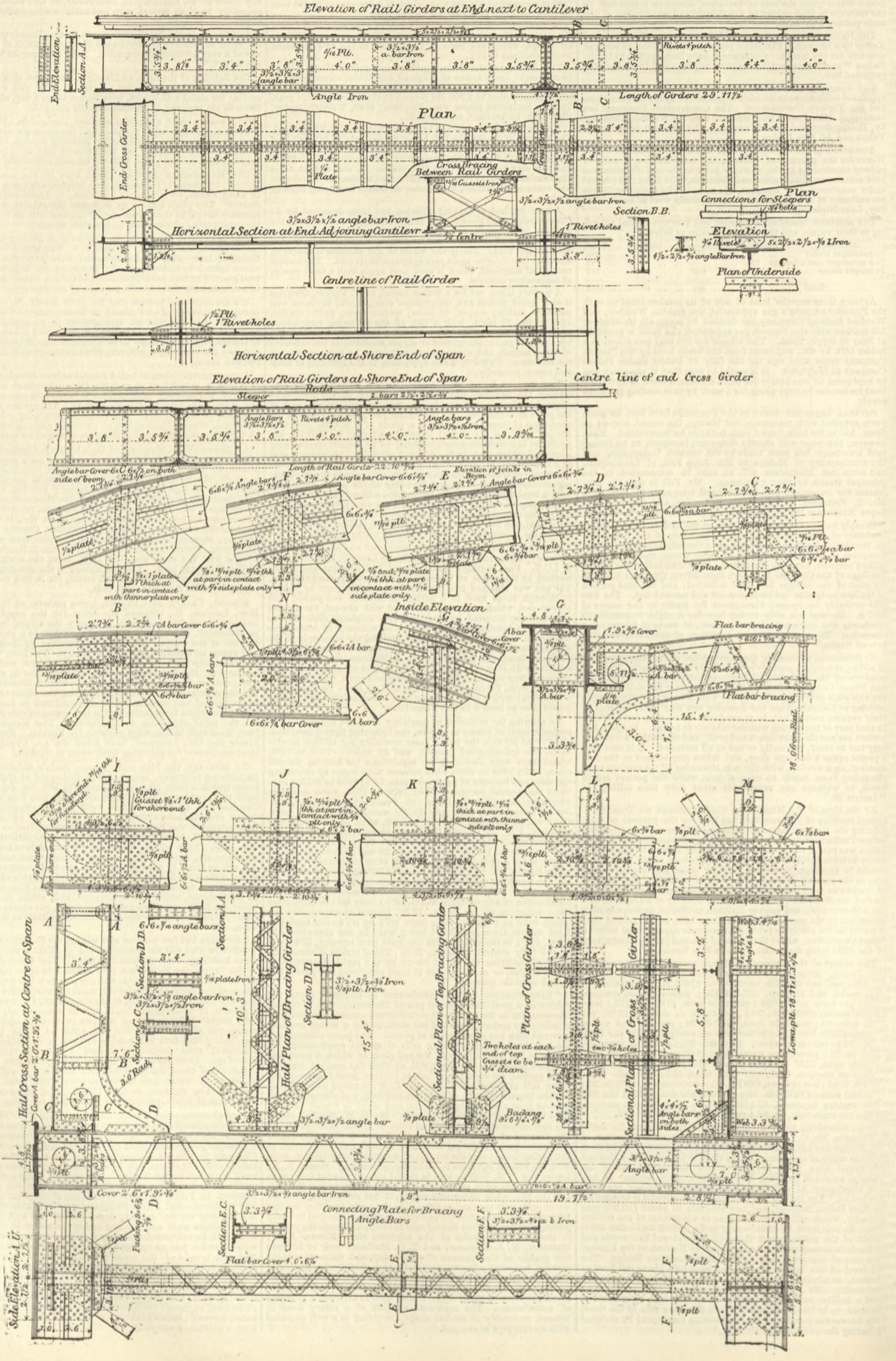
ON Saturday, the 14th inst., Messrs. Earle's Shipbuilding and Engineering Company, launched from their yard at Hull two iron steam trawlers 105ft. long, by 20ft. beam, by 10ft. 9in. depth of hold, built to the order of the Grimsby and North Sea Steam Trawling Company, of Grimsby. These boats are of somewhat similar design and similarly arranged to the Zodiac, the plans of which took prizes at the Exhibition of the Shipwrights, at the Fishmongers' Hall, in 1882, and at the International Fisheries Exhibition, 1883. They will be fitted with all the modern trawl fishing requirements, including Earle's steam trawling winch and windlass, and will be fitted by the builders with their triple compound direct-acting surface condensing three-crank engines, capable of indicating 200-horse power, having cylinders 11½in., 17in., and 30in. in diameter, by 18in. stroke, which will be supplied with steam from a steel boiler, made for a working pressure of 140 lb. per square inch. The vessels were christened Virgo and Libra respectively as they left the ways.

THERE are but few persons who went to the Fisheries and Health Exhibition who will not remember the excellent manner in which these buildings were electrically lighted. The Executive Council of the Inventions Exhibition have decided to light up the whole of the buildings by electricity, and the contract for supplying the whole of the motive power for driving the electric light machinery has been placed in the hands of Messrs. Davey, Paxman, and Co., engineers, of Colchester, who, it will be remembered, so successfully supplied the power at the two previous exhibitions. The plant—ten steam boilers and five powerful steam engines—as supplied by that firm last year is retained, and besides this eight additional steel locomotive boilers will be provided by the same firm. Each boiler will contain 610 square feet of heating surface, and these eight boilers, with easy firing, will evaporate 36,600 lb. of water into steam per hour. The total number of boilers will be eighteen, so that 110,000 lb. of water can be made into steam of 100 lb. pressure per square inch per hour.

A DETERMINED effort is being made by certain of the Birmingham and Wolverhampton steam pump makers to secure, at any rate, a share of the contract for 100 tripod pumps of galvanised iron, and six Bastier pumps with horse-gear, for which the Director of Army Contracts is this week inquiring; and there is some reason to believe that the efforts will be successful. It is assumed that the work is needed for the Soudan. A prominent feature of discussion at the annual meeting of the Chamber of Commerce in Wolverhampton on Friday last was the purchase of the American pumps. The president—Mr. Alfred Hickman—who has interested himself considerably on the subject, urged that it was well known that small matters were not brought under the notice of the Government, but he submitted that they should be informed there was a vigilant and a jealous eye kept upon transactions of this sort, and that the people of the manufacturing districts watched with sedulous care anything which seemed to be lacking on the part of the Government in giving manufacturers a full and fair opportunity of competing for any orders which might be given out. Other speakers held that it was a slur upon the district not to have given local engineers the opportunity of tendering. One manufacturer, however, insisted that the subject had been taken up mainly from a political standpoint.

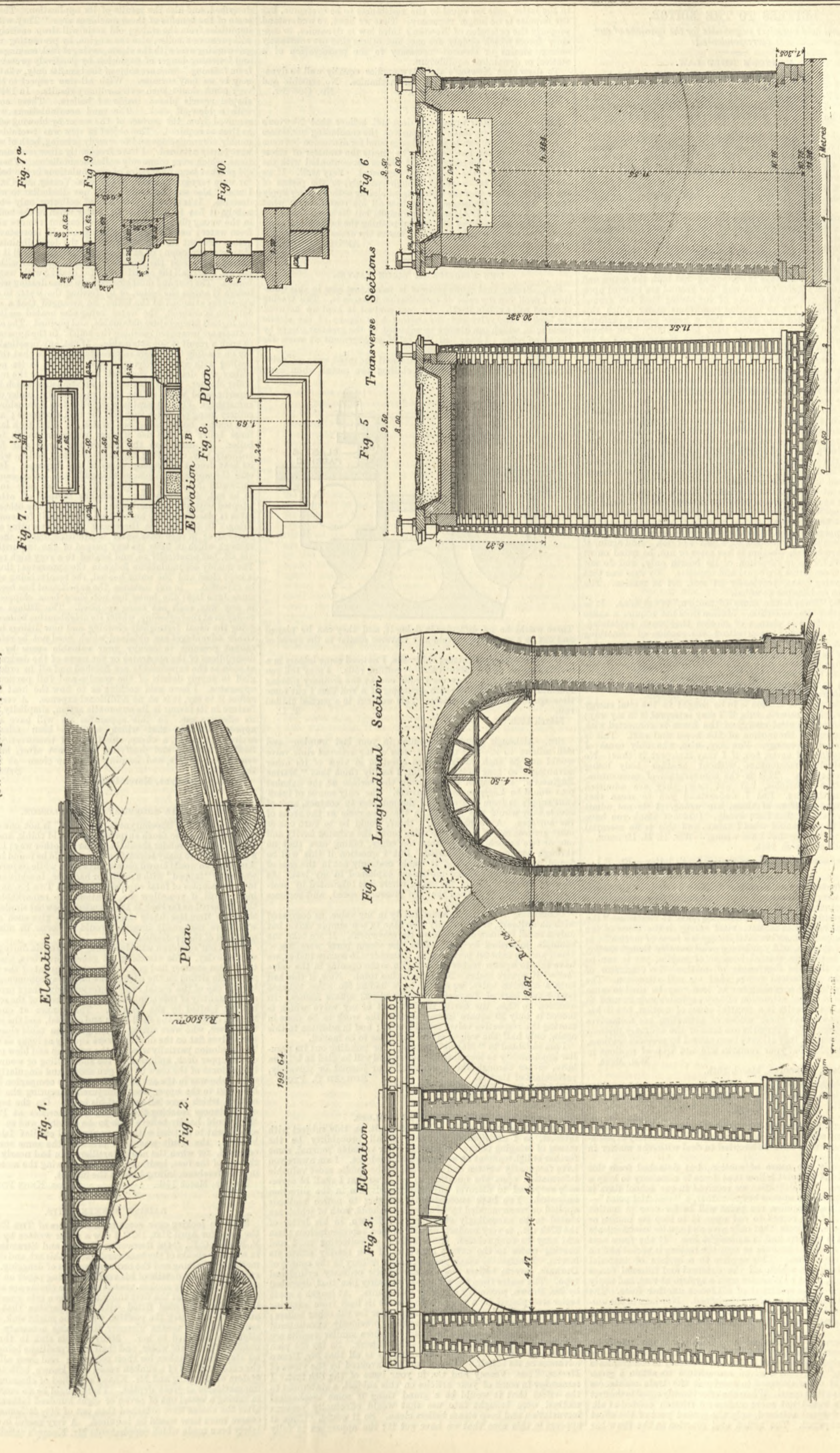
THE HOOGHLY BRIDGE—DETAILS OF GIRDERS.

(For description see page 231.)



THE MALMINOT VIADUCT, MONTAUBAN AND CAHORS RAILWAY.

(For description see page 231.)



LETTERS TO THE EDITOR.

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

NEWTON'S THIRD LAW.

SIR,—In your criticism of my explanation of the third law of motion you show that you have much misunderstood me. In saying force does not push, I mean force is not the agent; force is the action. The horse pulls the cart, the cart pulls the horse; neither the horse nor the cart is a force; but a pull is a force; so is a push.

The reason why an arch does not go up when the abutments are pushing it up is not that the push is not a force, but it is because the earth drags the arch down with an equal force. The reason why the arch does not knock the abutments down is not because the arch exerts no force on them, but because something else pushes them up with a force equal to that with which the arch pushes them down. Is it a puzzle to find out what that something is?

I fail to see the analogy between the circumstance that a number of forces can have a zero resultant and the curvature a fourth dimension of space. How it is that a push or pull can be estimated by the rate at which it could change the momentum of a thing pushed or pulled, is a subject I have entered into in my explanation of what is meant by force.

You make a grave mistake in supposing that both the action and reaction between a horse's hoofs and the ground are exerted upon the horse, and you make a joke of my saying that the ground pushes the horse. Try to imagine conditions under which this force cannot be called into play. Put a horse upon a perfectly smooth ground which he cannot push horizontally. He cannot move forward. He will be quite unable to transform any of his vital energy into the kinetic energic of horizontal motion. Why? Because he cannot by pushing the ground excite the ground to push him, and so enable him to acquire horizontal momentum. No engine, however powerful, can drag a train if the driving wheels do not grip the rails. I appeal to the experience of mankind.

It is quite possible for a rope to have varying tension. The data for plotting the curves for which you ask are these:—Suppose a unit length of the traces to have a mass of m lb., and suppose the horse and cart starting from rest to acquire, in t seconds, a velocity of v feet per second, with uniform acceleration, then the diminution of tension per unit of length of the trace as we approach the cart end of the trace is $m\,v \div t$ units of force, or if you prefer it, $m\,v \div g\,t$ pounds weight, where g is the numerical value referred to foot-second units of the acceleration of a body falling *in vacuo* to the place of experiment. I reassert that a straight rope, at rest, having appreciable mass, acted on at each end with equal and opposite forces in the direction of its length, will not move. If a straight rope have no mass, and be capable of being acted on at its ends with opposite forces in the direction of its length, these forces cannot be unequal, whether the rope moves or not. And again, if a straight rope at rest, whether it has mass or not, be acted on at each end with forces in direction of its length only, and do not move, then these forces are equal and opposite. My case was that of a rope having mass, previously at rest, set in motion. The forces at each end cannot be equal.

The phrase, "force is the cause of motion," is not mine. It is colloquial rather than scientific. Motion does not require a cause to account for it; it is change of motion that needs explaining. By change of motion I mean either the motion of something previously at rest, or else the alteration of the momentum of a moving body in magnitude or direction, or both. The explanation of this change is found—this is the first law of motion—in the action of some other body upon the former body. This action is called force; in this sense force may be said to be the cause of the change of motion, and so briefly, the cause of motion.

You say the cause of motion is to be sought in the vital energy of the horse. I agree with this, if I may interpret it in my way; namely, some of the vital energy of the horse is connected with the kinetic energy of the motion of the horse and cart. This is the conservation of energy. You say, also, the only cause of motion is motion. I agree, too, if I may interpret it thus:—No body can receive momentum without another body losing an equal momentum. This is the conservation of momentum. These are true principles, but not new; they are admitted by all the authorities. But I understand you to mean that the authorities, or some of them, are wrong. I do not admit that you have shown that I am wrong. I do not think you have got so far as to understand what I mean, and this is an essential preliminary to proving that I am wrong. WM. H. H. HUDSON.

King's College, March 16th.

[We reserve comment on our correspondent's letter.—ED. E.]

SIR,—Your criticism on Professor Hudson's article in your issue of the 13th is very refreshing, but the concluding paragraph of your remarks is not critical and is open to grave animadversion. Passing by the specimen of circular reasoning that it contains—"the only cause of motion is motion, vital energy is the cause of the motion of the horse, therefore vital energy is a form of motion"—as a mere slip of the pen, will you let me point out that though motion once caused is perhaps eternal because of inertia, yet it can be easily shown that the first cause of motion—the originator of motion—is the mysterious power that we call attraction. The cohesive attraction of a cooling bar of iron may be used to cause motion. The chemical attraction of any explosive may be used to cause motion, and gravity is a fruitful cause of motion, but it has never been shown that these modes of attraction are themselves modes of motion. Your remarks are true of the ordinary motions that we see about us, they all have been caused by previous motions, molar or molecular, but your remarks are not true of motions in general. WM. MUIR.

9, Angel-place, Edmonton, March 16th.

[We publish Mr. Muir's letter without any comment save this:—If he is right, then the law of the conservation of energy is a myth.—ED. E.]

SIR,—Permit me to say a few words concerning this question, which does not seem to have hitherto found a satisfactory explanation from those who have attempted to deal with the matter in these columns.

Force is really the cause of motion, but detached from this material world it does not follow that force is necessary to keep a body in motion. The definition we received in our school days is that when a force acts upon a body—rather, a "material point"—to give it only an impulse, the point will be for ever in motion unless another force comes to act upon it to stop its motion or modify the same. Forces that only give an impulse communicate a motion that is uniform and in a straight line. If the force acts constantly in a regular manner or not, the motion is varied and no longer in straight line. This applies to a system of material points, or of bodies in which all the external and internal forces are in equilibrio. Let us consider such a system at rest, and apply in the direction of the resultant of all forces another force. The system will at once move as above explained. Nowhere in the universe, however, is this case fulfilled. External forces not within the material system are constantly checking the progress of the body.

Let us return to the illustration of this law in the case of an engine and train. Now, on the point of starting there are in the draw-bar two distinct efforts—(1) that one necessary to communicate to the mass of the train a given momentum to attain a given speed; (2) that other destined to overcome the train resistances corresponding to that speed. When the effort is only equal to the first part, the train would not move unless no friction existed at all. Is the required speed attained, only the second part of the effort is that really required. The action and reaction in the draw-bar in the latter case are equal to the resistances to be overcome, but the impulse is no longer necessary. Thus we have, to understand properly the extension of Newton's third law in dynamics, to consider forces which simply act once and others that are constantly acting—strains or stresses—necessary to the preservation of a statical or dynamical equilibrium.

To deny that Newton's third law applies equally well to dynamics would be to deny the whole of mechanics. No sensible and intelligent man would ever do this. ED. GOBERT.

March 16th.

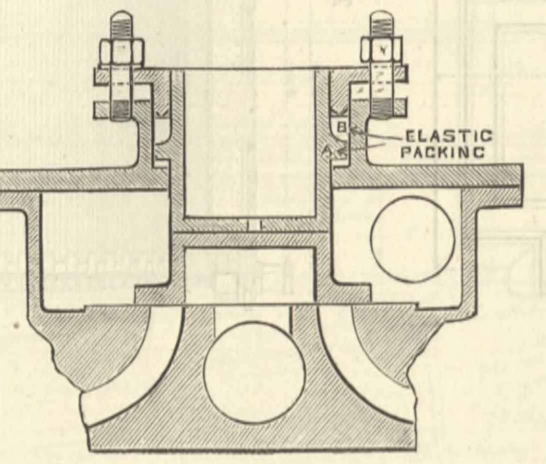
SIR,—As Mr. Muir apparently does not believe that Newton's third law is true—at least, so I construe the concluding sentences of his letter—there can be no further ground for discussion between us. I may ask him, however, why he limits the transfer of stress to the bearings of the crane barrel? He is not contented with the pull at the point of the jib, which I suggested. Very well. If we are to go farther, let us go far enough—namely, to the piston of the engine. How does the right-angled sliding action theory apply then? Professor Hudson seems to base all his reasoning on what has been known as D'Alembert's principle, but he is not lucid. I assume that he speaks of the ground pushing the horse along in an algebraical sense, which, of course, leaves the actual facts of progression untouched. AN OLD STUDENT.

March 17th.

THE FRICTION OF SLIDE VALVES.

SIR,—Seeing that much interest is taken just now in this question, I send you my mite of contribution towards it. The tracing enclosed will explain itself. An easy contact is kept up between the back of the valve and the casting A by means of the elastic packing B, which can always be adjusted to the greatest nicety by the gland bolts. I have had this relief arrangement at work for many years with perfect success.

I notice, also, a question is raised about the rapid wear of valve faces. I would suggest partial chilling the metal when cast.



There would be no difficulty in doing it, and they can be planed and cut by a very slow motion and traverse similar to the speed of chill roll turning.

Whilst speaking of cutting chill rolls, I noticed some letters in a recent number of THE ENGINEER—*re* milling rolls. I may tell you that forty years ago I saw chill rolls cut by the ordinary planing machine. I send you herewith a rubbing of a roll that I cut some time ago for rolling floor plates. This was cut in a partial chilled roll. T. C.

March 14th.

SIR,—Although I gave an opinion in your last number—and still adhere to it—that the even wear of my relieved slide valve would not be such an important question in view of its other advantages so long as it kept tight, I hardly think that "Marine Engineer's" suggestion of increasing the surface at the exhaust port would be likely to mend matters. The only source of lubricant supply is from the edges of the surfaces in contact, and of course they would not increase in the same ratio as the areas of the surfaces. A simpler plan, I think, would be to turn one or more grooves in the face of the valve round the exhaust cavity and one or two branch grooves from the edges, taking care that no through communication existed. But I question if this will be found necessary at all, and it would certainly not in the case of adopting the slight radial movement explained in my last. As regards the other part of the valve, where it is lubricated by over-running, it may be noticed that the pressure, speed, and surfaces all increase proportionately.

Concerning the total exhaust cavity in my valve, as compared with an ordinary, it is not only less than in the simple valve, but only a small fraction of it affects its movement. If we take the example published by you, where the steam ports were 8in. × 1½in., and an exhaust port of 4½in. diameter = 16 square inches, we have this 16 square inches + (8in. × 1½in. = the opening in the valve face =) 10 square inches = 26 square inches total. Now, if this had been a common valve, we should have had an 8in. × 2in. exhaust port + two bars of 1in. each = 8 × (2 + 2) = 32 square inches. In addition to this, the cavity in that part of my valve which is moved is only 10 square inches, so that the work to be done in moving the respective valves is as 32 to 10; and in addition to this again, only half the weight of the valve has to be moved.

I am indebted to "Marine Engineer" for pointing out its peculiar applicability to locomotive practice, and will be glad to let him have, either through the medium of your journal or privately, particulars of its trial. EDWARD C. PECK.

Old Charlton, Kent, March 18th.

FEED-WATER FOR BOILERS.

SIR,—I read your article of the 29th ult. on this subject with interest, as I anticipated it would in all probability be the means of bringing before us, through your valuable journal, some further enlightenment on so important a subject. I am aware you have frequently written and advanced to the public most valuable information upon the question, so much so that I shall be agreeably surprised to discover any marked advance in the direction indicated. You have succeeded in bringing to notice methods applied or recommended by two correspondents, both of which are stated to be exceedingly effective. Mr. Brown, in his letter of the 27th ult., is very modest, his sketch and representations plain and easy to comprehend. As a method of collecting mud and heating water to the extent he states, I can readily affirm its merits. I remember many years ago, at a colliery in the county of Durham, several boilers were in use of the ordinary cylindrical type. The water from the pit was of a quality like that described by Mr. Brown, producing similarly bad results. At length a spare boiler was placed in a position to receive its heat from escaping gases, and utilised as a heater and purifier for the other boilers; by this means the immense difficulties previously encountered were very much obviated. In many instances similar results are obtained by a properly constructed exhaust tank. So far the plan is good, and, if I understand correctly, it is all that Mr. Brown advances on its behalf. We are further favoured by the views of Messrs. Thos. Veasey and Co. in your issue of the 6th inst. I remember in some of your articles on this subject, a statement to the effect that it would be a grand thing if some mechanical method were brought into use that would effectually prevent incrustation and keep steam boilers clean. So it would. Then it appears in this case that we have got it; the apparatus is fully described, and also the results of its application. The writers say some of the benefits of these machines are: "They will remove all impurities from the water; old scale will drop entirely off. They will preserve a boiler, also the engine, by preventing more or less grit working over with the steam, saving of fuel, making steam easier, and lessening danger of explosion by positively preventing a boiler from foaming." Such are some of the benefits only, what others there may be we may surmise. With all due respect to the writers, I very much doubt such extraordinary results. In 1846 I saw bell-shaped vessels placed inside of boilers. These communicated with a blow-off cock. The mud accumulations were greatly removed from the surface of the water by blowing off from time to time as required. The object in view was twofold—to remove muddy accumulations and to remedy priming, both of which objects were partly attained. I have frequently since seen similar applications, which were commonly called scum dishes. These appliances did prevent large quantities of accumulations in the boilers, and so far were very good things. Of Messrs. Veasey and Co.'s apparatus I would also say the same. It is not dissimilar to what I briefly describe. It is a scum dish—a mud collector only—but, unfortunately, it has to deal with the water when in the boiler, which is in the wrong place. Messrs. Veasey cannot remove all impurities from water; neither can they bring off old incrustation or altogether prevent its formation; or in the least diminish a boiler's chance of explosion; or cause or aid circulation; all it will do is to collect mud from the surface. I am acquainted with, I think, if not all, nearly all the contrivances for dealing with water for steam boilers. The best and most effective are those dealing with the water before it enters the boiler, or by feeding the water to an auxiliary apparatus attached to the boiler, so arranged that a constant circulation is ensured, the water being also heated on its passage to the highest temperature obtainable, and purified. The objectionable matters are prevented reaching the boiler. In the apparatus referred to such a result is not attainable. What any practical man would say on reading the letters referred to, would be that the method of dealing with and purifying water previous to its admission to boilers was decidedly the best, and in practice the most effective boiler cleaner. I have before me an appliance which is now being experimented with, so far very successfully, under different circumstances. One apparatus is supplied to a Lancashire boiler at a colliery using pit water very bad for such a purpose; a second one to a marine boiler using sea water; a third to a large vertical forge boiler for the use of river water; a fourth to a Cornish boiler. In each case the boilers are large and fired in the ordinary way, excepting the forge vertical boiler, which obtains its heat from the escaping gases of the furnaces. In the latter case the apparatus is placed alongside the boiler, communicating therewith by a pipe. There is only one hole in the boiler to be cut, 4in. diameter; a similar method of attachment is adopted with the marine boiler; in each of the others the apparatus is placed on the top of the boiler shell for convenience in fixing. In no case are there any valves, excepting a regulating feed-valve; in each case water is admitted first to the apparatus, through which it finds its way purged of the impurities, perhaps not all, but practically so, and heated to a very high temperature. The muddy accumulations lodge in the apparatus; thus the boiler is kept clean and the water heated, the results being such as may be expected. In one instance the experiment has been continued since June last; the boiler has not since been chipped or cleaned in any way, such not being required. The fittings are as good to-day as at the beginning, whilst its neighbouring boilers are undergoing the usual fortnightly cleaning and new fittings being added. Other advantages are obtained which need not be referred to. I cannot presume to occupy your valuable space by giving full descriptions of the apparatus or the name of the designer, &c., but as soon as the experiments are finished and all in order I shall be glad to supply details of the results and full particulars of the apparatus. I have said nothing as to how the heat is obtained; suffice it to say, it is at no additional expense. A very important feature in its favour is its automatic action, simplicity, and so far its effective use. In this apparatus we will have a very near approximation to that which we have been endeavouring to arrive at, namely, a cheap, effective, and trustworthy method of feeding, heating, and purifying water, not after, but before it reaches the boilers, and keeping the same clean—at least such is the opinion of STEAM USER.

Newcastle-on-Tyne, March 16th.

THE SHOEBURYNESS EXPLOSION.

SIR,—The late Shoeburyness "accident" is not one of a nature calculated to cause much surprise, one would think, among professional men, the wonder should be rather the other way; but it is truly a marvel that so many scientific officers should be found in Woolwich Arsenal who would crowd round a live shell while its percussion fuse was being "tapped" with a mallet or hammer. In addition therefore, to the examples of fatal explosions given in THE ENGINEER of 13th inst., I will, if you allow me, mention two remarkable instances that occurred as far back as 1840, under somewhat similar though at the same time less likely circumstances to give such a result, all which, we may easily imagine, would be borne in mind by most members of the profession.

When our squadron was blockading Alexandria during the Syrian war, one day, while exercising at general quarters, the gunner of the Medea steamer had got a 10in. shell up out of the shell-room, and while sitting on the edge of the hatchway commenced unscrewing the cap of the metal fuse; unfortunately, there proved to be a small quantity of fuse composition in the thread of the screw, which became ignited by the friction. The gunner at once dropped himself down into the shell-room and escaped, and the surgeon and the purser, who were sitting at the gunroom table close by, threw themselves flat on the deck and were equally as lucky as the gunner. The explosion partially wrecked the gunroom and blew up a portion of the upper deck, splinters of the shell killing or wounding about half a dozen of the crew of the gun above, and singularly enough, a mate, who was in the act of running up the companion ladder, was blown on to the upper deck uninjured, excepting the loss of his clothes, which were all torn off his back. On the report of the circumstances reaching the Excellent authorities at Portsmouth, they would hardly believe such to be possible, and so ordered an experiment to be tried with an empty shell on Rat Island in that harbour; the result was that precisely the same sort of thing occurred, for when the marine artilleryman had nearly unscrewed the cap of the fuse, ignition took place, blowing the metal cap right into his forehead, killing him on the instant.

London, March 14th. THOS. KNOX FORTESCUE.

RAISING SUNKEN SHIPS.

SIR,—In looking over some back numbers of THE ENGINEER in the issue for April 21st, 1876, I saw a paper written by Mr. Henry F. Knapp, C.E., "On Recovering Sunken and Stranded Vessels," in which he speaks of the backward state of this art, and describes his method of chaining and the ordinary process of dragging. Without entering into the details of his very interesting paper on the various methods of raising sunken vessels after the chains are attached, it appears to me that the first thing to be taken into consideration is to have every vessel fitted with an apparatus that would be automatic and mark the position where she might sink, and at the same time be a means whereby the chains necessary for raising might be attached to her. Many vessels sink in three or four hundred fathoms of water, and their exact positions being unknown, no steps can be taken for their recovery; and even allowing that the exact position of a sunken vessel were known, both the ordinary system of dragging and Mr. Knapp's method of chaining would be impracticable at great depths. There would be no more difficulty in raising a vessel out of seven or eight hundred fathoms of water after the chains were attached than out of fifty fathoms, though of course more time would be required. A very useful invention has lately been made which supplements Mr. Knapp's article in a very material degree. It is an apparatus which by means of buoys automatically marks the place where a vessel might sink, providing it were within a certain depth of water, say a thousand fathoms. By a very simple process by means of this apparatus, the necessary chains can be attached to the sunken vessel, and she can be raised, and if not seriously damaged, could be temporarily repaired, pumped dry, and towed into port, by vessels sent out to her for that purpose. The buoys are also fitted with life lines, and would be useful in saving life in case of a collision or other sudden disaster, should there not be time to save all the passengers and crew in the boats before the vessel sank. As this apparatus is very simple and inexpensive and requires very little space, it can be fitted to vessels already built as well as to those that may be building; it ought therefore to be of the greatest utility to underwriters and shipowners, who suffer the loss of millions yearly on account of being unable to recover vessels and cargoes, which in many cases would leave a handsome profit after paying all expenses connected with raising and bringing them into port.

I hope you will kindly insert this for the benefit of those who are interested in shipping and marine insurance offices.

St. Petersburgh, March 13th. H. T. M.

RAIL JOINTS.

SIR,—Allow me to call your attention to the communication in the *Railroad Gazette* of 6th inst. concerning the breaking of angle fish-plates. You will see what a number of them have gone in the middle where the rail ends abut. I have been contending for some time past that although angle fish-plates serve a useful purpose in some cases to strengthen weak rail joints, yet it is hardly well to adopt them indiscriminately, especially in the case of rail sections of strong design. I make bold to say that it is the tendency now-a-days to get the joints too rigid to brace up and strengthen the rail ends, with such a solid structure of fish-plates spiked down each joint sleeper with two spikes, that in many cases the joint will not yield at all, and in point of fact is stronger than the rail in the middle. With what result? Either that the fish-plates themselves fail or that the rail ends give and crush over before the rail is at all worn in the middle. This is no mere theorising, for steel rails have been so worn out, whilst, on the other hand, rails fished with ordinary plain fish-plates have worn uniformly throughout their length, and have not gone more at the ends than they have in the middle.

I speak from experience, having seen some rails recently on a surburban line where the traffic was very heavy and watched them for months together, as they were waiting renewal. Having been down thirteen years in the track, the jarring on the fish-plates had worn them loose, and to make them serve at all the platelayers had simply reversed them, so that whilst they spliced the rails laterally, they offered next to no vertical support to the rails under the head; and yet for many months together they remained like this, without the rails crushing over at the ends. These were double-head rails, about 70 lb. per yard. I have had to deal with flange rails of similar weight per yard, and broad base of 5in. These are fished with plain fish-plates, and under several years of wear there is no sign of the rails failing at the ends.

You may suppose that in the case of the American angle fish-plates they may have failed, owing to inferior quality, but you will observe they have practically all gone in the middle, and as the customary test during manufacture is to bend samples cold to right angles, one would imagine this could hardly be. But as I say above, they have no chance of bending—the joint being such a solid structure—they must either crack or break, and if the fish-plates hold their own and refuse to yield, then I maintain the rail ends bear the punishment and crush over prematurely.

22, Great George-street, Westminster, F. G. FIELD.
London, S.W., March 17th.

FLOATING BREAKWATERS.

SIR,—Mr. Leeds handsomely acknowledges the part I have borne, with the independent impartial aid of the press, in arousing public attention to the subject of floating breakwaters, and thinks the tide has at last permanently turned in their favour. It is certainly high time, but prejudices and vested interests yield very stubbornly. In speaking of the Greenway breakwater he is not quite accurate. The counter currents and collisions produced by it are by no means confined to the lateral ones. Upper and under currents, and currents at various inclines and angles, are produced and brought into collision designedly by the peculiar though apparently simple form of my turnwater. By all means let him or others invent something better, but I cannot permit them to claim as original the very thing that my models, pictures, and words have been teaching the public for two years, so I trust he will be careful. Of course everything progresses by degrees, and nothing is incapable of improvement, but to be claimed by him or others they must be clearly original.

Next, his idea that quieting the mere surface will make a harbour is a mistake. Ships are torn from their anchors not by surf, but by rolling billows many feet deep. The few inches that a boat needs may be quieted by oil or other simple means, but the 10ft. or 15ft. that even small ships are immersed in cannot be deprived of its power when in movement by any mere surface effect, as Mr. Leeds desires.

I shall in a future issue, if you permit, give a brief sketch of the different forms of floating breakwater through which we have arrived at our present position, and among them Mr. Leeds will find one horizontally breaking the water as his does, and on a much larger scale. For the present bronchitis keeps me in bed, despite all breakwaters. E. C. GREENWAY THOMAS.

National Club, Whitehall-gardens,
March 19th.

RAILWAY SIGNALLING.

SIR,—Are we to understand from Mr. Croft's letter, page 213, in answer to "Express Driver," that the invention which he says he has seen tried on one of the engines belonging to Richard Evans and Co., Haydock Colliery Railway, Earlstown, gives a true and proper signal on the engine when he is passing a signal at danger, whether it be a distant or home signal? Mr. Croft says in his letter that the patentees claim that signals against a driver shall be as clear to him in foggy weather as though there was no fog. Sir, I should think that, if such an invention has been tried as "Express Driver" says he has seen on the above railway, also in Mr. Croft's remarks on the above invention, I should think that, if such an invention is as good as "Express Driver" and Mr. Croft represent it to be, can "Express Driver" or Mr. Croft tell if any railway company is adopting it, or has it been brought under their notice, and if they can tell who the patentees are of the above invention? GOODS DRIVER,

March 18th. North-Eastern Railway.

BOILER FURNACES.

SIR,—In this week's ENGINEER you have a notice of a paper on this subject read lately before the Manchester Association of Employers and Foremen, by Mr. Samuel Boswell, and in which Mr. Boswell is reported as saying "that the Hawksley and Wild flange, like the Bowling and Adamson and other flanges, possesses the inherent defect, viz., that when repairs are necessary the boiler end has to be taken off before the furnaces can be extracted." Surely, Sir, Mr. Boswell must have been misreported, as he will be aware that one distinguishable feature in our flanged rings is that they can be taken out without disturbing the end or stays of the boiler. The insertion of this correction in your next issue will much oblige, HAWKSLEY, WILD, AND CO.

Brightside Boiler and Engine Works,
Saville-street, Sheffield, March 16th.

THE INSTITUTION OF CIVIL ENGINEERS.

THE CONSTRUCTION OF LOCOMOTIVE ENGINES, AND SOME RESULTS OF THEIR WORKING ON THE LONDON, BRIGHTON, AND SOUTH COAST RAILWAY.

AT the meeting on Tuesday, the 3rd of March, Sir Frederick J. Bramwell, F.R.S., President, in the chair, the paper read was on "The Construction of Locomotive Engines, and some Results of their Working on the London, Brighton, and South Coast Railway," by William Stroudley, M. Inst. C.E.

The author, on his appointment to the London, Brighton and South Coast Railway, in 1870, had to consider what kind of locomotive engine and rolling stock would best meet the requirements of the service; as, owing to the great increase and complication of the lines and traffic, the original primitive engines and rolling stock were not able to do so. He, therefore, in the same year, designed a large goods engine, class "C," arranging the details so that they would enable him to construct the several classes illustrated, all the principal parts being interchangeable. Having had long experience with both outside and inside-cylinder engines, he adopted inside cylinders, but placed the crank pins for the outside rods on the same side of the axle as the inside crank, the outside pin, however, having a shorter stroke; and he thus obtained the advantages of both systems. He adopted the method of putting the coupled wheels in front, instead of at the back as usual, which permitted the use of small trailing wheels, lightly weighted, and a short outside-coupling rod for the fast running engines, and also a much larger boiler than could be obtained when the coupled wheels were at the back. The author adopted a somewhat high centre of gravity, believing that it made the engine travel more easily upon the road, and more safely at high speeds; the slight rolling motion, caused by the irregularities of the road, having a much less disturbing influence than the violent lateral oscillation peculiar to engines with a low centre of gravity. The high centre of gravity also threw the greatest weight upon the outside or guiding wheel when passing round curves; and this relieved the inner wheels, and enabled them to slip readily. The author used six wheels in preference to a bogie for these engines, to avoid complication and unnecessary weight. The engines were very light for their power. Spiral springs were used for the middle axle, and these had a greater range than the end ones for the same weight. The two cylinders of the large engines were cast in one piece, with the valves placed below, giving lightness, closeness of centres and easy exhaust and steam passages. The crank axle was the only disadvantage left in an inside cylinder, inside framed engine, and, when this was of good proportions, it offered but a small objection. Owing, however, to the narrow gauge of the rails in this country, the crank axle could not be made so strong as it ought to be, or there would be no reason why a crank axle should break. When the flanges of the driving wheels were turned down thin, so as to avoid the side shock given by crossings and check-rails, there only remained the strain of the steam upon the pistons to cause breakage; the action of this was precisely the same as the methods used by the late Sir William Fairbairn in testing to destruction the model tube for the Menai Bridge, by letting a heavy weight rest upon it suddenly at frequent intervals. The deflection, if sufficient, caused a crack at the weakest place, which gradually extended until fracture took place. This was precisely what occurred in the axle; the crack invariably commencing on the side of the axle opposite to that to which the steam was applied.

The author, after thirty years' experience, believed that the separate parts of locomotives, including tires, axles, piston-rods, side-rods, bolts, cotters, and carriage and wagon axles, broke from the same cause; they did not break when carefully designed and made with proper materials and workmanship. As the crank axle could not be made of the proper strength, it was well to consider how to avoid, as far as possible, risk of accident by its failure. By making the axle-boxes and horn blocks deep and strong, giving large flat surfaces against the boss of the wheel and the outside of the crank arm, the driving-wheel was kept in position after the axle was broken, if the fracture occurred in the usual place, namely through the inside web, near the crank pin, or through the centre part where it joined the inside web. An axle broken in this manner would run safely over any part of the road, except at a through crossing, where the guiding-rail was lost, and the flange was liable to take the wrong side of the next point; this, however, had not happened in the author's experience. The author had always hooped the larger cranks, and had for some time hooped every new crank in the same proportion as adopted on the Great Northern Railway, thus reducing the risk to a minimum. The engines had been arranged that part of the exhaust steam might be turned into the tender or tanks, so that the feed-water might be heated. This was a special advantage in a tank engine, by increasing the total quantity of water; it also kept the water supply of greater purity, and it relieved the boiler of a certain amount of duty in heating the water from the ordinary temperature to that which feed-water required. The feed-pumps had been designed to meet the requirements of pumping hot feed-water. The proportions of the valve gear gave an admission of 78 per cent. of steam in full gear, which could be reduced to 12 per cent. with excellent results; and as at high speeds the steam was never exhausted, the temperature of the cylinder was maintained and as much steam was locked up in the cylinders as raised the pressure at the end of the stroke to near that in the steam chest. This made the engine run very smoothly at high speeds, and turned what would otherwise be an extravagant coal burner into an economical machine. And for the same reason the compounding of fast passenger or frequent-stopping locomotives was not likely to show much, if any, economy over a well designed simple engine. The case was different, however, in heavy goods engines, working with a late cut-off most of the time, and where the conditions approximated closely to those of a land or marine engine with a constant load. The back pressure observed in the diagrams of high speed locomotives was not therefore a defect, but an advantage, and the author accordingly used small steam-ports and short travel of slide-valve. These remarks as to back pressure did not apply to the pressure in the exhaust pipes, where it should be as small as possible, but only to the back pressure in the cylinder. The latter was greatest at high speeds, when a small volume of steam was passing through the cylinders, and small power was required, and least when working full power with the smallest expansion. All the passenger engines and many of the goods engines were fitted with the Westinghouse automatic air-brake, as were also the whole of the carriages. This brake gave entire satisfaction, and complete control of the trains. The author took considerable pains with the fittings and details when it was first introduced, and arranged the gear for the engines, so that the brake acted upon each wheel independently, allowing the springs freedom to act; or it acted upon the front of all the wheels, as in the tank engines, the brake of which was moved by hand as well as by the air-pressure. The Westinghouse air-pump had been fitted with a plunger at the bottom end of the rod, 1⅞in. in diameter, and this pumped water into the boilers of the goods engines when they were in sidings or were delayed by signals. For the express and large goods engines, the greatest possible amount of heating suface had been provided; the fire-box was capacious, with small tubes of considerable length in proportion to their diameter, little or no flame being generated with the coal used, and a very small amount of soot. The fuel which was found cheapest to consume in this locality was smokeless coal from South Wales, mixed with a small quantity of bituminous coal from Derbyshire. The boilers were made of the best Yorkshire iron with plates having planed edges; holes were drilled after the plates had been bent; the joints were butt-joints, and they were hand rivetted. The construction of the ash-pan and its dampers, perforated plates, water supply, and the arrangement of fire-bars, brick arch, fire-door and deflector, was shown. The indicator diagrams, taken by one of the Crosby Steam-gauge and Valve Company's indicators, at various speeds, and under varying conditions of gradient, afforded a fair idea of the working capabilities of these engines, the economical value of which was best shown by quoting the consumption of fuel for the half-year ending the 30th of June, 1884, when the average of the whole of the engines on this line was 29·74 lb. per engine mile, including the coal used in raising steam. A great number of careful tests had been made of the amount of coal required to raised steam in the engines from cold water, and also from the partially heated water when the boiler had not been emptied, and this amounted on an average to about 3 lb. per mile run. Some doubt had been expressed as to the value of heating feed-water by the exhaust steam. The author, therefore, had a number of tests made with the ordinary heating apparatus removed, and water fed to the boilers by the feed-pumps, and in one series by a Borland's injector. The amount of power required to work the pumps was inappreciable; and the heated feed-water brought about reduction in the consumption of fuel to the extent of over 2¼ lb. per train mile. It had also been found that heating the feed-water by direct contact of the steam did not, on this railway, injuriously affect the boiler plates. With a view to ascertain what was the amount of power required to haul a train from Brighton to London, a complete set of 49 diagrams was taken from the engine Gladstone working an express train of twenty-three vehicles, the total weight of train and engine being 335 tons 14 cwt. A section of the line was given, and clearly illustrated the result, giving the horse-power at about every mile, the speed, and the gradient. The temperature of the gases in the smoke-box was taken at frequent intervals; also the degree of vacuum in the fire-box and in the smoke-box, and the quantity of water used out of the tender. To the latter had to be added the water condensed from the exhaust, which from experiments the author estimated at 20 per cent. This gave an evaporation of 12·95 lb. of water per 1 lb. of coal, and 1 lb. of coal would convey 1 ton weight of the train 13½ miles, at an average speed of 43·38 miles per hour, over the Brighton Railway, the rate of consumption being 2·03 lb. of coal per horse-power per hour.

H.M.S. "STAGNATION."

ADMIRALTY DUET.

Sung Nightly, with the greatest enthusiasm, by the present First Lord and his Chief Secretary.

DO ye want to know what's a first-class craft
For a home or a foreign station?
Why then, come give a look, Mates, fore and aft,
At her Majesty's Ship *Stagnation.*

Every inch of her hull's our own design:
Her plates are as thick as a wafer;
While her belt, just down to the water-line,
Makes her cheaper, my Mates—and safer!

Then her bow and stern are planned with a skill
That should rouse an enemy's wonder;
For as soon as they're hit they'll quietly fill,
Come off in a lump, and go under.

No matter—the moment peril she spots,
She can heap on her coals in plenty,
And make, at high pressure, her thirteen knots,
While the foe that's in chase makes twenty.

And if through her boilers a shell goes clean,
And she's forced to offer resistance,
She'll run out her guns,—when the fact she'll glean
That they won't carry half the distance.

What's the odds? Old-fashioned, useless, condemned
On inquiry, searching, judicial,
Let them burst! Why not? Don't they serve their friend,
The permanent Woolwich Official!

"With ships and with guns,—not as these, of yore
Did NELSON make all Europe caper?"
That's true; and these here, by which we set store,
Exist only yet, Mates—*on paper!*

But contracts are placed; and, fifty years hence,
If work goes on fairishly steady,
Should ten be required for sudden defence,
It's possible one may be ready!

And she'll be, my Mates, quite a first-class craft,
And a credit to this here nation;
So let the salt breezes three stout cheers waft
For "Her Majesty's Ship *Stagnation!*"

—*Punch.*

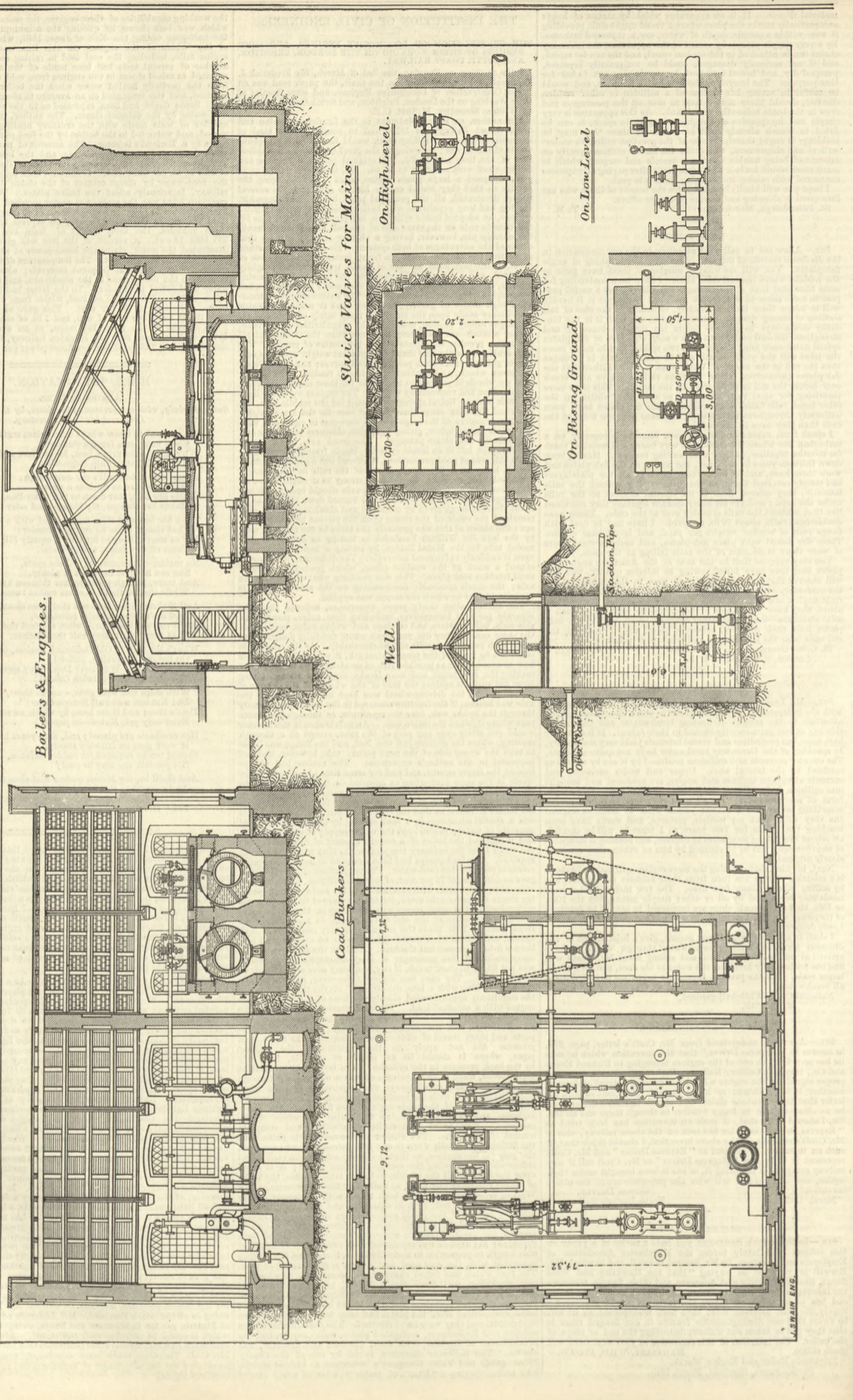
THE American *Mechanical Engineer* gives this from the *Indicator*, the Stevens Institute journal, as showing how the young engineers in that school chop logic:—"For the benefit of those reciting on 'Materials of Engineering,' we publish the following as a mathematically correct conclusion from the statement of Professor Thurston, that: The factor of safety is a factor of ignorance. Hence we have: Factor of safety = factor of ignorance, safety = ignorance, hence safe = ignorant. A safe man in materials of engineering = an ignorant man in materials of engineering. But a man safe in materials of engineering = a man safe to pass in materials of engineering. Axiom: two things equal to the same thing are equal to each other. A student ignorant of materials of engineering is safe to pass in it."

KING'S COLLEGE ENGINEERING SOCIETY.—At a general meeting held on Tuesday, March 3rd, a discussion took place on "Lighthouse Illuminants." Mr. C. H. Wordingham, in opening the discussion, pointed out that among other conditions to be fulfilled by a good system of light for lighthouse purposes, there should be (1) great penetrating power both in fine and in foggy weather; (2) perfect regularity in intensity and in character, as the light might otherwise become a source of danger instead of security; (3) facility of maintenance for a considerable time without any adjustment of the lamp or other apparatus connected with it; and (4) small dimensions of the source of light, so as to allow of its being placed in the focus of the optical apparatus, in cases where a parallel beam of light is required. Having given a brief history of the modes of lighting lighthouses down to the recent experiments at the South Foreland—the results of which he thought would probably, when published, go far towards determining which system of lighting best fulfils these requirements—Mr. Wordingham claimed undoubted superiority for the electric light over gas and oil, in respect to intensity and relative cost, except for isolated positions, but stated that for hazy weather the oil and gas lights were generally found to have greater penetrating power owing to their containing a larger proportion of red rays. In an experiment, however, at the South Foreland, made during a dense fog, the gas and oil lights were lost sight of at 1000 yards, whilst the electric light was visible at a distance of 1300 yards. As to the question of expense, Mr. Wordingham quoted a table given by Sir James Douglass, which showed in favour of the electric light, that the relative cost diminished in proportion as the required maximum intensity was increased. Mr. Fielding thought that an additional requirement to be fulfilled by a system of lighthouse illumination was that it should afford the means of increasing the intensity of the light during foggy weather. In answer to Mr. Davy, he said that he did not think that the Albo-carbon light had yet been tried for lighthouse purposes, but that he believed Mr. Dixon intended doing so at the South Foreland. Mr. Anderson advocated the use of Pintsch gas for lighthouses and buoys, owing to the ease with which it could be manufactured and stored. After some further discussion, in which several other gentlemen took part, the president, Mr. C. J. Thornton, made some concluding remarks, in which he pointed out the advantages of multiform and revolving arrangements of lights.

THE REMSCHEID WATER WORKS—PUMPING STATION.

HERR L. DISSELHOFF, ENGINEER.

(For description see page 219.)



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.*

W. C.—*We have not the name of the publisher of Thwaites' brochure "On the Gas Engine," but will obtain it.*

M. M.—*Several; but it is very difficult to get an apprentice taken without interest, or, at least, very good introductions.*

A. L. (Golden Hillock).—*We cannot find anything new in your suggestion about screw shafts, and the ball-and-socket joint would not drive unless it was screwed up so tight as to be rigid.*

A CONSTANT SUBSCRIBER.—*Do away with the countershaft and drive direct. We have not sufficient data to say what the saving will be, but whatever is lost in transmission now between* A *and* F *will be about halved.*

EXPANSION.—*The total expansion is found by dividing the number of cubic feet of space in the small cylinder behind the piston at the moment the expansion valve closes into the space behind the piston in the large cylinder at the moment the exhaust opens.*

PEAT MOSS LITTER MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Can any reader inform me of the name and address of makers of plant for making peat moss litter? Messrs. Von Beck are mentioned to us as makers. Could any one give us their address? H. M.

Hyde, March 13th.

AMERICAN RAILWAY COUPLERS.

(*To the Editor of The Engineer.*)

SIR,—Your correspondent "Assoc. M.I.C.E." can see, by calling at this address, several specimens of automatic couplers and buffers used upon the Pennsylvania Railway and many of the other large railways in the United States ALFRED DAVIS.

Parliament Mansions, Westminster, March 17th.

THE TRANSMISSION OF POWER.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers inform me from experience how power conveyed from a water-wheel some distance off answers conveyed by wire ropes on carriers, and who are the best parties to obtain estimates and information from? CHAFF-CUTTER.

North Wales, March 18th.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 24th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion, "The Electrical Regulation of the Speed of Steam Engines and other Motors for Driving Dynamos," by Mr. Peter William Willans. Friday, March 27th, at 7.30 p.m.: Students' meeting. Paper to be read and discussed, "The Compound Principle as Applied to Locomotive Engines," by Mr. Fred. Platt, Stud. Inst. C.E. Mr. G. B. Bruce, Member of Council, in the chair.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, March 26th: "On the Seat of Electro-motive Force in a Voltaic Cell," by Professor Oliver J. Lodge, D.Sc.

SOCIETY OF ARTS.—Monday, March 23rd, at 8 p.m.: Cantor Lectures. "Carving and Furniture," by Mr. J. Hungerford Pollen. Lecture III. The age of Gibbons, Boule, and that of their successors. Wednesday, March 25th, at 8 p.m.: Sixteenth ordinary meeting. "The Musical Scales of Various Nations," by Mr. A. J. Ellis, B.A., F.R.S. Sir Frederick Abel, D.C.L., C.B., F.R.S., Chairman of the Council, will preside.

DEATH.

On the 4th Feb., at the Lisbon Berlyn Gold Fields, Transvaal, from malarial fever, ALFRED "JOE" ATTENBOROUGH, C.E., A.S.I., aged 29.

THE ENGINEER.

MARCH 20, 1885.

THE ADMIRALTY AND THE NAVY.

ON Monday night the Naval Estimates were moved by Sir Thomas Brassey. There was some discussion, and a great deal of criticism. In fact, the Navy was considered from several aspects by various members. We do not intend to say anything here about the criticism; nor to follow Sir Thomas Brassey and consider his proposals. It is impossible to regard these with much interest. They refer to events which may possibly take place in the future. The precise ships which Sir Thomas Brassey tells us are to be built never will be built; all sorts of changes and modifications will be made in them. It is more interesting to discuss the Admiralty itself than its schemes. The British Navy is always dealt with in a make-believe kind of way by Admiralty after Admiralty. We are always going to have plenty of ships and guns and men. The authorities at Whitehall live in the future; for them the present seems to have no existence. We are on the brink of war with Russia, and the most powerful ships of the British fleet exist only on paper. We have a splendid peace Navy. Is it fit for war? There can be, we hold, but one answer to this question: It is not. We shall not go into details. They have been recently discussed by the daily press *ad nauseam*. We propose here to deal with an aspect of the question which has not been properly considered. It is admitted by all, save, perhaps, Sir Wilfrid Lawson and Mr. Richard, that the British Navy is not what it ought to be. Why is this? It cannot be argued that political influences are responsible. The state of the Navy never yet made a good party question, because no matter what party was in power, the facts regarding it were the same. Why, then, we repeat, is the Navy not what it ought to be?

The answer to be complete must involve many considerations. The more influential and important we can easily state, and the statement may, perhaps, do some good. In the first place, then, there is divided responsibility between the Admiralty and the War-office. Again, successive Boards of Admiralty have vied with each other in being economical. The notion seems to have become deeply-rooted at Whitehall that the Naval Estimates must be kept down. There is, however, no instance, we believe, since the Revolution, in which Parliament has refused to vote any sums that were required for the Navy. It is true that when the outlay was a little larger than usual there has been a little grumbling, but the grumbling would have been just the same no matter how small the sum asked for; and it would have been the same for obvious reasons which we need not stop to explain. If we dive beneath the surface we shall find, too, causes at work inducing parsimony—we shall not say economy, because that word has no application in the present connection. The first of these is tradition. After the Battle of Trafalgar, England found that her naval supremacy was universally acknowledged. That supremacy had been purchased at a tremendous cost, and thenceforth economy in naval matters became the order of the day. The tradition has been continued. The second cause to which we have referred is that expenditure on war ships is regarded as immoral. The Minister who asks for money for the Navy always seems to apologise for the act. He regrets that money should be so spent, and to minimise his guilt, he asks for as little as possible. All the money spent on the Navy is regarded as money wasted. It brings in, we are told, no return of any kind. The building of an ironclad is the loss of so much wealth to the country. Did our readers ever yet meet with any one who did not hold this view? If they have, they have been fortunate. Even in times like the present, when we are on the verge of a panic, we still hear regrets expressed that large sums should have to be spent on the Navy. There are, of course, exceptions—men who hold that money spent on the Navy is not an immoral waste of taxes; but they are the exception, and they do not speak often enough or loudly enough to influence the Admiralty.

There is another and it seems to us a yet more potent reason why the Admiralty does not get money enough voted to keep up our naval strength to the proper point. This is the circumstance that if they had the money they would not know how to spend it. Let us suppose that a couple of millions extra were voted any night this week by the House of Commons, on the distinct understanding that this sum was to be laid out within six months in augmenting our naval power. We do not hesitate to assert that the Admiralty could not spend the sum to any advantage in the time. It would not know. It would be in the same condition as the schoolboy landed with half a sovereign in a toy shop. The competitive claims of a dozen attractions prove too much for him, and he has to go home and sleep on the matter. In the same way the conflicting recommendations of torpedo boats, ironclads, Scouts, unarmoured cruisers, rams, *et hoc genus omne*, would prove too much for the Board of Admiralty. Then red tape would have to play its part; and the War-office would have to be consulted; and weeks and months would be lost before one sixpence was spent as it ought to be. No one seems to have dealt with the Admiralty as an institution from this point of view. Over and over again it has been said, Why does not Whitehall ask for money? and the true answer, which is that Whitehall does not want it, has been overlooked. It must be understood here that we are not talking of the officials. We do not refer to Mr. Barnaby or his assistants. Those who are behind the curtain know that months are taken up by my Lords in making up their minds to adopt any design. A proposal to suddenly break out and build half-a-dozen ironclads, a dozen fast cruisers, and a hundred torpedo boats off-hand would strike the Board as being sheer lunacy. If such action were forced on my Lords it would trouble them very much indeed. If the Admiralty Board were really a power, if it had a determinate policy, our Navy would not be what it is. The excuse that money is not to be had is but an excuse. It is not true.

A remarkable instance of the accuracy of our diagnosis is supplied by the incessant delays and changes and alterations made in our men-of-war while on the stocks. If the authorities could but see that the difference in the merits of any two ironclads is based on certain broad principles, we would have less delay than we have. The three essentials in an ironclad are:—Strong armour, heavy guns, and considerable speed. If we have two ships, one armoured with 14in. armour, the other with 15in.; the one mounting 80-ton guns, and the other 100-ton guns; the speed of both being the same—say 14 knots—the difference between these two ships will be so small that it is not worth while to wait for it. What is the course pursued by the Admiralty? A ship is laid down to mount 80-ton guns. She is to be constructed in three years. At the end of that time it is thought advisable to put 100-ton guns into her. She has to be all pulled to pieces and strengthened, her turrets enlarged, and so on. Then other changes are found necessary, because the new guns will make her draw more water than was intended; and so three years more are wasted. Should not common sense show that the superiority of the new design over the original is so small that it is not worth waiting three years for? One 80-ton gun at sea in such an emergency as the present would be worth one thousand 100-ton guns to be had in, say, ten years. The Admiralty never has sufficient strength of mind to believe in its own designs. It is always chopping and changing, and the changes are by no means always in the right direction.

No matter what Parliament may do, there never will be any radical change for the better in the Navy until it is fully understood that the outlay on our fleet is no more an immoral expenditure than that on sewers or police. It is essentially necessary that we should be strong that we may be safe. To be weak in naval power is immoral, because our weakness tempts others to go to war with us. We have often pointed out that even supposing that it was quite unnecessary for our national safety to build a big ironclad, the outlay on her would not represent a dead loss. The money so spent would go into circulation in England. It is not as if we had to buy our munitions of war abroad, like other nations. It is unnecessary, however, to pursue this argument further. The only direction in which we can see the prospect of a change for the better lies in remodelling the whole Admiralty system. It ought to be entirely dissevered from the War-office, which supplies it with guns, and it ought to be composed of men of a different type from those who compose it generation after generation. As a peace institution it is no doubt useful, and in a blundering, pottering kind of way it carries out valuable, if costly, experiments. If war breaks out the Admiralty will tumble to pieces. What is wanted is a Board composed of men who will ask for money enough, and who will know how to spend it when they get it. The mischief which has already been done is very serious; let us hope that the British nation may not learn how serious before 1885 has become a thing of the past.

MADRAS AND COLOMBO HARBOURS.

WE understand that Sir John Coode left England on the 18th of this month for Western Australia, *en route* for which colony he will call at Ceylon to finally inspect the works at the new breakwater at Colombo prior to handing them over as complete to the local government. When doing so he cannot fail to contrast satisfactorily the result of his own labours with that which has followed at the sister works at Madras. We have followed with much interest the rivalry as to completion which has attended these two since they were commenced at, comparatively speaking, the same date. For a long time the progress with the Indian harbour seemed to promise that it would be out of hand long before that at Colombo even approached completion; but we have since seen the old fable of the hare and the tortoise verified, and while the residents in Ceylon have now to congratulate themselves on the possession of a safe and secure harbour, those of Madras have nothing to look upon for all their outlay but the crisping of the waves as they break upon the ruins of their destroyed breakwaters. It is not our intention to pursue this painful contrast further than to remark that the expenditure at Madras is to be limited to such an amount as may secure some small advantage to the shipping resorting to that port, a limitation which seems to present no prospect of a completed work for many years to come.

When Sir John Coode reaches Ceylon, he will find, we believe, that there is but little more for him to do than to officially declare the operation complete, and arrange for the dismissal of the staff which has worked so efficiently under his direction, and the removal of the valuable plant, either to be stored or offered for sale. That plant, we are informed, cost the Government of Ceylon no less a sum than £60,000, and it included much that was of a perfectly new type, the efficiency of which has been fully proved by the low rate of cost at which, through its agency, the breakwater has been brought to completion. Now we can readily enter into the feelings of the colonists when, with future necessities apparent, they are disinclined to see this plant consigned either to the loss attendant upon the sale of such a speciality, or to the inevitable deterioration which must follow its being stored for an indefinite time in such a climate; and we may express the hope that the local government will be able to take some steps to avert such a loss, and utilise both the plant and staff in the early prosecution of the further work which both the mercantile interests of Ceylon and the experience of the consulting engineer deem to be desirable. Before dealing with this part of the subject by the light thrown upon it by the scientific reports and the comments of local experience, we may just refer to the cost incurred to date upon the works now practically completed. We see that in his report to the end of 1884 the resident engineer stated that to that date the whole amount expended had been £797,506, and assuming a further expenditure of £2000 monthly until the end of April, that total will have increased to £805,500. We have not data sufficient to enable us to separate out of this sum the relative cost of breakwater, dredging, and pier work, but, doubtless, details affording so much information of interest will ere long be forthcoming. Such works as the Colombo breakwater, mark, by their comparative paucity, an era in the advance of economical engineering, and we shall be able to learn by these details, when available, how far the adoption of the most scientific mechanical aids has enabled the cost of such a work to be reduced from that of its forerunners of a similar type.

It is the expressed desire of the colonists that no time should be lost in the construction of another breakwater to the northward, which shall ensure perfectly still water within their new harbour at all times. Although now sheltered from the fierce storms of the south-west monsoon, a long-shore wind often raises such a nasty joggle of the sea that coaling operations, save by boat, are impracticable, and almost from the first inception of the scheme Sir John Coode has declared such a northern arm to be a desideratum. This need only be of the roughest description, a mere mound of *pierre perdue*; and we understand the estimate for it to be about £185,000, for which additional expenditure all the advantages of a perfectly land-locked harbour will be secured. A deputation recently waited upon Sir Arthur Gordon, the governor of the colony, to urge that in view of the loss which must ultimately follow the dispersion of the staff and the removal of the valuable plant above referred to, as well as of the proved necessities of the annually increasing tonnage using the port, this work should be put in hand at once. It is with surprise that we hear of the nature of the governor's reply to this application. He did not, we understand, in the least contest the desirability of the work or the advantages, pecuniary and otherwise, which must attend its prompt construction, but he based what seemed to be a refusal of the request made to him on the sole ground that he had no guarantee that the present estimates of the paying tonnage would be verified to the end of the thirty-five years which are the term for the repayment of the contemplated outlay by a sinking fund. If all public schemes proposed are to meet with opposition for the want of such a guarantee, it is impossible to see how any great works of public utility are ever to be carried out. The estimates upon which the deputation referred to based their application have been drawn up by the most competent authorities, and have been founded upon the progress which has been the result of the operations of the past six years. Except in the event of great Imperial calamities, it needs the most pessimist of minds to foresee any reduction in the shipping trade to the East. All, in fact, points to its further great development; and we fail to realise, therefore, that Sir Arthur Gordon's objection can have weight.

Another branch of the subject will claim attention by Sir John Coode while in Colombo. It is a fact generally recognised, that no great port can be considered to be complete unless it possesses docking accommodation for the vessels resorting to it. Now at present Colombo is absolutely destitute of such accommodation, and if any vessel chances to meet with an accident necessitating docking for repair anywhere to the south of Calcutta or Bombay, it is to one of these ports that she is at present compelled to make her way; and as the monsoons blow steadily either from one or the other quarter for many months together, a disabled steamer endeavouring to reach those places under canvas alone is at great disadvantage. We feel sure, therefore, not only that a dock is required at Colombo, but that it has every chance of becoming an exceedingly well-paying investment. Two schemes have been submitted to the authorities for providing such accommodation. The one embraces the construction of a land dock within an area known as the Lotus Pond, in close contiguity to the harbour, the other offers the alternative of a floating dock. Before discussing the relative advantages of these schemes we may refer to the fact, now well known, that the report of the Royal Commissioners on Colonial Defence included in its proposals the provision of docks at our several colonial coaling stations which do not as yet possess them. It is evident such a provision would be a most valuable adjunct to the efficiency of our naval operations in the event of war with a European Power; but it is also evident that such docks, to serve their intent efficiently, must be capable of taking in the largest of our ships of war. Certainly we have in such a need justification for large Imperial help towards aiding the colonists of Ceylon to provide a dock at their new port, and we must express the hope that it will be given with no niggard hand, and enable a land dock shortly to be commenced. We are informed that the estimate for this is £135,000, while probably a floating dock could be provided for £75,000; but it seems to us to be doubtful if for that amount efficient accommodation could be provided by a dock of the last-named description for enormous weights such as our largest war ships. The question as we have put it will doubtless receive the fullest consideration by the engineer during his approaching visit, which from the matters we have mentioned will evidently be possessed of great public and scientific interest. We sincerely trust that no half-hearted apprehension for a distant future may delay works which will add to our colonial strength.

BOILER EFFICIENCY.

To get more heat out of a lump of coal than there is in it is a feat that has only been performed on special occasions, and by expert manipulation of figures. Sometimes it has been done by intentional or accidental omission of figures; the performance has, however, usually been occasional, and has been too great an achievement to be spoiled by repetition under the keen eyes of critics. At all events, this has been the view taken when boilers have shown phenomenally high powers of evaporation. The validity of the view, of course, depends on the unquestioned accuracy of the thermal value of combustible materials as found by calorimetric experiments. Occasionally figures obtained in practice have reached so near the theoretic limit that those who obtained the figures have been tempted to doubt the theoretic standard. Some results of evaporative tests of locomotive engines on the Brighton Railway, as given by Mr. Stroudley in a paper read last week before the Institution of Civil Engineers, are of so unusual a character that unless they had emanated from extensive trials, and from an engineer of known ability and carefulness, they would be rejected offhand as founded upon incorrect assumptions or measurements; and no doubt Mr. Stroudley's figures will be treated as open to question as to the way in which they have been obtained. He gives the evaporative power of the boilers of two of his passenger engines as ranging from 11·0 lb. to 13·81b., and an average of 12·95 lb. of water per pound of coal, the water being heated to a maximum of 186 deg. by exhaust steam turned into the tender.

Welsh coal is used. Now, if we take 14,544 units as the calorific value of pure carbon, such as coke or charcoal, and use only as much air as is necessary to provide the 2·667 lb. of oxygen required for combustion, namely, 12·2 lb., and the specific heat of air as 0·238, and the temperature of the air and carbon employed as 60 deg., we get, by proceeding on the method described in these columns on the 25th July last, as the possible theoretic number of units of heat available on perfect combustion, 16,127, equal to 16·69 lb. of water evaporated from and at 212 deg. The highest possible temperature of combustion will, however, be $(460 + 60) + \frac{14,544}{13{\cdot}2 \times 0{\cdot}238} = 5150$ deg., but if we take the temperature of the escaping gases as 300 deg., the lowest given by Mr. Stroudley, we then get a possible theoretic efficiency of $\frac{5150 - 760}{5150} = 0{\cdot}852$, so that under what are believed to be impracticable conditions there must be a loss of 15 per cent., or the greatest possible evaporation from and at 212 deg. becomes $\frac{16,127 \times 0{\cdot}85}{966} = 14{\cdot}19$ lb. Now, instead of pure carbon, Mr. Stroudley's results were obtained with Aberdare coal, and instead of 12·2 lb. of air there is little reason to suppose that he used less than 18 lb. as a minimum. If we take the coal as containing, say, 85 per cent. of carbon, we get, calculating as before, but giving the coal credit of 4·26 per cent. of hydrogen, and 3·5 per cent. of oxygen, the highest possible temperature of combustion 3257 deg., and a maximum efficiency of 0·793, or, say 0·8, and the highest possible theoretic evaporation 13·7 lb. per lb. of coal. According to this, some of the locomotive boilers on the Brighton line have done work equal to unit efficiency. Clearly there must be something wrong somewhere. Either there must be some error in the measurement of the water put into and taken out of the tender, or in the coal used, or there may be some error in Mr. Stroudley's estimate of 20 per cent. of exhaust steam which he turns into the tender to heat the feed-water, and by which 3 lb. of coal per train mile are saved. Nearly 90 per cent. efficiency has been reached in carefully conducted trials with boilers of the locomotive type. How far it may be supposed that the very complete combustion which takes place in the Brighton Railway fire-boxes and the low temperature in the smoke-boxes are to be credited with higher achievements it cannot be said, but it certainly seems that the figures obtained need to be carefully revised, or the experiments repeated with every care.

It has been suggested several times that the calorific value of combustibles, as obtained in the calorimeter with a few grains of the combustible, may not be as great as if obtained under other conditions of combustion; and although it cannot be stated with any strongly supportable argument that the high temperatures obtained in a locomotive fire-box are higher, or the conditions more favourable than in the calorimeter, it may, perhaps, be permissible to observe that the time which would be occupied in making some calorimeter experiments on a large scale would not be wasted; and it may be further observed that very high duties have been so many times observed during late years, and by men of known carefulness, that new calorimeter tests of the calorific value of coal are much wanted. At present we are led to conclude that boiler efficiency is so high that there is no room for improvement.

AN EXTRAORDINARY VERDICT.

On the 13th ult. a boiler explosion took place at the Mid-Kent Brickworks, Beckenham, which resulted in the death of five men, namely, John Poor, Frederick Edmeades, John Butler, and James and Daniel Fisher. After an adjournment to allow time for the examination of the boiler plates by a skilled engineer, the Coroner, Mr. Carttar, resumed an inquest last Saturday, at the offices of the Local Government Board, on the bodies of the men, and at its conclusion he sanctioned and recorded the following verdict:—"That the deceased men died from injuries received from the explosion of a boiler, through the undetected external corrosion of the shell by dampness in the setting, and not by the felonious hands of any person whatever." On enquiry we learn that the boiler—a Cornish one, 15ft. 3in. long, and 5ft. 7in. diameter—is about thirty years old, judging by the material of which it is made and the style of workmanship. In 1873 it was bought in Messrs. Jacob's yard, Newington Causeway, but whether it had got there from Government or a scrap heap, neither the representatives of that firm or anyone else seemed to know. We were, however, informed that the price recorded in Messrs. Jacob's books as having been paid for it was £98, and as this sum may be supposed to include a liberal commission, it is not easy to arrive at the precise value of the boiler. The purchaser was an oil company which had been floated by Baron Grant. This company was not successful, and after a fitful existence came to grief, when the boiler of which we write became the property of the Mid-Kent Brick Company. The manager of this company at the time, being undesirous of starting the boiler to work before having it inspected, duly got a man to examine it; this man, however, knew nothing about it, and in answer to queries at the inquest stated that he is a bricklayer, and on being asked what he knew about boilers he said, "Nothing; only the gentleman asked me to examine it for him, and I did so." For about ten years the boiler has therefore been at work in an open brickfield, and though we know that agents from boiler insurances have called upon the owners time out of mind, they objected to be hampered by any restrictions as to pressure, inspections, &c., which a boiler insurance company would have insisted upon. Some three months ago the fireman, one of the deceased, found much difficulty in getting steam, and supposing naturally that something must be wrong, he drew his fire, and upon examination found that one of the flues had fallen in, from the amount of dampness which had accumulated. This being repaired without any examination of the boiler having been made, steam was again got up and very easily maintained for eight weeks—in fact until the 13th ult., when the whole boiler separated along the sides, under 60 lb. pressure of steam, and five valuable lives were sacrificed to the economy of saving the pound or two a year which would have secured the careful inspection of a boiler insurance company. Mr. Maw, the engineer, for whose evidence the inquest was adjourned for three weeks, said that the cause of the explosion was corrosion, caused by damp setting, and he further expressed a very strong opinion that boilers should be examined periodically, at least once a year. We have seen the plates where they ruptured, and in places the iron has corroded down to a mere film of metal, which it is marvellous could withstand any pressure at all. When one reads of damp setting, it is natural to imagine that a boiler has been put to work before its bed was ready, and we, cannot quite see how the owners of this boiler after using it for so many years, can be entirely exonerated from all blame, when it was competent to them, and indeed their duty, to have careful examinations made. The damp setting no doubt came from leaking seams, and would have been detected in a moment, and the danger obviated, had a competent boiler maker examined the flues. Steam users should be made to understand that the mere payment of a sum of money in case of explosion or collapse is not the be-all and the end-all of a boiler insurance company, but that for a very small sum steam users can secure periodical and careful inspection of their boilers by competent men; get frequent reports as to its condition, and an entire immunity from blame should human life be sacrificed.

"THE TRAVELLERS' REST."

Our grimy friend, the collier, is not without a vein of humour, even in the hour of his affliction. At a time when he pleads that, work as he may, he can scarcely make sufficient wages to obtain the barest necessaries of life, he quietly takes note of his surroundings and schedules district collieries according to his knowledge or fancy. Passing through a leading mining district the other day, a gentleman was surprised to hear the term "Travellers' Rest" frequently applied to several collieries. On enquiry he found that the title had been bestowed by the miners on these collieries for certain—to them—all-sufficient reasons. According to their story, the present low wages are tending to the practice of much dishonesty. At these collieries thus dubbed with the distinctive title of the "Travellers' Rest," fresh hands are being constantly taken on. They remain until they run into debt. Then, when credit is gone, they go also, to repeat the experiment elsewhere. It is unfortunate, perhaps, that so serious a thing as practical dishonesty should be looked upon almost solely from a jocular standpoint; but the miners appear to think that the employers will themselves regard this misfortune as one of the factors to restrain excessive reductions of wages. But even the colliery proprietors can scarcely be expected to withdraw from their position because members of the mining class have forgotten to be honest. It is not uncommon indeed to hear some coalowners express a desire that the output could be diminished, if only to get rid of accumulated stocks. During the wages agitation at the end of 1883 an enormous demand for coal sprang up. Books were big with orders in anticipation of a strike, and prices advanced. It was expected that similar results would follow the present dispute, but the extra demand has not arisen, and the market is glutted with coal. Stacks of fuel are rising at the rate of 150 tons per day; hundreds of laden wagons block the railway sidings—one colliery alone having over 200 wagons of hards, which were offered at a reduction of 1s. per ton under selling price to clear. A month's enforced idleness would effect a clearance of pitbanks and wagons, and it is probable that better prices would rule. On the other hand, it is an expensive business to keep a colliery standing. Royalties are running on as usual, "wages" have to be maintained, interest accumulates on capital, and customers find other markets. A mere reduction of the pay sheet is a small affair compared with keeping colliery undertakings idle, when there is nothing coming in, and everything going out, and the distant coalowner industriously booking orders which he may continue to receive after the struggle is over. "A brother offended is harder to be won than a walled city," wrote the old sage. Yorkshire coalowners have found to their cost that it is perilous to permit large consumers to try other districts for supplies. They sometimes find that cheaper coal than superior Yorkshire can be made to serve their purpose; and having learned that lesson they remember it. Lost customers rarely return.

SHEFFIELD STEEL FOR HEAVY ORDNANCE.

The Surveyor-General of Ordnance—Mr. Brand—made a statement in Parliament on Monday night which is pleasant reading for Sheffield manufacturers. He said the Government having determined to encourage the production of large steel forgings in Sheffield, were now doing as much as possible to give the great Sheffield firms an opportunity of recouping themselves in some degree for their heavy outlay. He assured the House that it was not now a question of months, but of weeks, before the Sheffield firms would be in a position to supply large steel forgings for ordnance. Towards this end Messrs. Thomas Firth and Co., Messrs. Charles Cammell and Co., and Messrs. Vickers, Sons, and Co. were making energetic efforts, and in a very short time they would be able to execute any orders with which the Government might favour them. Mr. Brand added that similar efforts had been made by Sir W. G. Armstrong and Co., at Elswick, "so that at the present time forgings of this heavy character would be produced at home entirely to the satisfaction of the Government." Mr. Brand's references to Sheffield are scarcely complete. Messrs. John Brown and Co. are also exhibiting similar enterprise, and are well forward with their work. The particular direction in which the extensions are being made is not in the putting down of heavier hammers for the manipulation of large masses of steel, but in the erection of forging presses, which are believed to be more advantageous in dealing with great ingots. The four Sheffield firms mentioned are at present expending at least £200,000 to £250,000 on new forging presses, with the necessary adjuncts of powerful cranes, furnaces, &c. Messrs. Vickers, Sons, and Co., are about ready for operations. Messrs. Cammell and Co. are erecting a special building to hold their press. Messrs. John Brown and Co. are able to utilise their rail mill. There is not the slightest doubt of the Sheffield manufacturers being able to do all that is required of them in the future as they have done in the past. According to Sir Thomas Brassey the Government is preparing to spend on shipbuilding £3,000,000, or double the amount placed at the disposal of any other naval administration, their scheme for the strengthening of the Navy including four ironclads, five belted cruisers, torpedo ram, eight scouts, five gun vessels, and fifteen torpedo boats, of which ten were to be ordered at once. This list implies a good deal of work in steel, but it is altogether exclusive of the heavy ordnance needed, not only for arming ships, but for land defences. It is chiefly for these monster guns that the Sheffield firms are at present expending money so freely. It should not be forgotten that Mr. John Haswell, formerly locomotive superintendent of the Austrian State Railways, was the originator of the forging press, and for many years he has used his presses on a large scale and with perfect success in Vienna.

A STRIKE OF COLLIERY LADS.

"As the auld cock crows, the young cock learns." Thus runs the old Scotch proverb, and the colliery field has recently afforded somewhat frequent illustration of its truth. Fifty-two boys employed as pony drivers and jenny lads at Orgreave Colliery, belonging to the Rother Vale Collieries Company, complained that they had been kept in the pit twenty minutes longer each day than they should have been detained under ground. The manager told them they would be paid for their overtime, and that they had not been kept below with his concurrence. A difficulty then arose as to when the extra payment should start. The boys wanted it to begin from February 18th. This the manager declined to do. The youngsters then demanded a promise that he would have them signalled to come out of the pit at the proper time. As the manager could not see his way to give this promise, the boys struck work for two days, involving a loss to the proprietors of £100 1s. 6d. The managing director of the colliery, giving evidence at Rotherham Police-court, where fifty-two lads were summoned for refusing to work, stated that the company had never heard a single murmur from the men, although some of them had to wait at the bottom of the shaft for nearly three quarters of an hour. At the Court the boys insisted that they had "a very real grievance," and that they had no other remedy but to strike. They had agreed to settle the matter if they were paid a quarter of a day for the time they had worked, though they would have been entitled to a day and a-quarter. The Bench thought there had been some lack of tact in the alteration of the time for stopping the engine, but the boys had acted wrongly and thoughtlessly, for which each would have to forfeit three days' wages, and to pay costs reduced to 5s. This severe lesson will probably bring home to the juvenile mind the fact that the best way to get paid for overtime is not by ceasing to work and setting down their masters' pits. At the same time, boys will be boys, and colliery managers must not imagine that if they are kept twenty minutes too late in the pit, the pony drivers and jenny boys will exclaim with long-suffering Mr. Toots, "It's of no consequence."

THE BUILDING TRADES EXHIBITION.

FOLLOWING very closely upon the Exhibition in the Floral Hall organised by the Society of Architects, is the sixth annual Building Trades Exhibition in the Agricultural Hall, Islington. Exhibitions, even of this special kind, are being overdone. People are evidently getting tired of them, and they are falling quite to the level of a market in the estimate of the purchasing and sight-seeing public. The Building Trades Exhibition remains open for two weeks, and this may account for the comparatively small attendance up to Wednesday; but this does not account for the very much smaller extent of the Exhibition, the smaller space covered, and the smaller number of exhibitors. The character of the Exhibition is, however, better than formerly; articles with few claims to entry in this special show, and things without any claim to novelty, are more rare than usual. The chief feature of the Exhibition is the evidence of the growing use of coloured cement concretes for building and ornamental structure purposes, and the use of rubbed and carved brickwork, with bricks, plaques, and panels of the same red brick material, for houses of the modern revival of Queen Anne and Renaissance design. Mosaic work of very highly commendable character is also noticeable amongst the more ornamental exhibits, whilst amongst the useful are sanitary wares and machinery. The latter is a comparatively small contingent, and some of the engines exhibited are of the kind that reminds a visitor that some people still think that a cheap machine must be of bad design. A very useful "variety wood-worker" is noticeable amongst the wood-working machinery of one maker, but the machinery by other makers seems to be of the same design as that previously shown. Some of the machinery is shown in operation, but the quantity is less than on previous occasions, that class of machinery which is mostly used in builders' workshops being chiefly represented. The number of ventilating fittings and apparatus show the increase in the attention being paid to this subject. A novelty in this class is shown in the form of an "Aerophor," for ventilating buildings and ships, worked by steam. Usually they are worked by water, but this arrangement is to meet the requirements of places provided with steam. Builders' wood-work is exhibited by several firms, and improvement is shown in design.

THE WEAR COAL SHIPMENTS.

A RETURN has been issued by the River Wear Commissioners which is of interest as showing the fluctuations in the coal trade of the river. Last year the tonnage of coals shipped was the largest—with one exception—in the history of the port. For the twenty-four years covered by the return, the tonnage of coals shipped in the Wear has varied from 2,924,660 tons to 3,958,564 tons. The first-named quantity was in 1874, a year of very high prices, and the last-named quantity was in the year 1883. Last year the quantity shipped came comparatively near to the maximum, it being 3,789,481 tons. The quantity shipped last year was divided thus: Shipped in the South Dock, 1,928,947 tons; in the North Dock, 15,583 tons; and in the river Wear, 1,844,951 tons. The port dues on these coals amount to the large sum of £23,407 7s. 10d. for the past year, which is—except for the preceding year—the maximum amount received. But the cost of the coal shipments to the Commission was £5823, apart from the proportion of the general expenses that would attach thereto—the largest part of this expense being found in the wages of the coal teemers. The return is interesting, as showing the fluctuation in the revenue of one of our great coal shipping ports, and as indicating also the expense needful to obtain that revenue. It would appear that the growth of the revenue of the port named has had a check, and that is probably due to the great depression that has prevailed in many of the chief industries. The Wear is one of the most noted of the ports for the shipment of gas coal, and though that branch of the coal trade has not experienced the falling-off in the demand that some other branches have, yet the rapidity of its growth must have, of course, been lessened. When to the reduced rate there is added the fall in the consumption for manufacturing uses, the wonder will be not that the shipments show the small decrease, but that that declension is comparatively so limited.

DISABLING GENERAL GORDON'S STEAMERS.

WE shall be curious to learn details as to the method pursued by which it was hoped to render useless to the Mahdi the steamers abandoned by our troops prior to their temporary retirement. We are acquainted with the instructions issued to naval engineers for this purpose, but these can only prove effective for rendering vessels useless for a time. Wherever repairs are possible and time is available, it is certain vessels treated pursuant to those instructions can soon be made serviceable again. We presume that it has been borne in view that it is desired these steamers shall again be fit for use when they are once more in our possession, and it is probable, therefore, that no vital injury has been done to their machinery, and that, as we read, only certain portions of this has been removed. If the Mahdi were quite without engine fitters or European skill to direct their labours, such a course would doubtless have sufficed; but, short of breaking the cylinders and removing the shafts, we can see no hindrance to the refitment of these boats by artificers of very ordinary skill. We have ourselves seen broken iron castings replaced by native brass founders up to 2 or 3 cwt., their work being afterwards faced with iron, and we may therefore fear that, unless the cylinders themselves have been destroyed, the Mahdi will be enabled during the months of inaction which must now ensue on our part to sufficiently patch up these vessels to render them effective agents against our advance later on in the year. We may rely upon it, also, that if the parts removed have only been buried or sunk the enemy will soon obtain news of their whereabouts, and will not have much difficulty, expert divers as the Arabs are, in recovering them. We should much like to hear what the steps taken in the direction we have referred to really were.

DRYING BY HEATED AIR.

So many instances occur in which this agent is employed, in agricultural operations mainly, but also in many manufactures of fabrics, that it occurs to us to draw attention to what we conceive may be an erroneous principle on which it is so employed in nearly every case within our knowledge. In such as have been under our notice the air is caused to *rise* through the material treated by its own diminished gravity. The inevitable result of such a method of use must be to cause irregularity of action which will certainly be detrimental to the success of the operation, for the layers of ascending air, so to term them, will not be of even temperature, an inequality which may prove injurious. On the other hand, if the heated air is drawn *downwards* through the material, it has been argued that each layer will arrange itself according to its temperature and consequent gravity, and thus uniformity of heat will be attained. We have had our attention recently drawn to this subject, and to the erroneous treatment generally adopted, by the fact that our theory has received practical application in a new tea drier, the invention of Mr. John Brown, a colonial engineer, of Cannon-street. No material is so dependent upon uniformity of treatment in its drying as is tea, and the quality of an out-turn has often proved to be very unequal from the irregular drying caused by heated air applied after the old fashion. We believe that in many other operations similarly uncertain results follow the variable temperatures ensured by the methods at present in general use, and the avoidance by such a course as we have named to be practicable seems therefore to strongly recommend itself.

THE CRISIS IN THE YORKSHIRE COAL TRADE.

NOTWITHSTANDING the statement that a general strike was not likely to take place in South Yorkshire, a large number of notices have been given, so that in all probability not far short of 10,000 miners and colliery workmen will ere this meets the eye of the reader be under notice. In addition to these, in the Rotherham district, Wombwell Main, and Church-lane, workmen are under notice to leave work in a month. The notices given in the Rotherham district terminate a week, and in another case a fortnight before others. On Wednesday and yesterday the following firms gave their men notice:—Mitchell Main, Lundhill; Darfield Main, Carton Wood; Houghton Main, Monk Bretton; Wharncliffe Silkstone; Edmund's Main; Swarthe Main; and the old Silkstone and Dodworth Coal and Iron Company. There seems to be the impression now that although there will not be a general stoppage, many of the leading firms will take part in the struggle. In addition to the above, 1800 hands employed by Messrs. Newton, Chambers, and Co. are under notice, as are also the furnacemen and coke makers in the employ of the firm. It is said that owing to the action of the men the firm have decided to damp down their two blast furnaces, which have been in blast for a number of years, and have produced about 600 tons of pig iron weekly. This step, if carried out, will almost stamp out the production of pig iron in South Yorkshire, the Milton and Elsecar Works having not only been set down, but the hammer beds, &c., have been blown up with dynamite, and the metal for the most part taken to Denby, in Derbyshire, where it is expected it will be re-smelted.

LITERATURE.

The Principles of Ventilating and Heating, and their Practical Application. By J. S. BILLINGS, M.D., LL.D. (Edinburgh), Surgeon U.S. Army. London: Trübner and Co. 1884.

THE greater part of this book appeared as articles in the American *Sanitary Engineer*, but the articles have been revised and extended to form a guide for architects and others in judging of the relative merits of different systems of heating and ventilating for buildings of various kinds. The author does not, as far as can be gathered from his preface, entertain any very exalted notions of the character of his performance, although he speaks in very plain terms upon the false notions held by some who have paraded their notions of ventilation with equal confidence and want of knowledge.

It is difficult to find much that is new to say on the principles which underlie successful ventilation, though there is something new to be said respecting the means of heating. Even in the latter, however, the most successful heating work has been done by well-known means and appliances, but carried out with systematic attention to theoretic considerations. Really successful ventilation and heating of large buildings is seldom met with, and success is not, perhaps, quite so easily reached in England as in America, inasmuch as in the latter country a temperature of about ten degrees higher than is thought desirable in England is there considered essential. We seldom ask for more than 60 deg.; in the States from 68 deg. to 70 deg. is required. This higher temperature makes it necessary, in the first instance, to adopt more powerful heating apparatus, involving an unavoidably high expenditure as compared with ordinary English arrangements, but securing at the same time greater facility for ventilation than is obtained when the greater attention to prime cost is a first consideration.

Mr. Billings has omitted a great deal of the older kind of writing in handling his subject, and instead of simply compiling a book, he has compiled but little, and written enough to make a new book. In a sufficiently comprehensive way he describes most of the important experiments in ventilating, and deals as much with English as with American experiences.

In speaking of the method of ventilating a room by making a gigantic register of the whole floor by finely perforating it, and causing the air to ascend into it in fine pencils, as was done by Mr. Thos. Winans, of Baltimore, and Dr. Reid, in our House of Commons, Mr. Billings says that though 1in. per second for the upward flow of the air would be sufficient to remove all products of respiration, a velocity of at least six times this is practically necessary to overcome disturbances by opening doors, &c. This mere statement does not carry conviction, for it would seem that if the air entrance velocity of 1in. or 2in. per second through the small holes be sufficient to supply the air requirements, the slight check to the flow caused by open doors ought to be compensated by the open door admission.

The author is not imbued with the idea that carbonic acid is the one great impurity to be dealt with in ventilating a room, and his remarks upon the general belief that carbonic acid, being heavier than air, falls to the floor, and, consequently, foul air removal should be made at the floor and not at the ceiling, would stamp the author as rather more egotistic than the book generally warrants. He says that "whenever a man takes the ground that carbonic acid is the special impurity to be provided for, and asserts that as it is heavier than ordinary air, therefore it sinks to the floor, he demonstrates that he is a person who may be a very estimable gentleman, but whose opinions about ventilation should be received with very great distrust." Taken with some other remarks, this may be meant for someone in particular, but it is not free from objection as a form of criticism. There is, no doubt, truth in the author's reasoning that though heavier than air, carbonic acid becomes perfectly diffused, and the proper method of ventilation is not affected by difference of specific gravity of air and of carbonic acid taken separately. It is not perfectly certain, however, as he states, that the proportion of carbonic acid to the other gases is "substantially the same at a point ten miles above the earth that it is on the sea level." Simple methods of testing the amount of carbonic acid in the air are given by the author.

In dealing with some of the more simple thermo-dynamic questions involved in heating, a mistake occurs, the author speaking of a thermometric unit instead of a heat unit, and saying that one unit will raise one pound of air 42 deg. instead of 4·2 deg. Again, for the expansion of air the author gives the expansion of one volume of air due to a rise in temperature of 50 deg. "as 1 is to $1 + \frac{50}{491}$ or $\frac{1}{10}$ nearly," instead of using the more correct expression $V' = V + \frac{460 + t'}{460 + t}$. Taking the normal temperature as 60 deg., the expansion for 50 deg. rise in temperature would be from 1 to 1·117, or over one tenth instead of under it. Another typical error occurs at p. 32, where 16·11 is printed in place of 6·11. In dealing with the form of chimneys in section, the author remarks that "the circle is the best form, because it gives the greatest area in proportion to the perimeter or surface-producing friction, and the square is next." This is not true, except in comparing the square with other rectangular forms, inasmuch as the octagon and hexagon, common forms for chimneys, are better in this respect. The author approaches the question of chimney areas by reference to the quantity and velocity of gases to be passed, but for boiler chimneys falls back on the empiric rules of Tredgold and Murray, which is to be regretted, although those rules may be looked upon as safe rules. As already stated, a good number of examples of heating and ventilation of buildings is given, and these will afford useful information to those who are engaged in heating buildings by steam or hot water. The disagreeable dryness, or that state of the air in rooms heated by steam pipes which causes the uncomfortable sensations that are well known, the author attributes mainly to insufficient supply of fresh air, and does his best to show the means that should be adopted to ventilate equally, and to remove the several contributing causes of the peculiar character of the air heated as mentioned. In arranging the heating apparatus, the author supports the centralisation system advocated by Drs. Drysdale and Hayward, but does not forget to deal with the heating of the many houses so planned that such a system cannot be used. In speaking of the open fire as the means of heating rooms not so well heated by other means when the ventilation is difficult, he credits a much smaller heating efficiency to the open fire than was found to be the case with open fires tested at the Smoke Exhibition by D. K. Clark. At the same time, he admits that the experiments of Morin, Peclet, and more recently of Mr. Putnam, were not satisfactory. The best of these gave 18 per cent., while the South Kensington experiments, which were conducted after the manner suggested by Mr. Billings, gave as high as 40 per cent.

We cannot follow the author further in his treatment of the various parts of his subject as relating to large and crowded buildings, but may recommend his book as one which should be perused by every one interested in its subjects.

THE SERVIA IN A GALE.

OUR special correspondent at the New Orleans Exhibition crossed the Atlantic in the Servia, and he has narrated his experiences as follows:—

The vicissitudes of ocean travelling are many and varied, and an Atlantic voyage in the winter has risks and possibilities which suggest the need for precaution. Happily, there are now available such splendid steamships, ably manned, that a traveller may consider as too remote for anxiety the chances of disaster. Such a feeling of security was encouraged when embarking at Liverpool on January 24th for New York by the appearance of the Cunard mail steamer Servia as she lay at her moorings in the Mersey, and the occurrences of the voyage, unexpected and unwelcome as they were, fully confirmed it. With a length of 530ft. and a width of 52ft. the Servia spans so wide a space and towers so high above the water that she is free from the motion that troubles smaller boats, and inland seas like the Irish Channel have little effect on her. The day after leaving Queenstown strong head winds were encountered, rapidly increasing to a gale. From about 8 p.m. on Tuesday, 27th, at a point 800 miles to the west of the Fastnet, the storm intensified and raged until nightfall on Saturday, the 31st. On Wednesday morning the sea carried away one and wrecked another of the ship's boats. On Thursday the starboard side of the bridge was swept away with the forward boat and the ventilators. On Saturday, while the passengers were at breakfast, a dangerous sea boarded the vessel, shattering the skylight above the music room and pouring into the saloon, where it was met by a torrent which had entered by a forward skylight, and in a moment the saloon was a foot deep in water. But for the shock and momentary scare, the scene would have appeared somewhat ridiculous, the contrast between the gilded, gaily furnished room and the intruding sea being so sudden and complete. In the afternoon a more serious accident happened, which might have had disastrous consequences but for the prompt action of the officers and crew. An enormous sea struck the vessel, wrecking more of the boats, carrying away the starboard stays of the after funnel, and causing such a strain on the vessel as to break the chain which connected the steam steering gear on the bridge to the rudder, one of the massive links forged from 1⅝in. cable iron having opened out at the weld. All control of the rudder being for the time lost, the ship swung round into the trough of the sea and was for a few minutes unmanageable. With the readiness and discipline which are associated with the Cunard service, the links and pins for connecting the tiller to the ordinary steering gear in the wheel-house under the poop were ready, and the men on duty at once connected them. Four men were not, however, sufficient at the wheel, and it was exciting to witness the smartness with which some seamen rushed aft, and the doors of the deck-houses being fastened, tumbled out through the ports and brought the rudder into subjection.

It is not often that an opportunity presents itself for examining the effect which wind and wave can have on a powerful steamship. The davits were of solid forged iron, 5½in. diameter, and some of these were snapped asunder by the sea, the socket castings in which the davits stand, 12in. diameter and of 1½in. metal, being torn asunder at the base, where, on massive flanges 3ft. by 2ft. by 2in. thick, they are attached to the deck. Some of the bulb T beams of steel, 8½in. by 6in., on which the boats rest at the davits, were also fractured. At the worst of the gale, as the propeller rose out of the water, the strain upon hull and machinery was intense, and under the heavy seas the vessel shook and quivered from stem to stern. A breakdown under such circumstances would be a more serious matter for the Servia than for some other of the Atlantic liners. Like most of the Cunard steamers, the Servia has only three masts, is lightly rigged, and has, in proportion to her size, very little sail power, probably not more than enough to give her steerage way, and with engines disabled would probably have to wait to be picked up. The White Star boats are, on the other hand, fully ship-rigged, and recently the Celtic of that line, having her main shaft broken when 500 miles out from New York, sailed to Queenstown in three weeks. But in a steamer like the Servia one has the satisfaction of knowing how everything that human foresight can do to avoid accidents and disaster has been done. When the vessel groans and shivers under the blows of the sea, it is comforting to remember that the hull is built of elastic steel, and not of brittle north-country iron; when one regards the massive beams it is satisfactory to know that no mere feeble handwork has been applied to the long and large rivets, but that every bolt in keel and framing has been held in the grip of a Tweddell rivetter, and cannot tear asunder.

The Cunard Company seems determined not only to maintain the lead in the Atlantic passenger service, but to recover the prestige which it seemed at one time to be losing in regard to speed and comfort. Every steamer is an improvement on the preceding one. The Servia has thus been followed by the Aurania, the Oregon (taken over from the Guion line), and by the Umbria. The latter, while of larger tonnage than the Servia, is 10ft. shorter, but of greater width, a length of more than ten times the beam, as in the Servia, though conducive to speed, allowing more rolling than is comfortable. In the wider vessel speed is maintained by the more powerful engines, and there is undoubtedly more stability. In the Umbria, as in the Servia, there is a complete equipment for electric lighting. In the latter vessel there are three separate direct-acting engines and dynamos, namely, two of Brotherhood's 3-cylinder engines and one of Tangye's verticals. Among the improvements in the Umbria are the centrifugal circulating pumping engines, designed and made by W. H. Allen and Co., of Lambeth. In shape and efficiency, and in the smallness of the space they occupy—an important point in a steamship—these engines exemplify all that is newest and best for the purpose, and as the suction inlets can be instantaneously connected to the bilge, the enormous capacity of the pumps gives additional security to the vessel in case of leakage.

After the gale above referred to had subsided a committee of the passengers collected £162 for a testimonial to the officers and crew, and a resolution was passed and duly published in the New York journals, "That the passengers on board the Royal Mail Steamship Servia, sailing from Queenstown to New York, on January 25th, under the command of Captain Horatio McKay, desire to put on record their admiration and respect for the courage, skill, and devotion to duty, by which they have been safely brought through the risks of a great Atlantic storm."

PRIVATE BILL LEGISLATION.

The expectations aroused a week or two ago with respect to the rapid progress of the private Bills before Parliament have not yet been realised, and it is now probable that little will be done in this direction before the Easter recess. As we observed at the time, immediately after the resumption of the session, great activity was displayed in pushing these Bills forward through their earliest stages, and it seemed likely that by this period great advances would have been made, but the early energy has subsided, and matters are now proceeding pretty much in the usual easy style. A few Bills have come before Select Committees, and some have actually deen disposed of, while a small number more will be taken in hand in the course of next week. Among those passed is the Port of Glasgow Harbour Bill, the object of which was to take power to borrow additional capital, and to make new bye-laws, with special reference to speed of vessels passing up or down the river. It was proposed to fix a low limit of speed, but this was objected to by the Clyde Trustees and the Clyde Pilotage Board, and, upon their opposition, was refused by the House of Lords' Committee, presided over by Lord Ducie. The other parts of the Bill were assented to. The same Committee are considering a Bill proposing to extend the time for the construction of the Thames Deep Water Dock, the main reason being the present depressed condition of business generally, and the consequent lack of money for prosecuting the work. The East and West India Dock Company sought to resist the proposal, but they refused a *locus standi*, and the Committee have now to decide upon the opposition of the National Bank, which owns certain land which will be required for the dock, and which they would rather have taken off their hands now than two or three years hence.

The largest scheme this session, viz., the Manchester Ship Canal Bill, has now come before a Select Committee of the House of Lords, presided over by Earl Cowper, the idea of a Joint Committee having been abandoned. The Committee have held six sittings, two of which were taken up by opening speeches and other preliminaries. Although this is the third time Parliament has been asked to sanction the construction of this canal, the interest in the project appears to be unabated, and on each day the large Committee-room has been crowded to inconvenience by people more or less concerned in the matter. As in previous years, there is a strong and numerous array of counsel, including such eminent members of the Parliamentary Bar as Mr. Pember, Q.C., who leads for the promoters; Mr. Michael, Q.C., Mr. Littler, Q.C., Mr. Aspinall, Q.C., Mr. Bidder, Q.C. The Corporation of Liverpool, the Mersey Docks and Harbour Board, the Weaver Navigation Trustees, the Bridgewater Navigation Company, the London and North-Western Railway Company, and some other bodies, appear by counsel in opposition to the Bill to a greater or lesser extent, and several other companies, corporations, and persons have presented petitions to protect their interests. The Marquis of Cholmondeley, who owns some miles of the foreshore of the Mersey, had presented a petition, but a satisfactory arrangement having been come to, that has been withdrawn. A few weeks ago we gave in some detail an outline of the scheme, and explained in what way the present plan differs from that of last year and the previous year. This difference arises not in regard to the canal proper, but to the proposed waterway in the estuary of the Mersey, in continuation of the canal. Upon that part of the scheme mainly the Bill was thrown out, first by the Lords and then by the Commons, and the new plan claims to be in accordance with the suggestion made last year by the Mersey Dock Board, who were then opposing. That body intimated that if such a course as they suggested was adopted by the promoters they would not raise much, if any, further objection to the Bill; and the promoters contend that they have in their present scheme carried out that suggestion; but there is a conflict of opinion between them and the Board as to that point. With respect to the commercial and general aspects of this project, there is probably little that is new to be said, and the Committee have decided to deal with the engineering part of the scheme first. If they decide against that portion of the Bill the scheme will fail, whatever else may be said on other points; and similarly if they pronounce in favour of the proposal as an engineering practicability, it may with some safety be assumed that the Bill will be approved and recommended for sanction by Parliament. Therefore, after Mr. Pember's opening speech, which occupied nearly two sittings, Mr. Leader Williams, the engineer, was called into the witness-box. Before glancing at his evidence, we may give briefly Mr. Pember's description of the proposals contained in the Bill. These, he said, were, first, to incorporate a company under the name of the Manchester Ship Canal Company. The next object was to vest the undertaking of the proprietors of the Mersey and Irwell Navigation in the Ship Canal Company, and to enable the company to acquire compulsorily or by agreement the undertaking of the Bridgewater Navigation Company. It was next proposed to constitute Manchester a port, the limits of which, however, would not be so wide as those that were formerly thought necessary. It was not now proposed to carry the bounds of the port down the Mersey at all. The fourth object of the Bill was to construct a ship canal from the river Mersey near Eastham to Manchester, with docks, branch railways, and other works. The canal crossed under certain railways whose lines would have to be raised in order that masted ships might pass under them. The total length of the canal from Manchester to Eastham was 34 miles 4 furlongs. It was divided by four locks into four portions. From the docks at Manchester to Barton, where the first lock would be built, was a distance of 3 miles 6 furlongs; the second lock was from Barton to Irlam, and measured 2 miles 6 furlongs; the third lock extended from Irwell to Latchford, and was 7 miles 3 furlongs in length; and the fourth lock went from Latchford to the sea, being about twenty miles long. The construction of the canal was such that the lower reaches would be on a level with the water outside, and ships would be able to enter without locking. The general width of the canal proper was 120ft. at the bottom. The top varied from 260ft. to 135ft. At Runcorn the bottom width for three-quarters of a mile was 200ft. At Manchester the bottom width was 170ft. for four miles. Facilities were contemplated for lay-byes and side basins in the event of public works springing up on the canal. The navigable width was twice that of the Suez Canal, being wide enough for two ships of 50ft. beam to pass easily. The bottom width of the Amsterdam Canal was 89ft. The minimum depth of the proposed canal was 26ft. at the lowest state of the water. The Suez Canal was the same depth; the Amsterdam Canal 3ft. less. The headway under the various bridges, consequent on the raising of the railways, would be 75ft., but in one instance the height would be 2ft. less. It is proposed to provide quay space at Manchester between three and four miles in length, and the docks there would be in communication with the Bridgewater Canal and the Bury and Bolton Canal, and through them with the Rochdale, Ashton, and Macclesfield canals, and the Aire and Calder Navigations. The canal crossed no fewer than five railways, deviations of which would have to be made and the gradients raised. On this point the learned counsel pointed out that whenever Parliament had sanctioned the construction of a railway in the neighbourhood the idea that the navigation of the rivers would be improved had always been in view, and provision had been made accordingly. The promoters asked not that the strict letter of the law should be fulfilled; they simply demanded an alteration of gradients. Mr. Pember next entered into a detailed examination of the plans, and submitted that there was nothing in them which could injuriously affect the navigation of the Weaver or of the Mersey. The estimated cost of the works was £7,292,000, being an increase of £388,000 upon the estimates of the previous year. This was accounted for by the fact that the railway deviations would be more expensive. It was proposed to raise a capital of ten millions sterling, eight millions being share and the remainder loan capital. The difference between the estimates and the capital proposed to be raised included a sum of about £1,500,000 for the purchase of the Mersey and Irwell and the Bridgewater Canals, and there would thus be left a surplus of £1,200,000 to meet contingencies.

Mr. Leader Williams explained that the proposed channel in the Mersey would commence a little above Eastham Ferry, proceed for two miles along the foreshore, then pass into and through the land for some distance, then cross the mouth of the river Weaver with an embankment, and so on until it reached the well-known Runcorn Bridge. Under the Cheshire span of this bridge it would pass, occupying one-half of the span of 300ft., and then join the real inland canal to Manchester. The old proposal was for a low-water channel almost parallel with, and near to, the Lancashire side of the river; this new channel keeps entirely to the Cheshire side for many miles, and that is the essential difference between the two schemes, although it will be seen that there are necessarily many other differences involved by reason of the altered course and the proximity to the land. At Eastham it is proposed that there shall be a group of tidal docks, but the ordinary navigation will be conducted with the gates open. The embankment along the shore is to contain forty-eight tidal openings of 100ft. wide, allowing the tide to flow in and out of the canal without interruption, so that the water shall be at the same level inside and out. The upper surface of the embankment is to be 9ft. above high spring tides, and this in rough weather will prevent the waves affecting the canal, and also prevent the washing away of the shore and the consequent increase in the sandbanks in the estuary. Means are provided for enabling vessels to pass without difficulty from the Weaver into the Mersey, and in case sailing vessels should require towing from the former river along the canal until they can get well out into the open river and spread their sails, the promoters engage to provide the required power. As to whether this scheme is that recommended by the Dock Board engineer—Mr. Lyster—last year, Mr. Williams holds that it is practically the same, except that Mr. Lyster's plan would abstract more water than his from the estuary, and to that extent would injure the river; but that is at present a contested point. The total length of the canal, Mr. Williams explained, is to be 34 miles and 7 furlongs, 20 miles and 6 furlongs being the length from Eastham up to Latchford, and the remainder entirely inland. The inland canal is devised to prevent the floods which now occasionally cover the land, and there are to be four locks. The promoters expect to be able to complete the work in five years by letting it out in sections, using the electric light, and employing the most improved excavators; and the estimates are these: Five deviation railways, one junction and three branch railways, £457,292; docks at Manchester and Salford, £1,225,051; docks at Warrington, £95,084; Ship Canal works, £5,224,381; new roads, £77,530; opening bridges, £129,942; minor works, £83,692; total, £7,292,972. Mr. Williams has been subjected to cross-examination by some of the opposing counsel, but this is as far as the inquiry has proceeded. If the Bill should fail upon engineering grounds, the matter will no doubt be once more decided before the Easter vacation.

Among the unopposed Bills passed by the Chairman of Ways and Means is that of the London, Chatham, and Dover Railway Company, the object of which is to enable that company to issue Arbitration Debenture Stock in lieu of Sheerness Rent-Charge Stock, and to raise £600,000 by the issue of new shares, together with £200,000 to be borrowed, on account of various new works, especially the new Blackfriars Bridge, for which half-a-million will probably be required. The Eastern and Midlands Railway Bill, being unopposed, has also been passed. The Great Eastern (General Powers) Bill, the London and Blackwall Railway Bill, the North Metropolitan Tramways (No. 1) Bill, and the South-Eastern (Various Powers) Bill, are among the measures read a second time during the past week, and now waiting for Committee. The Channel Tunnel (Experimental Works) Bill was to have been read a second time this week, but it has been deferred till April 21st, and then it is expected that Mr. Chamberlain will move its rejection. The Water Companies (Regulation of Powers) Bill gave rise to a short discussion in the House of Lords, the Earl of Camperdown moving its rejection. The second reading was, however, agreed to, and the Bill referred to a Select Committee.

It now appears probable that the Glasgow Corporation Water—Loch Katrine—Bill will pass through Committee without serious opposition, the principal petitioners having been arranged with.

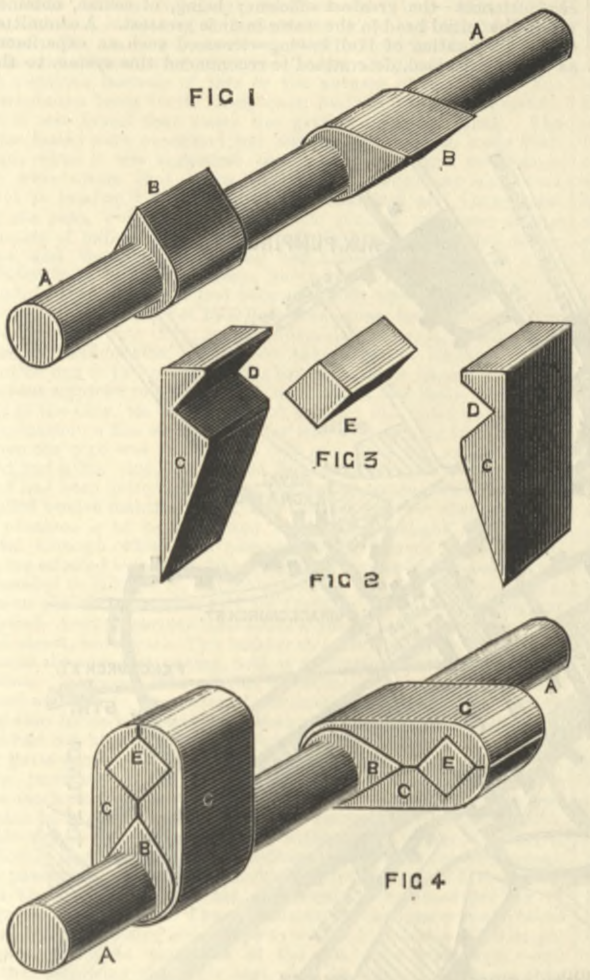
It appears that, after all, the scheme for constructing a railway from Charing Cross, under the Strand, St. Martin's-lane and Tottenham Court-road, to join the London and North-Western system near Euston Station has been abandoned for this year at all events, the Bill, which we described some weeks ago, having been withdrawn.

The numerous railway rates and charges Bills are still in jeopardy. No less than 280 petitions have been presented against these Bills, 86 of which have come from chambers of commerce, trade, and agriculture; 100 from traders, agriculturists, and trade and agricultural associations; 85 from corporations and other local authorities; 8 from railway companies; and 1 from a canal company. Of the total number, 55 petitions are lodged against the London and North-Western Bill, 54 against the Midland Bill, 52 against the Great Western Bill, 33 against the Great Northern Bill, 32 against the North-Eastern Bill, 18 against the Great Eastern Bill, 17 against the London, Brighton, and South Coast Bill, 10 against the London and South-Western Bill, and 9 against the London, Chatham, and Dover Bill. All or most of these petitioners ask to be heard by counsel if the Bills go before a Committee; and there are many other petitioners stating objections to the Bills, but not asking to be heard. Among the first-named petitioners are the Derbyshire, Nottinghamshire, Leicestershire, and Warwickshire Colliery Owners' Association; and it is understood that if the Bills pass the second reading, the Mining Association of Great Britain will then take up the opposition in Committee. Meanwhile a conflict has arisen with the Board of Trade as to the tribunal to which the Bills should be referred. Mr. Chamberlain proposes to deal with them by a Royal Commission instead of a Select Committee; but many of the concerned, while objecting to the Bills by themselves, are strongly opposed to a Royal Commission. More than one Committee, composed partly of members of Parliament, has been formed to watch the progress of these Bills, and throughout the country there is a good deal of excitement on the subject. It has been estimated that, if the Bills are proceeded with, an expenditure of something like £100,000 will be involved in promoting and opposing them.

During the autumn session a Select Committee, with Mr. Shaw-Lefevre as chairman, was appointed and held some sittings, to consider the question of restoring Westminster Hall, which, since the removal of the old Law Courts, has been in an exposed and dilapidated condition. The Committee have now resumed their sittings and taken further evidence from experts and others. Mr. Ayrton, an ex-First Commissioner of Works, has been one of the witnesses, and Mr. Morris one of the hon. secretaries of the Society for the Preservation of Ancient Buildings, has also been examined. Mr. Morris, speaking of course from the point of view of his society, was opposed to any notion of reproducing the original architecture, urging that only protection of what remained of the old building should be attempted. Several members of the House of Commons have urged that the space rendered available by the demolition of the old Law Courts should be utilised for increasing the accommodation of the House, but Mr. Shaw-Lefevre, the late First Commissioner of Works, considers that further accommodation may be obtained in other directions. The plans for restoring the west side of the Hall were prepared by Mr. Pearson, and the total estimated cost is £34,000.

LINNEY AND LAWSON'S PATENT CRANK AXLE FORGING.

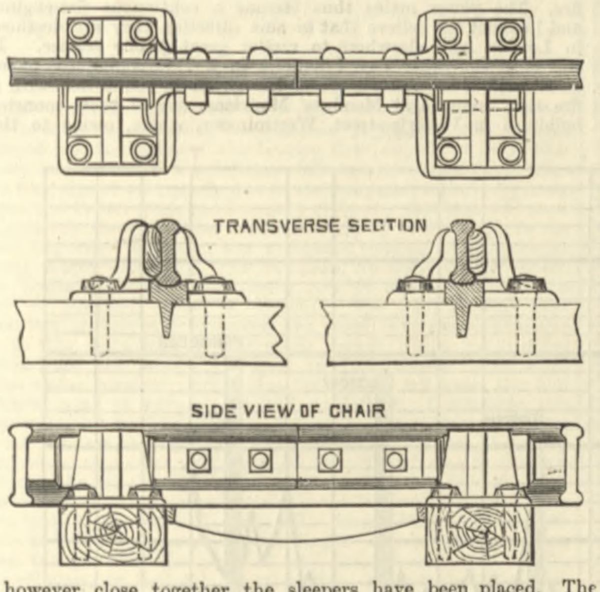
THE object of this invention is to obtain a crank axle possessing greater strength and tenacity than has hitherto been attained, and the inventors claim to accomplish this end by forging the crank axle in several portions, by which means they are enabled to have the grain or fibre of the iron running in different directions, as best suited to bear and resist the different strains that



are put upon the several parts of the crank axle when in motion, thus obtaining the maximum strength of the metal; and by this method of forging they are also enabled to dispense with twisting the iron in order to obtain the right angles of the cranks, except when it is absolutely unavoidable. The accompanying engravings show this method of forging, which will be understood without further description.

HARDIE'S RAILWAY JOINT CHAIRS.

THE object of this improvement is to overcome the movement at the rail joints, which, the inventor asserts, takes place with all forms and modes hitherto used of fishing the rail joints, and



however close together the sleepers have been placed. The invention "consists in casting two chairs together, at a distance of say 2ft. more or less apart, with flanges abutting against each sleeper, with a strengthening web between, and so formed to admit of each rail having a bearing thereon of 1ft. 6in. or more, so as to assist the usual fishplate and prevent its moving." The annexed engravings make description unnecessary except to say that to effect the same purpose a detached plate has been made for use under the present chairs, at the joints, and fixed to the joint sleepers in a similar manner to that of the double chair, so that a test of the capabilities of the support may be made at little expense. This joint chair is made by Mr. T. G. Hardie, of Spring-gardens, Whitehall.

THE MALMINOT VIADUCT.

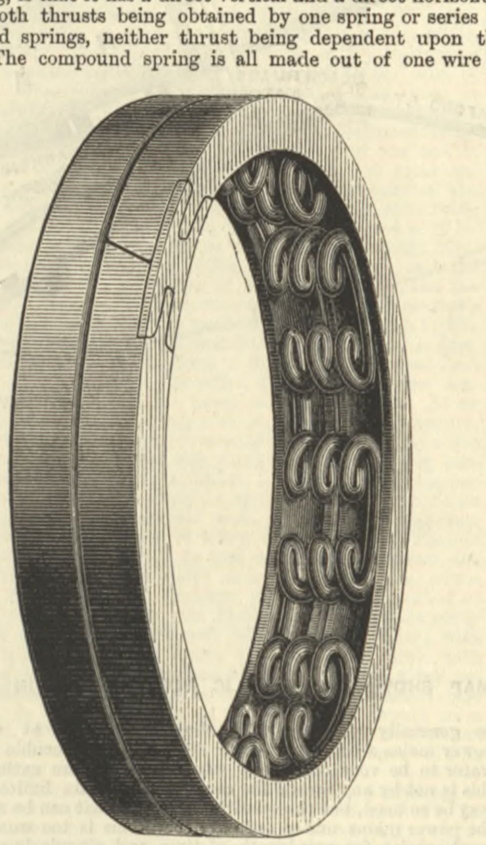
THE viaduct which we illustrate by our engravings, page 223, Figs. 1 to 10, has been built on the Montauban and Cahors line, about two miles from Montpezat station, and over the valley of the Pax. It is not a large structure, but its design is good, and affords a pleasing example of masonry viaduct for situations whereat stone may be used with advantage and economy.

The viaduct consists of fifteen arches of nearly 30ft. span each, the whole length being 618ft. It is built on a curve of 1640ft. radius, and on a gradient of 1 in 100. The height at the middle is 63ft. The foundations are in compact marl except three of the piers, which are built on the calcareous rock of the district. The foundations presented no difficulty, but some of the piers had to be carried to a depth of about 30ft., the excavations requiring care and timbering. The building of the foundations occupied four months, and the superstructure sixteen months. The former are built in hydraulic lime and sand from the bed of the Aveyron. The piers up to the top of the base are in rough dressed edged stone from the Anques quarries near Montpezat. Above the rock the piers are in brickwork, the bricks being made on the site, and the angle facings are in rough dressed stone from the Rouby quarry. The stone of the arches and parapet is from the same quarry. The spandrils are in brickwork. Each of the centres was supported on a single rail fixed in the masonry, and the maximum sinking on striking the centres was two millimetres. Fifteen days were allowed between the keying of the arches and the striking of the centres. The maximum compressive stress at the keystone is 71 lb. per square inch. The superficial elevation area over all is 28,083 square feet, the unfilled area being 1445ft., leaving actual area 13,638ft., or a ratio of space to actual masonry surface of 1 to ·94. The area in plan is 17,373 square feet. There are 135,613 cubic feet of masonry in the foundations and 346,802 cubic feet in the superstructure, or a total of 482,412 cubic feet. The cost, as given by the *Annales Industrielles*, from which we take our engravings, was as follows:—

	£	s.	d.
Foundations	3,858	0	0
Superstructure	13,300	0	0
Centreing	1,084	0	0
Accessory expenses	518	0	0
Total for superstructure	15,712	0	0
Total with foundations	19,568	0	0
Cost per lineal foot, including foundations	31	11	6
Cost per cubic yard of masonry, including foundations	1	3	2½

DURHAM AND CHURCHILL'S PISTON'S.

THE speciality of this packing, illustrated by the accompanying engraving, is that it has a direct vertical and a direct horizontal thrust, both thrusts being obtained by one spring or series of compound springs, neither thrust being dependent upon the other. The compound spring is all made out of one wire or

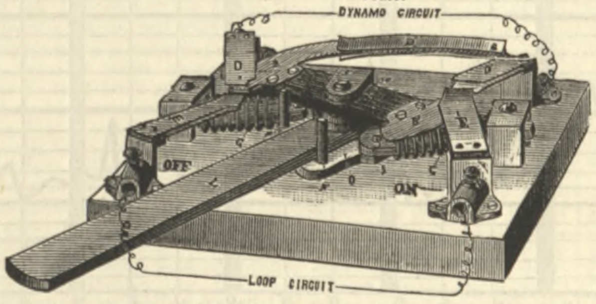


rod; but if desired, or in case of breakage, can be made and joined in any number of sections. There are no sharp bearing points, all the bearings being long, flat vertically, and curved horizontally to the same radius as the inside of the piston rings. The piston is supplied by Messrs. Durham and Churchill, Hallamshire Works, Sheffield.

DAVIS'S POSITIVE ACTION CUT-OUT AND CONTACT CHANGER.

THE cut-out and switch illustrated by the accompanying engravings, is made by the Electrical Development and Manufacturing Company, of Boston, Mass. The American *Electrical World* has published the following description by the company.

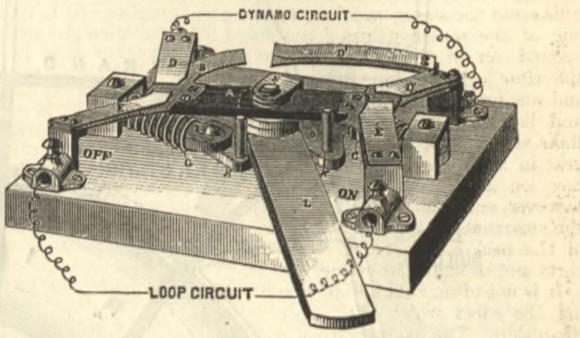
FIG. 1.



In using this cut-out for electric light circuits, it is impossible to form a dangerous arc, even under the severest tests, for the reason that the contact points are not moved until the switch handle has brought them under the control of powerful springs, and out of control of the operator. This being the case, when the handle is moved in either direction, the possibility of leaving the contact pieces in a dangerous position, or of drawing an arc by a slow movement of the parts, is avoided. The most important feature of this switch is the embodiment of the principle above explained, but in all other respects the parts have been so arranged and constructed as to avoid all objections hitherto discovered during an extended experience with various other forms by the inventor. The contacts are all double and removed to a safe distance from any inflammable material, the contact points are well separated by air spaces, and the general construction is substantial in every respect. Constructed as a circuit changer for switching lamps from day to night circuit, the rapidity of movement, and its position, as well as automatic character, renders the manipulation of the switch perfectly safe in the hands of an inexperienced person. As a pole changer, the rapid automatic movement is obviously of especial advantage.

Following is a description of the construction and operation of the Davis cut-out, reference being had to the diagrams. Each cut-out is properly enclosed in a neat box, with sliding cover, not shown: Fig. 1 represents the position of switch, with lamps cut out of circuit; the dynamo terminals D and D^1 being connected by contact piece B, and the loop terminals E and E^1 being out of contact with the dynamo circuit. Contact pieces B and B^1 are mounted on the hard rubber block A, which block is loosely pivotted upon shaft A^1, and may be thrown powerfully in either direction by compression springs G G. The moving ends of compression springs G G are attached to oscillating plate O, which is a part of the shaft A^1. Oscillating plates O carries two pins N N, arranged in the path of lever L, also loosely pivotted on shaft A^1, and lies between the pins N N. In switching the loop of lamps into the dynamo circuit—that is, from the position shown in Fig. 1 to that shown in Fig. 2—the operation is as follows: If the lever L be moved in the direction

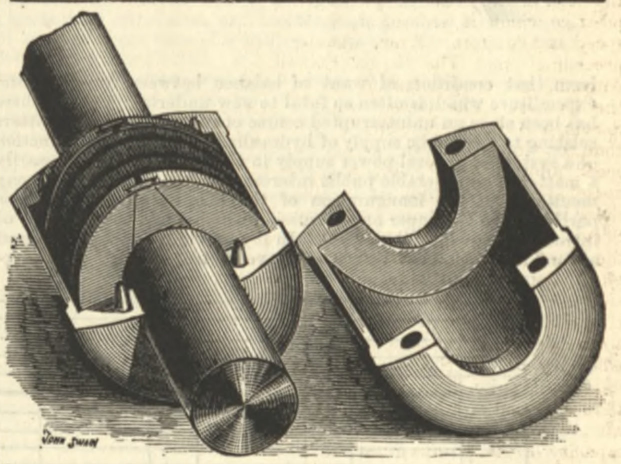
FIG 2



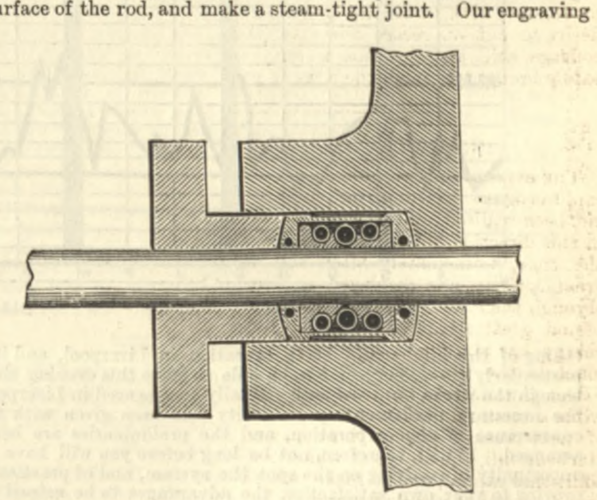
of its reversed position, it will bear against one of the pins N N, and move the oscillating plate O, so as to compress the springs G G, bringing them to a position of equilibrium. Thus far, however, the block A, carrying the contact pieces, has not been moved. If, now, the lever L be carried a little farther, the springs G G will pass beyond their equilibrium and throw the plate O, the pin N being thereby brought forcibly against block A, carrying it, with the attached contact pieces, into a position shown in Fig. 2, breaking the dynamo circuit by separating the contact pieces B and D^1, previous to which, however, the loop terminals E and E' are electrically connected with dynamo terminals D and D^1. To again cut off the lamps, a movement of the lever L in the opposite direction will bring the springs to a position of equilibrium before moving the contact pieces, and reverse the operation above described. It will be understood that the lost motion between the lever L and pins N N prevents any to-and-fro movement of the contact pieces by manipulating the lever, and the lost motion between the oscillating plate O and block A prevents a change of contacts until the springs have absolute control.

SMITH AND MARSHALL'S PATENT GLAND PACKING.

THE accompanying engraving illustrates a new form of gland packing, which has, we understand, been used at sea with great success on rods as much as 8in. diameter, with pressure of 90 lb. It consists of a set of Babbitt metal semi-rings, each fitted with



two dovetailed gluts, as shown, and compressed on the rod by coiled wire springs, as shown. These springs force the Babbitt metal rings endways against the top and bottom of the stuffing-box, and they can be tightened on the rod by screwing down the gland. In a very short time they adapt themselves to the surface of the rod, and make a steam-tight joint. Our engraving



shows the packing in section and in perspective. Numerous voyages have been made without touching this packing. Any packing which does not require fibrous or vegetable packing will commend itself to sea-going engineers. This is being introduced by Messrs. Smith and Marshall, of Euston-road.

THE HOOGHLY BRIDGE.

WE publish on page 222 the last of a series of page illustrations of the large girders for this bridge. Other illustrations have appeared in previous issues, and a description appeared in our impression for the 20th February last.

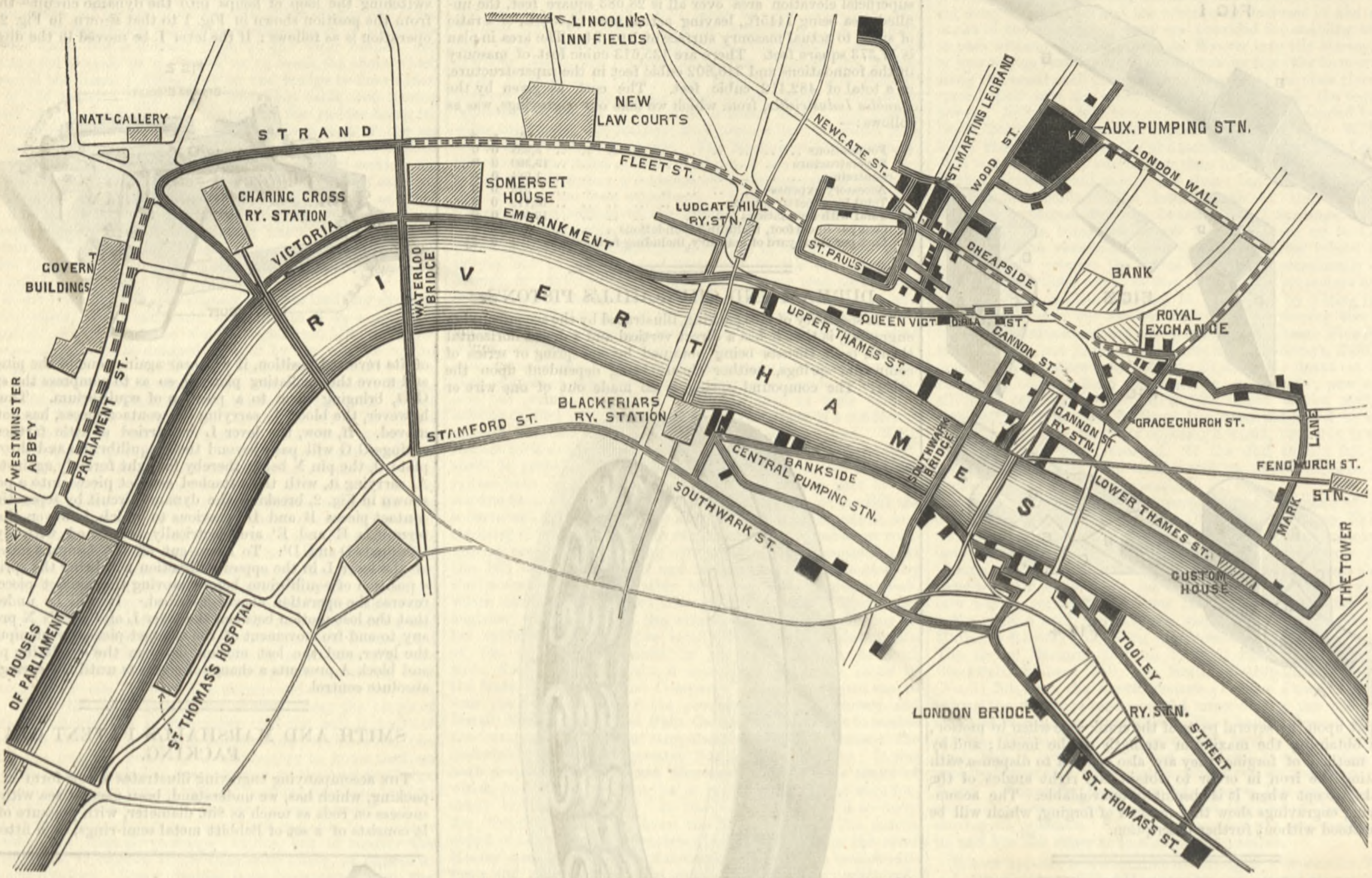
RECENT PROGRESS IN THE PUBLIC SUPPLY OF HYDRAULIC POWER.*

It is now a little more than four years since I first brought before you the subject of the public supply of hydraulic power, when I gave a description of the works and operations of the Hull Hydraulic Power Company, which had then had three or four years' experience of actual work. The Hull works were of an unambitious character, but being the first of the kind in existence, naturally attracted a good deal of attention. The growth of the undertaking was at first slow, due partly to bad trade and partly to the indisposition of the majority of the warehouse keepers and others to adopt the new system until they had had some experience of its working. Four years ago the Hull Company was just emerging from that condition of want of balance between revenue and expenditure which is often so fatal to new undertakings, but there has been since an uninterrupted course of prosperity in all matters relating to the public supply of hydraulic power. The introduction of a system of general power supply in the metropolis is necessarily a matter of considerable public interest and importance, and I may mention that the inauguration of the London undertaking was partly due to the paper and discussion which I had the pleasure of introducing in November, 1880. In my previous paper I expressed a confident hope that before many years had elapsed an undertaking of this kind would be in operation in Liverpool, and it is particularly gratifying to me to be able to state this evening that, though the works have not been actually commenced in Liverpool, the necessary parliamentary authority has been given with the concurrence of the corporation, and the preliminaries are being arranged. It will, therefore, not be long before you will have an opportunity of studying on the spot the system, and of practically proving to your own satisfaction the advantages to be gained by the various applications of the power. This position of affairs is very largely due to the interest which Sir James Allport has taken in the question, and to the influential support he has given to the undertakings, both in London and Liverpool.

With regard to the progress in Hull, the power continues to increase in favour with the various wharfingers and other users; no consumer, except from causes beyond his own control, has abandoned its use, and the great economy which has been claimed for the system has been fully established. As to the maintenance of the service, since I last addressed you, there has been no repair to the mains needed, which have, moreover, been extended to supply additional buildings. During the four years there has been no consumer unsupplied with power when he required it. The last few returns of power used are the largest on record. I do not see any limit at present to the development of the Hull undertaking, and you will easily understand that the experience gained by the working in Hull has been most valuable in dealing with the London works; many questions which would have been extremely difficult to have dealt with in an economical manner have been settled in London with a large measure of confidence in the success of the decisions taken. The only novelty since my former paper in the application of the power in Hull is in its use for the extinction of fire. This is, however, one of the very greatest public importance, and it has been forced into prominence in Hull owing to the frequency of the fires in the wharves and mills alongside the Old Harbour. It would be generally supposed that the great head at which the power mains are charged—over 1600ft.—would enable the power water to be very effectually used direct for fire extinction; but this is not by any means the case. To a certain limited extent it may be so used, but the quantity of water that can be spared from the power mains under ordinary conditions is too small to be of much service for any length of time, and, singularly enough, the pressure is too great. A hose pipe to stand 700 lb. per square inch pressure is unmanageable, and the water is dissipated in fine spray at a very short distance from the nozzle. What is wanted for a good jet is 150 gallons of water discharged per minute through a 1in. nozzle. This through 200ft. of hose corresponds to a pressure of 150ft. head, or 65 lb. per square inch at the back of the hose. This condition is one that cannot practically be fulfilled by the power supply alone, and very rarely indeed by the ordinary domestic supply. Mr. Greathead, in conjunction with Mr. M. D. Martindale, has devised a very simple and perfect apparatus for combining these two services, and by so doing the deficiencies of each are made good. The power supply gives over to the domestic supply part of its pressure, and its own volume; the domestic supply gives its volume to the power supply, which, moreover, draws the water out of the domestic supply mains, and so makes up for possible deficiency in their size. The whole forms one of the prettiest pieces of hydraulic apparatus I have ever seen.

Referring to the hydrant, on turning on the water from the ordinary main, say, at a pressure of 60ft. head on a 3in. branch pipe, it is delivered through 200ft. of hose at the nozzle at the rate of about 100 gallons a minute to a height of 30ft. Turn off the ordinary water and open the inlet from the power main, and fifty gallons per minute are delivered to about the same height—a very feeble exhibition of power water at 700 lb. pressure. Now turn on the water from both supplies, and the result is most startling—a splendid jet of water of 150 gallons per minute is at once thrown to a height of 80ft., and the pressure in the ordinary water main falls to 30ft. head, while the quantity of power water used is much less than in the former experiment. Mr. Greathead has read more than one paper on the subject of his hydrants, and I must refer you to the "Proceedings" of the Institution of Mechanical Engineers and other published papers for fuller details. It will suffice to say that the efficiency of the apparatus under varying heads, size of nozzles, &c., has been very carefully worked out, and that the useful effect obtained is from 30 per cent. to 33 per cent., according to circumstances—the greatest efficiency being, of course, obtained where the initial head in the water main is greatest. A committee of the Corporation of Hull having witnessed such an experiment as I have described, determined to recommend this system to the town, and at the present time a number of these hydrants are being put down in the streets of Hull for public use as a supplement to the ordinary means provided for the extinction of fire. The power mains thus become a continuous fire-engine, and I cannot but believe that in this direction they are destined in London and elsewhere to render great public service. It was only the other day I noticed in a Liverpool daily paper an allusion to the possible use of the power in connection with a fire that occurred at Members' Mansions, one of those monster buildings in Victoria-street, Westminster, where, owing to the height, there was considerable difficulty in bringing pressure to bear. It may be that the London streets will be so provided in time; but in the city of London the water company has refused to allow these hydrants to be connected to its mains, for reasons which it carefully keeps to itself. Fortunately for you, you are not under the dominion of a water company in Liverpool.

Hydraulic power in London.—Hydraulic mains between Blackfriars and London Bridges, on both sides of the river Thames, have been under pressure since November, 1883, and in a few weeks extensions as far west as Victoria Station will be completed. The main pumping station is on the south side of the river, and the two sides of the river are united by two mains carried across Southwark Bridge. There are four 6in. mains carried from the pumping station at Blackfriars, two of them to serve the City and West End, and two quite independent for the service of the southern district. All these mains are in communication with the two accumulators at the pumping station, and at present these are the only accumulators in use. Each pair of mains is laid in circuit. There are main stop valves on the line about every 400 yards, so that any particular length of 400 yards of main can be isolated without interfering with the supply over the rest of the system. This is a most important matter when repairs have to be effected. By get-



MAP SHOWING HYDRAULIC POWER MAINS IN LONDON.

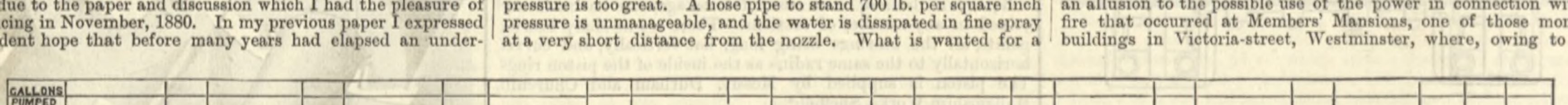
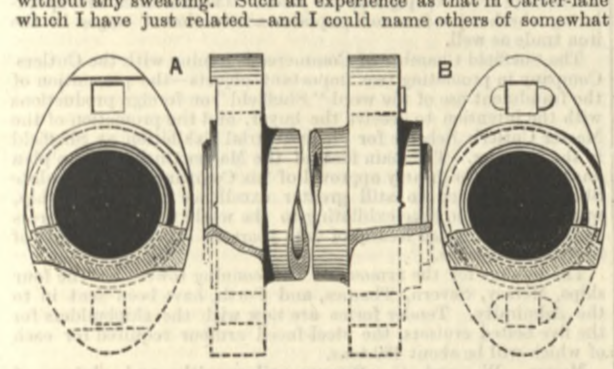


DIAGRAM SHOWING FLUCTUATIONS IN DEMAND FOR POWER IN HULL.

* A paper read before the Liverpool Engineering Society, by Mr. E. B. Ellington, M. Inst. C.E., on January, 28th, 1885.

ting down to the defective joint and taking out one pipe a temporary repair can be effected in two or three hours, and a new pipe inserted during the night after working hours.* We have so far had very few failures, but the few we have had have shown that a bad pipe can be removed and a new one inserted in from six to eight hours according to the character of the paving. In laying long lengths of mains of this character with bolted flanges and subject to the large number of irregular bends and deviations required to avoid obstructions in the line of main, it is a very difficult matter to avoid undue straining of the flanges in bolting up, and what failures in pipes we have had have been either due to initial strains of this character or to settlements in the ground. The mains will, however, stand a considerable amount of settlement without any further result than a slight leakage. There was a curious instance of this in the autumn of last year. The Metropolitan Inner Circle Completion Railway was nearly finished, and it was found that water was getting into the tunnel. The water mains were examined but nothing appeared to come from them, when it was suggested that it might be from our mains. We were aware that there was a leak somewhere and were about to localise it when the intimation reached us. On examining the pipe, which was laid in made ground, we found that a quantity of ballast had sunk and left the pipe unsupported at the joint, and the pipe in sinking had allowed the joint to open sufficiently to create a leakage, but without any break, notwithstanding that this joint had been so tightly made that there was no escape at a pressure of 1000 lb. on the square inch. This instance serves to show that there is a considerable amount of flexibility in these hydraulic mains. While on the subject of leakages I may mention one or two other curious experiences we have had during the past eighteen months. In one place on the main, in Carter-lane in the City, we found a slight leakage was going on, and, on examination, a fine stream of water was seen coming from a joint. When the pipe was removed it was seen that the spigot of the joint had a fine slot in it about $\frac{3}{4}$in. long and $\frac{1}{32}$in. wide. This joint had been quite tight under the test pressure which had been applied twelve months before, and the slot was not then existent. Its presence is to be accounted for by a very slight flaw in the metal through which the pressure finally forced its way, and having effected a passage, like a nibbling mouse had industriously proceeded to enlarge it, until the volume escaping directed attention to the circumstance, and its further ravages were promptly checked. Another curious instance of a leakage occurring was in Holland-street, Southwark. This leakage commenced suddenly and came at once through the paving, and it was assumed that a pipe had broken. However, this was not the case—the pipe being perfectly sound and good. The cause of the leak was that the gutta-percha ring that forms the joint had been a little too large in diameter, and had not fitted perfectly in the recess. The excess of length in the gutta-percha ring had bulged into the pipe and formed a loop. This joint was in the first length of main laid in London. It was made in February, 1883. It passed the test of 1000 lb. per square inch, and continued under pressure until November, 1884, quite tight, when one morning, without any apparent cause, it suddenly developed a leak of sufficient amount to come through the pavement. The gutta-percha ring was intact as first put in, and the fact, as far as I can see, is only to be accounted for by vagaries of the spirits. I have been on more than one occasion taken to task for subjecting every pipe to such a high test as 2500 lb. per square inch—the thickness of the 6in. pipe being $1\frac{1}{8}$in.—and further requiring that this test shall be applied for some time without any sweating. Such an experience as that in Carter-lane which I have just related—and I could name others of somewhat



PIPE FLANGE.

similar character—is a proof that such tests are absolutely necessary to insure a successful installation. A diagram of the water pumped into the mains of the London Company shows in October a very marked rise in the delivery, followed by a rapid fall. That rise was almost exclusively due to the two small leaks in Cannon-street and Carter-lane, and I cannot state any fact that will more conclusively show that the absolute integrity of the main is the most important factor in the successful working of a hydraulic power supply company. This being so, no consideration within the limits of what is practically possible should stand in the way of obtaining what is desired. We may, I think, congratulate ourselves, considering the small experience available as to the behaviour of hydraulic power mains in crowded streets, on the results obtained in London, for with eight miles under pressure during nine months of last year, the first working year of supply, we had no failure. I attribute this success largely to the assistance I have had in carrying out these works from my colleague, Mr. Corbet Woodall, M. Inst. C.E., who has had so large an experience in gas supply, and also to the care exercised by our chief assistant engineer, Mr. G. Cochrane, now the company's superintendent. All the hydraulic pipes I have seen broken, whether under test with flanges bolted on, or in the main as laid, have parted at the flange. It seemed to me that even though breakages were of very rare occurrence, it would, nevertheless, be desirable to strengthen, if possible, this weak place. The most obvious way was to thicken the flange, but this was already too thick, as shown by the fact that in the flanges broken the metal in the thickest part of the flange was generally faulty, due, as is well known, to the difficulty of getting perfectly sound castings with sudden and large variations of section. I was led, therefore, to design a new form of joint, putting a considerable projection on the pipe beyond the flange, the spigot and faucet being formed on this projection. The practical effect of this is to increase the depth of the flange without increase of its section at the junction with the pipe. I had a number of similar pipes, with the old and improved flanges, made and tested to destruction with flanges bolted on, and the mean of twelve experiments gave the following result:—With old form of flange, breaking strain, 3300 lb. per square inch; with new flange, 5030 lb. per square inch; increase of ultimate strength of new flange, 52 per cent. In all the larger sizes of pipes we have, on the strength of these results, adopted the new form. The main valves used are of the balanced type of lift valve, with a waterway the full area of the pipe. The balancing is accomplished by the insertion of a small controlling valve $1\frac{1}{2}$in. diameter inside the large valve, the only work to be done by the turncock being the raising of the small valve and the dead weight of the main valve. By this means a 6in. valve which is pressed upon its seat with a pressure of 28 square inches × 700 lb. = 8·8 tons, can be manipulated with ease with one hand on a 12in. lever. The chief novelty in the arrangement is the method by which the valve remains balanced on whichever side of the valve the pressure is admitted. This is an important consideration when the valve has to be used on a circuit main with the water sometimes flowing in one direction and sometimes in the other. The engines used at the main pumping station possess several points of novelty. The considerations which influenced me in their design were (1) the use of three-throw pumps; (2) direct connection between the pump plungers and the piston; (3) the compound principle in the steam cylinders; (4) the facility for starting; (5) the saving of space occupied. The centre cylinder is high pressure, 19in. diameter, 2ft. stroke; the two outer cylinders, low pressure, are 25in. diameter, the pump plungers are 5in. diameter, and the quantity of water delivered into the accumulators under trial was 296 gals. per minute. The work stipulated for was 140,000 gals. in ten hours, the actual quantity pumped being 156,480 gallons, or an average of 260 gallons per minute. The engines are fitted with surface condensers and air and circulating pumps, the condensing water being obtained from and returned to the reservoir tank forming the roof of the engine house. The automatic starting gear for the engines consists of a bye-pass valve admitting steam direct to the low-pressure cylinder. This valve is opened by the accumulator on its commencing to fall, through the medium of a small hydraulic ram connected to the steam valve. As soon as the engine begins to move it pumps a small quantity of water into this hydraulic cylinder, reversing the motion and closing the valve. These engines will stop and start in any position, make a single revolution, and stop again.* I do not know any type of engine which so well fulfils the conditions required in a hydraulic pumping engine, where space is valuable and coal expensive. The advantages are no doubt gained at the cost of some additional complication of parts and increase of first outlay over older types, but the use of a three-throw pump when working at such pressures as 700 lb. on the square inch is an immense advantage. Compare the piston and plunger pump—the usual form of pump for hydraulic power purposes—to deliver the same quantity. There are the same number of pump valves in each case, but the suction valves are $6\frac{1}{2}$in. diameter in the piston and plunger, and only 5in. in the three-throw pump. The water in the suction pipe to the two pumps has to be stopped twice in the revolution; in the three-throw pump there is a continuous flow, and altogether the vertical three-cylinder and three-throw pump combination gives a better balanced engine and flow of water than can be obtained on any other system with which I am acquainted. The indicated horse-power of the engines in London gave a maximum of 205-horse power and 84 per cent. of efficiency in water pumped, the consumption of small coal in Lancashire boilers with Vicars' stokers being 2·4 lb. per indicated horse-power, and the weight of steam 20·7 lb. per indicated horse-power. The temperature of the condensing water at the end of the run was 98 deg. The delivery of the pumps was measured from the tank reservoir for one hour, and for the remainder of the ten hours' run the water was passed back to the tank after being pumped into the accumulators. The boiler pressure used is 80 lb. per square inch. The accumulators are two in number, 20in. diameter, 23ft. stroke, loaded to 750 lb. per square inch, and the general condition of the eight miles of mains and valves, and the valves and machinery worked from the power supply on consumer's premises is such that the pressure has been kept up through twelve hours on a Sunday with 290 revolutions only of the engine, including in this the use of the power in the lifts in the Parcel Post Department of the General Post-office, and by every other consumer who may have used the power during the time. At an earlier period of the undertaking, with six miles under pressure, the accumulator has been known to remain up from Saturday night to Monday morning. A test of this kind, owing to existing conditions of working, is now impracticable, but it will often happen that there is hardly any perceptible motion in the accumulator for a few minutes at intervals with the engines standing. The water used in the system is taken direct from the Thames at the station at Blackfriars. As you can well understand, the water in this condition is quite unsuitable even for power supply, and it was a grave question with us what method of purification we should adopt. In Hull the principal impurity of the water consists of a fine soft alluvial mud, which, with the limited quantity required daily, has been easily dealt with by a settling tank and subsequent filtration through a bed or, rather, partition wall, of coarse gravel. This method was inadmissible in London, owing to the space that would have been required. We accordingly determined to adopt some system of mechanical filtration, and finally selected the "Thames" filters, in which sponge is used as the filtering material. There are four distinct filters arranged in two pairs. Each compartment has within it a movable diaphragm or perforated piston, fitted with a piston-rod attached to a hydraulic piston above each pair of filters. A pressure of about seven tons is maintained upon the hydraulic piston by the accumulator pressure, and sufficient sponge is inserted through suitable doors into the compartment until there is a layer of about 1ft. of compressed sponge 4ft. 6in. in diameter. The water from the Thames is pumped by centrifugal pumps or a pulsometer into a tank, divided into compartments, over the engine-room, designed, when complete, to contain 100,000 gallons. The water to be filtered is drawn from either of the three compartments of this tank, and passes through the filters by gravity into a filtered water tank, of about equal capacity to the unfiltered tanks, also divided into compartments, fixed over the boilers, but 7ft. below the level of the unfiltered water tanks. After its passage through the sponge filters it passes through a small bed of vegetable charcoal, 18ft. by 12ft. 3in. by 9in., which both brightens the water and stops any little impurities that may have passed through the sponge. Two or three times in twenty-four hours it is necessary to clean the filters. To do this all that is required is to shut off the unfiltered water, and open a communication to the drain—the flow of water being then reversed, and the dirt washed out of the sponge. At the same time the hydraulic piston and diaphragm are set in motion, alternately compressing and releasing the sponge, the action being precisely the same as when cleansing a dirty sponge by hand. From time to time fresh sponge is added of a value of 28s. per cwt., and so far the cost of maintenance has been trifling. The chief objection to the system is that the efficiency of the apparatus depends very much on the care with which it is worked by the attendant. The quantity filtered by the four presses is 10,000 gallons per hour. The water after filtration is, of course, quite unsuitable for drinking, but is sufficiently pure for power supply.

The boilers are of the Lancashire type, fitted with Vicars' mechanical stokers, with self-feeding hoppers, and Green's economiser, the stokers and economiser being driven by a small Brotherhood hydraulic engine bolted to the boiler-house wall. We have found that this method of driving is both convenient and economical, for the speed of the whole apparatus is varied by opening or closing the stop-cock of the engine, and the hydraulic engine will run equally well at two or three or fifty revolutions a minute. Less coal is burnt when the hydraulic engine is at work than when the gear is driven from the donkey engine. I should add that in addition to the stokers and economiser, the little hydraulic engine with 3in. cylinders and 3in. stroke also drives a lathe in the repairing shop. At the pumping station at Falcon Wharf, therefore, there are two novel and successful applications of hydraulic power, the direct-acting combined engines and presses —as I may call them—for the filters, and the hydraulic stoker gear. On the quay outside the boiler-house is a double power movable crane, used for landing and storing pipes, &c., from barges. This crane has a novel arrangement of double power. One valve and lever controls both powers, and there is only one moving ram and no piston. The cylinder and rams are arranged like the upper portion of the balance cylinders in my hydraulic balance lifts. There are some interesting historical associations connected with Falcon Wharf. There is an old house on the site, supposed to be some 200 years old, which has been renovated by the company, and is now occupied for its offices. This house is stated to have been the residence of Sir Christopher Wren during the contruction of St. Paul's, of which a very fine view can be obtained from the top of the new accumulator tower. Before Sir Christopher Wren's time Falcon Wharf was the site of the Falcon Inn, in the neighbourhood of the old Globe Theatre, of Shakespeare's time, and the great bard is supposed to have had many a frolic where the pumping engines now stand. I think you will agree with me that the present use to which the site has been applied is not unworthy of the traditions of the past. Blackfriars is not the only pumping station for the hydraulic power supply. There is a small supplementary station in the neighbourhood of Wood-street, in the City, and about two miles along the line of main from Falcon Wharf. In the City, the land is so enormously valuable that it is necessary to economise to the utmost the space occupied by machinery, and there is nothing of special interest in the machinery which is used at this station, excepting the fact that duplicate boilers, pumping engines of 40-horse power, and an accumulator 18in. diameter of ram, 20ft. stroke, with coal bunkers, tanks, &c., and a lift to the street level are all placed within a space of 29ft. by 15ft., and all except the upper portion of the accumulator is underground—the upper part of the building being let for business purposes. This station was originally intended to serve as a centre of supply to a number of large warehouses in the neighbourhood, recently rebuilt after the great fire of two years ago. Owing to the Corporation of London, in the first instance, giving leave to the company to extend its mains in this direction, and subsequently, to the extended powers granted to the company by Parliament during last year, no independent centre of supply has been needed, and it now forms part of the general system. There is another pumping station at Kensington, which is altogether a new departure. This station is placed on the estate now known as Kensington Court, but formerly famous as that white elephant, called Kensington House, erected by Baron Grant as his "hotel." The house has been pulled down, and on its site and the surrounding seven acres of ground some seventy private houses are being built; thirty of them are already about completed, and each is fitted with a hydraulic passenger ram lift in place of a back staircase. These lifts will all be worked by the Hydraulic Power Company, from its special station on the estate, at a fixed charge to each tenant per annum, the amount varying according to the number in use, and the minimum being £16 per annum. The charge includes the inspection and maintenance of the lifts. The lifts are so arranged that any occupant of the house can use them without an attendant; they can be controlled from either inside or outside; the doors of the lifts are interlocked with the controlling gear, so that no door opening into the lift well can be opened until the lift is stopped at that door, and until the door is closed the lift cannot be worked; the lifts can be automatically stopped at any desired floor. At Kensington Court the water after being used is returned to the pumping station. The pressure used on the estate is 400 lb. per square inch.

(*To be continued.*)

* In all cases where even a very occasional stoppage of an hour or two would cause serious inconvenience, two distinct supplies are given where this is done it is almost impossible for the supply to fail.—E. B. E.

* The engines were constructed by the Hydraulic Engineering Company at Chester.—E. B. E.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, March 7th.

THE States have passed quietly from the Republican to Democratic control for the first time in twenty-four years. The new President, though not a brilliant or particularly able man, has the qualities which will endear him to the hearts of the masses of the people — namely, doggedness and persistency, which is admired more than brilliancy. The new Administration promises no new policy, such as alarmed the country four years ago, when the then new Administration stepped into power. The people want no experiments—no brilliant statesmanship; but want the least possible legislation, and the least interference with all business matters. A number of pieces of legislation were to have been pushed to completion this session, at the urgent requests of the commercial and manufacturing interests. Nine thousand Bills of all kinds were introduced, and less than one hundred became laws, and many of these were of a trifling character. The great business interests were neglected. No Bankruptcy Act was passed; no silver legislation was reached; a host of important Bills were pigeon-holed, all of which will come out at the next session of Congress. The tariff will be one of the new issues. Friends of both high and low duties are now laying the foundation for an active campaign, and it is probable that one of the most active tariff campaigns will be prosecuted in Congress.

The railroad interests are pursuing a very conservative course, buying the least possible, and insisting on the lowest prices for material. Rumours prevail of steel rails having sold at 25 dols. per ton. There are inquiries on the market this week for spiegel and Bessemer, and large sales are likely to take place. Several thousand tons of bridge iron will be ordered before the close of this month, for delivery in early summer. The blast furnace industry of Pennsylvania is suffering severely from Southern competition. The bar mills throughout the West are working in a general way about one-half time. Manufacturers of plate iron, sheet, and pipes are working less than full capacity. There is no upward movement in prices probable.

The agricultural interests are looking about them for a larger export trade. The cultivation of cereals on the Pacific slope, and throughout the interior of the north-west, has been extended very largely within a year or two, by reason of the facilities afforded for the shipments of grain by the construction of long lines of railroad through those rich agricultural regions. A line of steamers is to be chartered to run between Mexico and Liverpool, in connection with the Southern Pacific Railroad, which is designed to handle the products of the Pacific slope. The purpose of this departure is to avoid the long sail around Cape Horn.

The lumber interests are preparing for a very active year. The centre of the lumber interests is Chicago, and according to tabulations just completed, there were received last year at that point 1,800,000,000ft. of lumber, 900,000,000 shingles, and 75,000,000 laths. Present stocks on hand are nearly 50,000,000ft. These stocks will be largely augmented by spring arrivals.

Broadway in our city—which is a narrow way, and unfit for the railway scheme which is now seeking to monopolise that thoroughfare—is likely to be obstructed by a double-track railroad, for the transportation of passengers from the Battery to Fourteenth-street. The property owners are fighting this measure, and are supported by the Board of Trade and Transportation.

Fires are unusually numerous and destructive. The ruins for February foot up 203, and the total loss 10,000,000 dols., in the United States and Canada.

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

(*From our own Correspondent.*)

IRONMASTERS could not on 'Change in Birmingham to-day—Thursday—quote to customers, with the same amount of assurance which they did a week ago, the probability of a war with Russia as a reason for asking firmer prices. The more pacific aspect of political affairs did not, therefore, improve the market. Yet business was kept from wearing so depressed a tone as would otherwise have been observable by the expectations which exist of further early demands on account of the operations in the Soudan. Ironmasters who are in a position to roll strip iron of wide sections anticipate that they will be amongst the first to benefit.

The orders on offer, whether for home or foreign account, are insufficient to provide anything like full employment for the works, and four days a week is, perhaps, the average. Sheets continue to be best called for, but even these mills are running very irregularly. Messrs. W. Molineux and Co., sheet makers, have, however, this week re-started the forge at the Capperfield Ironworks, which they recently purchased from the Chillington Iron Company, and in a few days they will also set the mills going. Prices of sheets are very varied, and the tendency is downward. Merchant singles are plentiful at under £6 10s., working-up doubles may be had at £7 to £7 5s., and lattens at £8 to £8 5s.

Galvanised sheet makers are still unable to give a good account of the demand, but certain of them are making large consignments to Australia and South America. Galvanised sheets of the Red Star brand are quoted £11 15s. for 18 and 20 gauge, £12 5s. for 24 g., £13 15s. for 6 g., and £14 15s. for 28 g. Sheets of the Lion brand are 10s. per ton more. Close annealed and cold-rolled galvanised flat sheets of the Woodford Crown brand are quoted £15 for 18 and 20 g., £16 for 24 g., £18 for 26 g., and £19 for 28 g.; best ditto, tinned, of the Anchor brand, are £17 for 18 and 20 g., £18 for 24 g., £20 for 26 g., and £21 for 28 g.

The requirements of Australian buyers chiefly relate to bars of best and medium descriptions, and to hoops. Orders for India are here and there heavier than a month or two back. The South American business in bars is of an average character, though the demand is largely confined to the cheaper qualities. The North American trade in bars is exceedingly limited, but orders are arriving pretty freely for best sheets.

The £7 10s. quoted for marked bars is in actual business confined to one or two firms. Branded iron of good quality can to-day be plentifully had at £6 10s. Ordinary bars are £6, and common range down to £5 10s. and £5 5s. Common hoops are to be purchased at £6 2s. 6d. to £6 5s., though some makers demand £6 10s. to £6 15s. Angles are £5 17s. 6d. per ton.

Pig iron is tame alike in native and foreign sorts. Stocks in the hands of Staffordshire makers are increasing, and as a result, a few firms are now either blowing out or damping down furnaces. Messrs. Groucutt, of Moxley, are amongst the firms who have just blown out, and Mr. D. Kendrick, of the Willingsworth Furnaces, has damped down. One or two of the Dudley makers are also blowing out. Thus South Staffordshire is following the example which I last week reported had been set by some of the Midland pig makers. By consenting to a revision of wages, the blast furnacemen at one or two other important Staffordshire concerns have for the present prolonged the operation of the furnaces.

Prices are no stronger on the week. All-mine pigs are 55s. to 60s., part-mines are 42s. nominal, and cinder sorts, 35s. to 36s. 3d. per ton. Hematites are quoted 55s., but less money is taken. Northampton pigs are plentiful at 39s. at stations, and Derbyshire at 40s. to 41s. per ton.

Coal remains very depressed. Furnace sorts vary from 8s. to 10s. Best forge qualities are 7s. 6d.; and ordinary, 6s. 6d. to 5s. 6d. long weight. There is renewed talk this week of the necessity of reducing wages. Already certain of the North Staffordshire owners are demanding a 10 per cent. reduction, and intimate that they will cease working if it is not conceded. Indeed, two or three North Staffordshire concerns where ironstone figures largely in the output have, I am informed, resolved to continue producing no longer under any conditions of the labour market, and have just shut down their pits. Unremunerative prices are the cause.

Ironmasters are hoping that a fair solution of the difficulty which has been originated by the new Bills of the chief railway companies—that design the increasing of maximum rates, and which aimed at the legalising of terminal charges—will be arrived at by the mixed committee which the Board of Trade has been instrumental in devising. At all events they trust that the outcome will be much less unsatisfactory to traders' interests generally than would have followed upon a fight in the usual committees. Through the different organisations formed for the purpose of giving forcible expression to the views of the traders of this district, fighting action will continue to be taken.

Good contracts continue to be booked in some directions by the constructive engineers and roofing manufacturers. I understand that within the last few days the order has been secured for this district for the roofing of the new shopping in connection with the New South Wales Railway, Australia. The iron roofing for a large drill hall at Liverpool has recently been sent away from the works at James Bridge of Messrs. Carter, Ford, and Co., who figure among the local manufacturers who remain well engaged, In their boiler yard this firm have lately constructed boilers for Norway, Buenos Ayres, and other export markets.

Engineers in Birmingham and South Staffordshire speak with satisfaction of the increased favour with which steel is being regarded by consumers for bridge and pier and similar work. They are more and more adopting the view that steel will certainly steadily, if not rapidly, supersede iron in such erections. The leading constructive concerns hereabouts are employing alike Bessemer, Siemens, and basic steel, and they report in gratifying terms of the behaviour of even the last-mentioned material. A few days ago a director of one of the largest engineering establishments told me that, after carefully watching the basic steel supplied to them by the Staffordshire Steel and Ingot Iron Company, he had no hesitation in pronouncing it admirable, and of regular quality. Steel is also being employed more extensively than hitherto by the boiler engineers in their manufactures intended to bear a high pressure.

It is hoped that some of the work that the Bombay, Baroda, and Central India Railway Company is about to give out for wheels and axles, road and brake van ironwork, bearing springs, axle boxes, crank axles, centrifugal pumps, and the like, may fall to this district. An attempt, too, is being made to secure for local makers the nuts and bolts inquired for by the Madras Railway Company in connection with their new steel rail contract. The horizontal condensing engines and double-acting pumps and gearing, needed by the City of Ely Local Board, may possibly come to engineers hereabouts. The supply of 14,600 yards of 12in. cast iron socket and sipgot pipes, required by the same buyers, would be a welcome item for some of our pipe founders.

Negotiations are still proceeding between certain of the wrought iron tube firms and authorities in London, which it is believed will issue in a considerable addition to the pipe contracts now under execution. Mr. John Brotherton, of the Imperial Tube Works, Wolverhampton, is understood to have received an inquiry concerning the supply of some forty miles of the pipe line, but up to the present the order has not been definitely booked. A new plant which Mr. Brotherton has just completed at a heavy expenditure, and which will allow of a considerable addition to his present production, places the firm in a good position for executing work for the Soudan.

Among the orders which have been completed during the past week or two on account of the Soudan, signalling ironwork for the Suakim-Berber Railways figures. In their chain and anchor department Messrs. Noah Hingley and Sons, Netherton, have benefitted by the necessities of the Government.

The vice and anvil trade is not in a prosperous condition.

Two new economical gas puddling furnaces which are in operation at the Wilden, Swindon, and Wolverhampton Works of Messrs. E. P. and W. Baldwin, best sheet iron makers, were brought before the Institute of Iron and Steel Works Managers at Dudley on Saturday by Mr. W. Farnworth, the manager of the Swindon works of the firm. Mr. Farnworth said the first was patented by Mr. Felton for use in sheet and tin-plate mills. The furnace had no grate-bars, but the fuel was placed in a chamber with a hanging bridge, to admit of air passing, and for the fuel to remain behind and become partially decomposed. Air was mixed with steam in the use of the furnace, and the results were steady, clear, softening flames, with perfect control. The second was a furnace patented by Mr. Felton and himself, in which bars were used, and the air was mixed more thoroughly with the gas than in the other by means of apertures formed at the top, and the fuel was retained whilst the ashes were removed. Facilities were given for this removal and for that of clinkers, thereby giving greater heat. The gas generators had been brought as close to the furnaces as possible so as to secure the greatest heat, and in lieu of regenerators the air was heated by means of the sides of the generators and the spent gases of the furnace. Mr. Farnworth stated that the quantity of iron puddled by his furnace in six turns was 11 tons 2 cwt. 12 lb. The furnace had been got ready on a Monday morning, and 3 tons 4 cwt. 12 lb. of puddled iron had been turned out on a consumption of about 19 cwt. of slack.

The Birmingham Tram and Omnibus Company has this week determined to apply to Parliament for power to authorise the construction of tramways in Birmingham and certain adjoining districts. The chairman expressed the opinion that steam as a motive power for tram-cars will be superseded in a few years.

According to Mr. W. Woodall, M.P., who has just expressed his views in North Staffordshire, there is "a levelling process" going on all over Europe. The longer hours of the continental workmen are being reduced, and their lower wages are being raised. The competition of the future will consequently, in his opinion, be a matter of skill, and the race would be won by the country which devoted itself most intelligently to the cultivation of its people, and especially of its youth.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—A stagnation of demand still characterises all branches of both the iron and the coal trades of this district, and prices continue weak. Both finished iron works and collieries are on short time, and it is only in exceptional cases that they are working more than four days a week, whilst the prospect of any improvement in trade seems to be no nearer than ever. Here and there orders in connection with Government contracts have given a little more activity to ironworks, and in railway plant there is rather more doing, but the general trade does not improve, the tendency in some branches of engineering which have hitherto been well employed being, if anything, towards lessened activity.

There was again but a very slow business doing on the Manchester iron market on Tuesday, and it was only in exceptional cases that trade was not reported as extremely dull. In pig iron, where any business is done it is still at excessively low prices, with, if anything, a weaker tone in the market. Lancashire makers are now open to take 40s. for forge and 40s. 6d. for foundry, less $2\frac{1}{2}$, delivered equal to Manchester, but they are still undersold by district brands, which in some cases can be got readily at 39s. 6d. to 40s. per ton, less $2\frac{1}{2}$, delivered here, although one or two of the leading makers would probably not be disposed to accept figures quite as low as this.

For manufactured iron quoted prices remain on the basis of about £5 10s. for good qualities of bars delivered into the Manchester district, but this is little more than a nominal figure, the average selling price being practically about £5 7s. 6d., with hoops about £5 17s. 6d., and local made sheets £6 17s. 6d. to £7 per ton.

Comparatively little change is noticeable in the condition of employment in the engineering branches of industry. The reports of the engineering trades union societies in some cases show a slight increase, and in others a small decrease in the number of members receiving out-of-work support; but generally employment may be said to remain fairly steady on about the same basis as a month ago. The slight improvement shown recently in the reports from some of the shipbuilding districts appears to be maintained, fairly good orders having been secured at Barrow; but the stationary engine building trade continues to fall off, and in some of the Lancashire districts is very bad. Locomotive builders in the Manchester district are still well employed, but in this branch of trade there appears to be a check so far as the weight of new orders giving out is concerned, and railway rolling stock builders, with the exception of one or two firms, have no great amount of work to look forward to. Amongst cotton machinists there is, if anything, a rather more hopeful tone. Although there is not as yet any great actual influx of new orders, activity is again showing itself both in home and foreign work. Special tool makers, and firms with an acknowledged reputation, are fairly busy, but in the heavy tool branches trade is generally quiet, and this is especially the case in the North of England. The large boilermakers in this district are tolerably well off for work, but where there are boilers to let the competition is so keen as to indicate an absence of any real activity generally.

Messrs. Collier and Co., of Salford, are building a massive and powerful self-acting sliding and surfacing brake lathe, specially designed for finishing marine, locomotive, and other crank shafts. The bed of the lathe is 5ft. 6in. wide, and of sufficient length to admit 24ft. between the centres; the height of the centres is 30in., and the gap to swing the work when fixed in centres 8ft. 2in. diameter. The fast headstock has single, double, and treble power gearing, and is fitted with a steel spindle 7in. diameter in front neck, running in parallel gun-metal bearings, and at the end the headstock is also fitted with reversing gear. The face-plate is 8ft. diameter, and the loose headstock is fitted with a sliding steel spindle 4in. diameter. The bed is fitted with two ordinary carriages and compound slide-rests, self-acting by screw, for sliding and surfacing; also with two special carriages and narrow rests at the back, for turning inside the sweeps of crank shafts, self-acting by screw, for sliding and surfacing. Each carriage is provided with quick hand traverse along the bed by rack and pinion, and the total weight of the lathe complete will be about 35 tons.

A powerful steam fire-engine, which has been built for the Britannia Mill, Oldham, by Mr. John Wolstenholme, of the Albert Works, Radcliffe, was put through a series of trials at the above mill on Saturday. In this engine the steam cylinders are 22in., the water cylinders 8in. diameter, and the stroke 24in., the full working capacity being 60,000 gallons per hour, which can be delivered through sixteen jets. The working parts of the engine are constructed entirely of wrought iron and steel, and the cranks, which are of locomotive pattern, are set at quarter centres to give a continuous and steady stream of water. The engine is provided with ample sized air vessels on both suction and delivery, fitted with improved self-acting air-feeders, and also with a large wrought iron receiver, to which the hose valves are attached. The whole of the water and hose valves, which are also supplied by Mr. Wolstenholme, are of the sluice type, giving an unobstructed passage to the water. During the course of the trials, which were of a very satisfactory character, a dozen hose pipes were, after an alarm had been sounded, attached to the hydrants, and in a very few moments were playing considerably higher than the roof of the mill, which is a building five storeys high. Another test was projecting a column of water above the top of the mill chimney, which is 75 yards high. For this purpose two hose pipes were connected by a breeching to obtain the requisite supply, and this was delivered through a $1\frac{1}{2}$in. jet at a pressure of 225 lb., the water passing clean over the chimney top. I may add that the engines have been tested, and will work up to 300 lb. on the square inch, and Mr. Wolstenholme has other engines in progress for several of the mills in Oldham.

The Manchester Association of Employers and Foremen continues to make steady growth in the direction of increasing membership, and at the quarterly meeting on Saturday, Mr. W. H. Bailey, the president, in the chair, two new life honorary members—Mr. Ralph Peacock, of the Gorton Foundry, Manchester, and Mr. Wm. Potter, of the Clarence-street Works, Cheetham—nine annual honorary and ten ordinary members were elected. At the next meeting, Mr. Rea, of Manchester, has undertaken to read a paper on "Turbines, as a Motive Power."

In the coal trade a moderate demand is kept up for house fire classes of fuel, but the common classes of round coal for iron-making and steam purposes still move off very slowly, and are becoming quite a drug in the market, with sales pushed at extremely low figures. The average prices at the pit mouth remain at about 8s. 6d. to 9s. for best coals, 7s. to 7s. 6d. for seconds, and 5s. 3d. to 5s. 6d. for common coals; but there is a good deal of underselling, and to move away stocks which are continually accumulating at many of the collieries special quotations are made altogether irrespective of list rates, and prices generally have a downward tendency. Engine classes of fuel continue only in very moderate demand, but the present limited supplies of slack are moving off fairly well, and at the pit mouth prices remain at about 4s. 6d. to 5s. per ton for burgy and 2s. 9d. and 3s. for common, up to 4s. per ton for the better qualities of slack.

In shipping a little more activity is reported in some cases, but generally trade continues very quiet, with prices for steam coal delivered at the high level, Liverpool, or the Garston Docks ranging from 6s. 9d. to 7s. 3d. per ton.

Barrow.—The chief feature in the events of the week is the statement, which has received confirmation, that the capitalists of Barrow are considering the expediency of inaugurating new works at Barrow for the rolling of steel plates. The shipbuilding trade at Barrow has been severely handicapped for years by the carriage charges of plates, &c., and now that steel is coming to the front for shipbuilding purposes, and as Furness is one of the chief centres of the steel trade, the manufacturers of the district are determined to produce, either at new works or at existing works, the plates required for shipbuilding and boiler-making purposes in the district, and probably to compete in the open market with other makers of plates. The business doing in steel is not at present active, and as makers of rails are finding they will not be able to keep their works fully employed in the manufacture of rails, for which there is no pressing demand, they are naturally turning their attention to other matters, and of late years they have not only extended their general trade in merchant steel, but have also developed a new trade in special steel made in bars of hard, mild, and medium quality, with specified percentages of carbon; and this class of steel has been found so valuable and cheap, comparatively speaking, that a fair trade has been established, and this is likely to extend. The addition of plate rolling on a large scale to existing branches of industry cannot but have a very satisfactory effect on the trade of the district. Pig iron remains in quiet demand, with mixed Bessemer samples at 44s. per ton net at works. Shipbuilders are likely to be much better employed. Iron ore and coal quiet. Shipping very dull. Engineers are fairly at work in the general trades; and there is a better outlook in the marine engineering branch.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THIS week the bulk of the notices to the miners in South and West Yorkshire have been given out, the majority of the employers having only to give fourteen days' notice. Curiously enough, the British public does not seem to believe there is going to be any strike. It expresses its unbelief in a practical fashion by refusing to lay in extra supplies. Even the large London merchants and other leading consumers do not order coals for stock. There is no modification of the attitude of employers and employed to account for this sanguine opinion on the part of the public. Every utterance on both sides expresses increased determination to resort to extreme measures.

Messrs. Newton, Chambers, and Co., Limited, have given their hands, numbering 1800, fourteen days' notice. They are employed at the Thorncliffe, Tankersley, and Rockingham collieries, from which the metropolitan merchants receive the largest supplies of house coal sent by any colliery company by rail. What has excited more surprise is the decision of the firm to blow out their large blast furnaces at Thorncliffe Ironworks. These furnaces have been in operation since 1873, producing about 600 tons of the well-known Thorncliffe brand of pig iron per week. The workmen are speculating whether the firm contemplates a reduction of wages in the iron trade as well.

The Sheffield Chamber of Commerce is joining with the Cutlers Company in promoting two important objects—the prevention of the fraudulent use of the word "Sheffield" on foreign productions with the intention to deceive the buyer, and the promotion of the Master Cutler's Scheme for an Industrial Exhibition at Sheffield in the summer. The main idea of the Master Cutler, whose plan has met with the hearty approval of his Company, is to stimulate Sheffield workmen to still greater excellence in workmanship, while at the same time exhibiting to the world the great progress which has been made locally of late years in every department of Sheffield industries.

The tenders for the armour of the conning towers for the four ships, Mersey, Severn, Thames, and Forth, have been sent in to the Admiralty. Tender forms are now with the shipbuilders for the five belted cruisers, the steel-faced armour required for each of which will be about 460 tons.

Messrs. W. and G. Sissons, silversmiths and platers, of St. Mary's-road, Sheffield, are about to retire, and sell their business. This firm is one of the oldest in Sheffield, and had for its founders several of the pioneers of the plating trade in Sheffield. They have conducted an extensive business over the kingdom for many years.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

NO change of consequence has taken place in the Cleveland pig iron trade during the past week. Quietude again prevailed at the market held at Middlesbrough on Tuesday last, and such sales as were made were at the lower rates reported last week. Merchants accepted 34s. per ton for No. 3 g.m.b. for prompt delivery, and for good orders makers would take 34s. 3d. to 34s. 6d. per ton. Few sales were made for forward delivery, as many expect that prices will advance when the shipping season commences. Forge iron is scarce, and the price is steadily maintained at 33s. 3d. per ton. The difference in value between forge and No. 3 is less now than it has been for long. Last summer it was 2s. to 2s. 6d.

There are no inquiries for warrants, the price remaining nominally 34s. per ton.

On Monday last Messrs. Connal and Co.'s stock of Cleveland pig iron at Middlesbrough was 50,832 tons, being a reduction of 100 tons for the week.

Shipments of pig iron are proceeding at about the same rate as during last month. Up to Monday last they amounted to 32,868 tons; in February in the corresponding period they were 33,473 tons. About one-half is for Scotland, and of the remainder the greater part is for British ports, very little being consigned abroad.

The demand for finished iron has slightly improved during the last few days, but prices remain about the same. Some orders for iron vessels have recently been placed with east-coast builders, and makers of plates and bars will no doubt be benefitted thereby. Ship-plates are offered at £4 15s. to £4 17s. 6d. per ton, angles at £4 10s. to to £4 12s. 6d., and common bars at £4 17s. 6d. to £5, all f.o.t. on trucks at makers' works, less $2\frac{1}{2}$ per cent.

About 250 miners, mechanics, and labourers employed at Messrs. Bolckow, Vaughan, and Co.'s Hunwick Colliery have received notice to leave. The coal from this colliery is coked at the Newfield Colliery ovens, and therefore the lessened output at Hunwick means a corresponding reduction of coke ovens in operation at Newfield.

The ironwork for the roof of the new station at Banktop, Darlington, has been let to the successors of the late John Butler, of Stanningley, near Leeds. This firm has also a contract for ironwork for the new Stockton bridge now in progress. The Tees-side Iron and Engine Works Company has just made an important contract for new bridge works for the North-Eastern Railway Company. Contracts for ironwork with this company are much sought after, a circumstance which arises in no small degree from the universal confidence among contractors and manufacturers in Mr. T. E. Harrison, the company's chief engineer. This gentleman, whilst he takes every care of the interests of his company, is always approachable by those who work for him, and always reasonable and moderate in his expectations. Unfortunately, this cannot in all cases be said of those who compile specifications and superintend their execution, The steel foundry business hitherto carried on at Middlesbrough by the firm of Butler Brothers has just undergone reorganisation as regards the proprietorship and management, and operations are now being conducted with greatly increased energy and attention. One of the brothers Butler has retired, whilst the other remains to conduct the practical part. For conducting the commercal department, Mr. H. L. Fox, son of the senior principal at Newport Rolling Mills, and brought up there, has become responsible.

The extension of the Middlesbrough dock, which was contracted for by Mr. Jackson last year, is being proceeded with somewhat more rapidly than at first. At the south-west corner, where for a time the workmen were flooded out, the excavation is now perfectly dry, and advances day by day. The trouble all arose from a drain pipe, which had been overlooked. As soon as it was got at and effectually plugged, it was easy enough to pump out the water, and prevent any further accumulation. The case is somewhat different at the east side of the dock, where the entrance is being widened. There great difficulty is still experienced in keeping the water from the excavations. This is because of the nature of the stratum operated on, it being largely intermingled with quicksand. However, the well-known pluck and perseverance of Mr. Jackson and his experienced staff will no doubt eventually overcome this obstruction as completely as they have innumerable others.

The proposed lighthouse on the Salt Scar rock off Redcar has been abandoned. A deputation of Elder Brethren of the Trinity House Board visited the locality, and heard what was to be said as to the danger to shipping which had long existed, and which might be avoided by a suitable light permanently maintained there. Before committing themselves, however, the Brethren wisely raised the question who was going to pay for the new light. The shipowners of the locality were not willing that the dues payable by them should be increased. The Tees Conservancy Commission, who were consulted, said they would not pay. They went even furthur, and said that taking into account the light they had themselves recently placed on the South Gare breakwater, they did not think one on the Salt Scar was necessary or desirable, so that under the circumstances the whole project has fallen to the ground.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

A QUIET business has been done in the iron market this week. The fluctuations of warrants have been smaller than usual, and comparatively little iron appears to have changed hands among speculators. Several hundred tons more iron is being sent weekly to the United States, but the exports there are still below those of last year. The week's shipments as a whole are scarcely up to the average, they amounted to 8879 tons, as compared with 8135 in the preceding week, and 12,238 in the corresponding week of 1884. There is not much change in the amount of the output. At Dalmellington ironworks one furnace has been extinguished, and there are now 92 in blast against 94 twelve months ago. The stock of pig iron in Messrs. Connal and Co.'s Glasgow stores shows an increase of 1960 tons for the week.

Business was done in the warrant market on Friday at 41s. 4½d. per ton for cash. There was a fair business on Monday at 41s. 4d. to 41s. 4½d. Transactions occurred on Tuesday at 41s. 4d. to 41s. 3d. cash. Business was done on Wednesday at 41s. 5d. to 41s. 4d. cash. To-day—Thursday—the market was very quiet, with quotations from 41s. 4d. to 41s. 3d. cash, closing with buyers at the latter.

The market values of makers' iron are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s. 6d.; No. 3, 46s. 9d.; Coltness, 54s. 6d. and 50s. 6d.; Langloan, ditto; Summerlee, 51s. and 46s.; Calder, 52s. and 46s. 6d.; Carnbroe, 48s. 6d. and 46s.; Clyde, 46s. 9d. and 42s. 9d.; Monkland, 42s. 3d. and 40s.; Quarter, 41s. 6d. and 39s. 9d.; Govan, at Broomielaw, 42s. and 40s.; Shotts, at Leith, 51s. and 50s. 6d.; Carron, at Grangemouth, 52s. 6d. and 47s.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 48s. 6d. and 43s.; Eglinton, 43s. and 39s. 6d.; Dalmellington, 47s. and 43s.

To the orders formerly received in the steel trade is to be added that for eleven Nile steamers, placed by the Admiralty with Messrs. John Elder and Co. The steel will be supplied by Messrs. Isaac and William Beardmore, of the Parkhead Iron and Steel Works, Glasgow.

The iron and steel goods shipped from Glasgow in the past week embraced eleven locomotive engines, valued at £26,000, for Bombay; a steam launch, yacht, and barge, £2200, for Penang, Surinam, and the River Plate respectively; £1100 worth of sewing machines; £2300 steel goods; and iron manufactures of different kinds valued at £31,000.

The coal trade is quiet in most districts. The week's shipments embraced 7199 tons at the General Terminus and 5988 tons at the Queen's Dock, Glasgow, this quantity being not much over half what has been usual of late; Greenock, 119 tons; Irvine, 1420 tons; Ayr, 7961 tons; Troon, 5385 tons; Grangemouth, 2619 tons; and Leith, 1150 tons. While the shipping demand in the Glasgow district is unsatisfactory, the inquiry for household and manufacturing purposes is also under the average. On the south coast of the Frith of Forth, in Stirling, and the Lothians, business is likewise assuming a less animated character. In Fife the shipping trade in coals is reported to be extremely dull. For inland orders the competition is said to be very strong among the coalmasters. But at many of the collieries the bings of coal are large, and it is the rule for the miners to obtain only about four days' work a week. On the Ayrshire coast, the demand for coals is good at Ayr, fair at Irvine and Troon, but dull at Ardrossan.

The slackness experienced in the coal trade in a number of districts has not merely reduced the working time of the miners, but also compelled the employers to make a reduction of 6d. a day in wages.

As will be gathered from a paragraph above, Messrs. John Elder and Co., whose shipyard was almost closed through want of work, have received an order to build eleven stern-wheel steamers of very light draught for service in the Nile. They are of the type of the Lotus, constructed by Messrs. Yarrow on the Thames. One of them is 138ft. long by 23ft. broad, and the other ten are 92ft. by 20ft. each. The hulls will be steel of ⅛in. in thickness. The utmost expedition will be used in their building, the whole number being carried forward at once.

The shipyard of Messrs. Birrell, Stenhouse, and Co., of Dumbarton, is quite empty, and the workmen are discharged until some contracts can be obtained. A yard at Sandpoint, Dumbarton, is also closed; nothing is being done by Messrs. Murray Brothers; only a few men are engaged in the yard of Messrs. Burrell and Sons; while in the two larger yards there is more work, but not sufficient to keep the available men fully employed. At the engine works of Messrs. Denny and Co. the wages of artisans are being reduced 1s. 6d., and those of labourers 1s. a week.

On Monday, Messrs. Scott and Co., of Greenock, launched a steel screw steamer of 2300 tons for the China service of the Ocean Steamship Company, of Liverpool.

Mr. J. S. Dixon, M.E., has been appointed president of the Mining Institute of Scotland for the ensuing year.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

MEN of pessimist tendencies were openly expressing their fears at Cardiff this week with respect to the passing of the Amalgamation Bill of the Bute Docks and Taff Vale Company. The Board of Trade, they said, did not favour the union of docks and railway. How about the Barry Docks and railway last year? The matter is scarcely worth discussing, and now that the question, ably supported, will soon be under judgment, it may fairly be left to the Committee. Of course opinions vary according to the interest at stake, but the unbiassed opinion of coalowners is strongly in favour of the amalgamation. There need be no fear of the docks and railway proving too great and unwieldy for management. The Taff management could cope with it and yet carry out those changes which it is now accomplishing, and which it ought to have carried out years ago.

Had the Taff Vale Railway in its early days been as untrammelled as it now is, it would have commanded every valley. But it branched feebly; it allowed canals, tramways, and rival railways to come into its own domain, and remained one of the most conservative and unprogressive of lines. I know, personally, that energetic officials chafed at this, but they have all lived to see a change, and now there is no railway in the kingdom that is broadening out with more vigour. Before the sod of a new coal pit a mile away is cut the Taff begins to lay its rails.

The clearances of coal have been good of late. A week ago the Roath sidings presented a picture of stagnation. Everybody seemed represented there, both in steam and house coal; but the shipping away of 150,000 tons to foreign and 20,000 coastwise from Cardiff soon cleared the sidings. Trade is brisker at all the ports, and prospects in steam coal certainly waking up, though prices are quiet. Demand must be more persistent to move prices. Last week Russian news suggested an advance, and there was a good deal of expectancy. Now it has died away again. House coal continues rather dead, and the anthracite of the western part of the coal basin is in little request. Small steam is firm at—best qualities, 5s.; and in consequence patent fuel, which runs in unison, is brisk both at Cardiff and Swansea. A good feature of the trade is the enterprise shown in various quarters. As I long anticipated, the steam coal of the Monmouthshire valleys is now regarded with interest. This is the future new field. The Powell Duffryn Company is planning new pits to the steam coal near Bargoed. Its new pit, the Elliot, is now turning out coal.

In the Rhondda Valley the coal trade is not so brisk as one would wish to see, and some pits in particular have exhibited partial idleness. Tyla Coch is stopped for the present, and the workmen are claiming £700 wages. The whole affair is a warning to coal speculators who essay coal working with insufficient capital. According to Mr. Kirkhouse, the speculation would be most remunerative, but £20,000 is required, and the late company only raised £3000. Middle Duffryn Colliery, in the Aberdare Valley, is also stopped. The men say that it is due to the agent who wished to deviate from the price for cutting various parts of the 3ft. seam. A petition has been filed for winding up the Rhondda Mountain Colliery Company, in the Neath Valley.

These are the leading incidents on the shady side of things. Generally speaking, the coal trade is more hopeful, and the port despatches larger. We sent away 220,000 tons from the three leading ports last week.

The long contested case of the Coedcae is finished—known as Jones *v.* Coedcae—as far as the law courts are concerned. I shall refer to it again after some few details are settled.

The Rhymney shareholders are on the alert, and, as suggested by one of the number, are wishful to come to terms with the Taff Vale in view of the amalgamation, and for the protection of their own interests. Another cargo of rails for Suakim left Newport last week. Ebbw Vale steel appears to be in good favour.

Tredegar, I hear, has secured some steel orders, and a good coal contract for one of the Irish railways. The rail and bar business is, however, very flat, and a good deal of destitution prevails amongst the ironwork labourers. At the present scale and short time it is a hard struggle to get common necessaries.

In tin-plate there is a shade less activity, and a stronger disposition on the part of buyers to force prices below the 13s. 6d. for ordinary coke plate. I have heard in a few cases of 13s. 3d. accepted, but makers of best brands are firm, and can afford to be so, as they have good orders in hand. In the Swansea district good cargoes are being despatched; one of 800 tons for New York left last week, and a number of steamers are expected in to load.

Mr. Hayhurst, a well-known colliery manager of the Rhondda, is dead.

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.

10th March, 1885.

3080. TYPE WRITER, M. A. Wier, Upper Norwood.
3081. APPLYING HYDRAULIC POWER to VELOCIPEDES, W. Phillips and G. H. Street, London.
3082. AIR-TIGHT MILK CHURN or CAN, W. Hitchman, London.
3083. ADVERTISING, A. R. Thomas, Birmingham.
3084. ADJUSTABLE ATTACHMENT for INCREASING the AREA of BASE of PORTABLE LAMPS, A. W. Doery, London.
3085. COMBINED BALANCE TENSION WHEEL for BICYCLES, &c., H. Hodkinson, W. Hasted, and T. G. Jelly, Coventry.
3086. ATTACHING DOOR, &c., KNOBS to SPINDLES, G. H. Taylor, Great Crosby.
3087. BRINGING the BALLS OUT of the POCKETS and RETURNING THEM to the BALK END of a BILLIARD TABLE, A. H. Colles-Orme, Manchester.
3088. ELECTRO DEPOSITION of COPPER, W. E. A. Hartmann, Swansea.
3089. TREATING POTTERS' STONEWARE CLAY, A. and W. Purvis, Glasgow.
3090. BOILER FLUE CLEANERS, F. L. McGahan, U.S.
3091. CHILDREN'S ROCKING BOATS, &c., P. Currie, Liverpool.
3092. STRAWBERRY SYRUP, C. Cockrill, Northampton.
3093. SHAVING TOOL for the USE of BOOT MAKERS, T. and B. Hartley, Manchester.
3094. STREET and other LAMPS, W. Sharp, London.
3095. FURNACE BARS, G. W. Hawksley and T. Andrews, London.
3096. DYEING, &c., TEXTILE MATERIALS, W. Mather, London.
3097. VITREOUS MATERIAL for PAVING PURPOSES, J. and H. J. Rust, London.
3098. DECOMPOSING LIQUORS CONTAINING CHLORIDE of MAGNESIUM, J. Wilson, Edinburgh.
3099. HINGES for RAILWAY CARRIAGE DOORS, &c., W. Defries, London.
3100. BANG and MORTICE LOCKS for DOORS, W. Defries, London.
3101. EXTRACTING OIL from MAIZE, &c., F. V. Greene, London.
3102. WHEELS of CARRIAGES, H. J. Lawson, London.
3103. FASTENERS for BOOTS, F. A. Lowman, London.
3104. FILES, &c., E. J. Rowland, London.
3105. PORTABLE WASH-STAND, L. A. Beauvais, London.
3106. COOKING UTENSILS, C. Clarkson, Brentford.
3107. RULING and ENGRAVING MACHINES, &c., R. W. Bentley, London.
3108. TANNING APPARATUS, L. Simpson and J. Davis, London.
3109. ELECTRIC CONDUCTORS, A. C. Tichenor, London.
3110. HAMMERLESS GUNS, R. Redman, London.
3111. GAS PRESSURE REGULATORS, W. T. H. Carman.—(*J. Fleischer, H. W. Müller, and J. G. Arnold, Germany.*)
3112. GRABS, BUCKETS, or SKEPS, N. G. Kimberley, London.
3113. NAIL for the HEELS of BOOTS and SHOES, E. A. Herbert, Erith.
3114. STUD or DRESS FASTENER, H. G. Smith, London.
3115. CARBON FILAMENTS for INCANDESCENT LAMPS, R. Dick, Glasgow.
3116. INTERNAL LOOSE SOLES or SOCKS for BOOTS, &c., R. Dick, Glasgow.
3117. IMPARTING MOTION to LAP FEEDING APPARATUS on WOOLLEN MACHINERY, W. Smith and J. H. B. Wigglesworth, London.
3118. LAMP, J. D. Mitchell, Glasgow.
3119. SCREENS, T. Heppell, London.
3120. ELECTROTYPE SHELLS and BASES, G. W. and J. R. Cummings, London.
3121. TRANSMITTING ROTARY MOTION to DYNAMO-ELECTRIC MACHINES, &c., H. Lindley, Manchester.
3122. HORSE RAKES, &c., J. Howard, London.
3123. CONSUMING SMOKE and GASES in FURNACES, O. Orvis, New York, U.S.
3124. SMOOTHING the FIBRES of YARN, W. S. Clapham, London.
3125. COCK or TAP, J. Boulton, London.
3126. LOCKING DEVICE for RAQUETS, F. L. Rawson, London.
3127. LAWN TENNIS and other BATS, F. Baden-Powell, London.
3128. TOOLS for MOULDING SCREW THREADS, &c., H. Codd, London.
3129. CARTRIDGE PROTECTOR, T. Nordenfelt, London.
3130. GLAZED STRUCTURES, J. E. Rendle and F. B. Rendle, London.
3131. STAMPING, &c., PAPER, &c., H. C. Gover, London.
3132. MULTIPLE WRITING, A. R. Marten, London.
3133. LINING FURNACES, J. Imray.—(*H. Rémaury and F. Valton, France.*)
3134. HELIOTYPIC or PHOTOLITHOGRAPHIC PROCESS, H. H. Lake.—(*C. Angerer and Göschl, Austria.*)
3135. ELEVATED RAILWAYS, H. H. Lake.—(*J. V. Meigs, United States.*)
3136. HOLDING BUNDLES of PAPER, H. H. Lake.—(*S. Wheeler, United States.*)
3137. ROLLER SKATES, C. M. Raymond, London.
3138. SECURING SLATES to ROOFS, G. Martin, London.
3139. FURNACE or KILN, F. Schiffner, London.
3140. PLAYING CARDS, E. L. Drew, Darlinghurst, New South Wales.
3141. BOXES, L. W. Stone, London.
3142. CARRIAGES, J. Guy, Lindfield.
3143. MULTIPLE CYLINDER ENGINES, H. J. Haddan.—(*R. H. Cowdrey, United States.*)
3144. STEAM ENGINE VALVES, H. J. Haddan.—(*R. H. Cowdrey, United States.*)
3145. STEAM VALVES for ENGINES, H. J. Haddan.—(*R. H. Cowdrey, United States.*)
3146. STEAM ENGINES, H. J. Haddan.—(*R. H. Cowdrey, United States.*)
3147. GRAIN SCOURERS, G. A. Dawson, Ohio, U.S.
3148. TUBULAR AXLES, E. Peckham, New York.
3149. BLUE and VIOLET COLOURING MATTERS, H. J. Haddan.—(*The Farbenfabriken vormals Fr. Bayer and Co., Germany.*)
3150. TRIPOD STANDS, J. Cheney, London.
3151. MOTIVE POWER, N. P. Burgh, London.

11th March, 1885.

3152. NON-INFLAMMABLE EXPLOSIVES, C. E. G. Simons, Gwainvarren.
3153. EXPANSION GEAR of STEAM ENGINES, A. Dobson, Belfast.
3154. BRACES, T. W. Newey, Birmingham.
3155. CUTTING COAL, J. Lodge, Lydbrook.
3156. TOBACCO PIPE, &c., G. Jolliffe, Birmingham.
3157. MILK STRAINERS, H. Williams, Liverpool.
3158. SHIRTS, D. Knibb, Oswestry.
3159. ROVING FRAMES for TREATING FLAX, &c., T. Craister, Leeds.
3160. LOCKING and UNLOCKING SAFETY LAMPS, &c., A. Howat, Manchester.
3161. CARDING ENGINES, J. Thompson and T. Barker, Manchester.
3162. SHIP'S LOG, J. P. Rawlings, Edinburgh.
3163. COLLAR, CUFF, and SHIRT STUDS, &c., J. W. Egginton, Birmingham.
3164. MECHANICAL SWINGS, H. Tipper, Birmingham.
3165. FURNACES, W. P. Thompson.—(*A. Backus, jun., United States.*)
3166. METALLIC PACKING, E. Wigzell and J. Pollit, Birmingham.
3167. SINGLE CHAIN BUCKETS and GRABS, G. Hind, Hull.
3168. SPRINGS, E. Spaulding.—(*N. E. Spaulding, U.S.*)
3169. SPRINGS, E. Spaulding.—(*N. E. Spaulding, U.S.*)
3170. DRY CLEANING TEXTILE FABRICS, J. Scott, Dover.
3171. STENCIL DRAWINGS and DESIGNS, H. E. West, London.
3172. TREATMENT and UTILISATION of SEWAGE SLUDGE, W. D. Curzon and G. S. Jones, London.
3173. ROTARY ENGINES, J. E. Bond, Birmingham.
3174. CRICKETING SPIKES, R. G. Barlow, J. J. Rice, and J. Hall, London.
3175. TWO-WHEELED VEHICLES, J. G. Stocks, London.
3176. LAWN TENNIS POLES, A. Cammack, London.
3177. VENTILATORS, G. Collings, London.
3178. MOTOR for VEHICLES and BOATS, L. A. Groth.—(*S. Achleitner, Austria.*)
3179. PULLEY WHEELS for CHANDELIERS, C. F. Nokes, Birmingham.
3180. FEEDING FUEL to FURNACES, R. Canham, London.
3181. PRODUCING TREMULOUS ACTION to ADVERTISEMENTS, H. Y. Dickinson, London.
3182. OPERATING VALVES, H. Hodgson, Manchester.
3183. SETTING SAWS, H. Ransom, London.
3184. STOP VALVES, J. H. Tattersall, London.
3185. APPLYING PHOTOGRAPHIC EMULSION, A. J. Boult.—(*E. J. Palmer, Canada.*)
3186. ORNAMENTATION of WOODWORK, W. H. Royston, United States.
3187. BUTTER DISH and PACKAGE, A. J. Boult.—(*A. Edwards, U.S.*)
3188. BOX for HOLDING, &c., SAMPLES of GOODS, F. W. Amsden, London.
3189. BOBBINS, W. R. Cant and H. Adam, Glasgow.
3190. REGULATING the OPENING and CLOSING of BOXES, J. Meek, London.
3191. CHECK CISTERNS, A. Sweet, London.
3192. SOWING MACHINES, H. J. Haddan.—(*O. Syllwasschy, Germany.*)
3193. PRODUCING MALT, A. Behr, London.
3194. COMBINED BROOCH and FLOWER HOLDER, F. Venour, jun., London.
3195. AUTOMATIC STEAM PRESSURE INDICATOR, &c., J. Chater, London.
3196. SILO PRESSES, &c., A. J. Cooke, London.
3197. PREPARING FIBRES for SPINNING, J. C. Mewburn.—(*D. Girrès, France.*)
3198. EMPLOYING HEATED AIR for BAKING, &c., S. C. Davidson, London.
3199. GAS MOTOR ENGINES, C. G. Beechey, London.
3200. ROUNDABOUTS, T. Blinkhorn and W. S. Key, London.
3201. ADZING and BORING SLEEPERS, A. Ransome and T. J. Wilkie, London.
3202. JOINT for SWING LOOKING GLASSES, E. Nunan, London.
3203. SEPARATING BARK from FLAX, &c., W. R. Lake.—(*E. Lepage, France.*)
3204. PHOTOGRAPHIC CAMERAS, J. Billcliff, Chorlton-on-Medlock.
3205. PREVENTING CORROSION in STEAM BOILERS, L. C. Caspersen, London.
3206. HAULING ENGINES, &c., W. Wilkinson, London.
3207. CUTTING HAIR, WOOL, &c., W. Bown and G. Capewell, London.
3208. PRODUCTS PREPARED from RICE, J. F. Gent, London.

12th March, 1885.

3209. PORTABLE CANOPY, M. A. Worsop, London.
3210. TWENTY-FOUR HOUR WATCHES and CLOCKS, R. G. Webster, London.
3211. SAFETY VALVES, H. Brecknell, Bristol.
3212. DYNAMO-ELECTRIC MACHINES, &c., G. Hookham, Birmingham.
3213. REGULATING the STROKE of TOOLS for SLOTTING MACHINES, &c., J. Butler, Halifax.
3214. OPERATING BOX TAPPITS EMPLOYED in BOX LOOMS, H. R. Middlemost, G. Hirst, and R. Ramsden, Halifax.
3215. WARDROBES, J. Collinge, Halifax.
3216. LIGHTING RAILWAY TRAINS by ELECTRICITY, W. Lowrie, Halifax.
3217. SELF-ACTING TILTERS for CASKS, &c., R. Rollason, Birmingham.
3218. ALARM BELL for BICYCLES, &c., J. G. Stormont, Birmingham.
3219. PYEING HOSIERY, &c., J. H. Ashwell, Liverpool.
3220. SECTIONAL WARPING, &c., MACHINES, J. Bethel, Manchester.
3221. PRESSURE and VACUUM GAUGES, C. F. Wright, Birmingham.
3222. WOVEN BELTING, J. Taylor, Manchester.
3223. DOUBLE-ACTION ARRANGEMENT to OBTAIN TWO FLUSHES of WATER to CLOSETS, &c., M. Syer, London.
3224. SHUTTLE GUARDS, S. Walker and G. Leck, Manchester.
3225. GRIDIRON, &c., CARRIAGE STEPS, J. G. Harrison, Birmingham.
3226. TRAM RAILS, &c., G. Hookham, Birmingham.
3227. SPOKE-SHAVES, E. H. and A. Marples, London.
3228. PIPE JOINTS, J. H. Taylor, London.
3229. NUT-LOCKS, C. Darlow, London.
3230. MOVABLE VENTILATING SEWER MANHOLES, &c., H. Taylor, London.
3231. LA GRANDE POUDRE de VIONS, G. L. Muraille, London.
3232. NOISELESS CLOSING, &c., DOOR APPARATUS, A. J. Maher, Dublin.
3233. STRINGING PAPER BAGS, J. S. Grierson, Glasgow.
3234. VELOCIPEDES, A. S. Bowley, London.
3235. ANTI-FOULING COMPOSITION, R. Uhlich and O. Müller, London.
3236. PACKING for STEAM ENGINES, &c., R. W. Harrison, Halifax.
3237. OPENING MINERAL WATER BOTTLES, R. T. Burtwell, London.
3238. SAUCE or RELISH, J. Warshausky, A. Apsey, and E. Hall, London.
3239. HEARING PROTECTOR, B. Gründler, London.
3240. PROTECTING the BOTTOM of TROUSERS, W. Shelley, London.
3241. CLOCKS, T. P. Battersby, London.
3242. THRASHING GRAIN, A. J. Boult.—(*A. Arrieta, Spain.*)
3243. DISSOLVING MATERIALS used in TANNING, M. Kitchin, London.
3244. FLAPPED AXLES, A. E. and H. Butler, London.
3245. IMPARTING REQUIRED TENSION to the WIRES of RAILWAY SIGNALS, M. Baines, London.
3246. UNSTOPPERING BOTTLES, JARS, &c., W. Stobbs, London.
3247. MEASURING ELECTRIC CURRENTS, O. March, London.
3248. INVERTED GAS-BURNER, D. W. Sugg, London.
3249. LIGHTING BILLIARD TABLES, W. T. Sugg, London.
3250. LEATHER DRIVING BELTS, C. Marie, London.
3251. BLACK or COLOURED PLASTER, &c., G. M. and E. G. Hammer, London.
3252. ADVERTISING, E. and J. M. Verity and B. Banks, London.
3253. OIL LAMPS, W. Nunn, London.
3254. SECURING LIDS or COVERS of BOXES, W. Sandbrook, London.
3255. CHIMNEY TOP, &c., W. H. Mead and S. Jenner, London.
3256. PUMPING ENGINES, J. Evans, London.
3257. TRANSMITTING MOTION, J. S. Williams, Riverton, U.S.
3258. INDICATING the PASSAGE of TRAINS on RAILWAYS, J. H. Johnson.—(*H. Lebasteur and Messieurs Mignon and Rouart, France.*)
3259. CHECKING BODIES MOVING in a RECTILINEAR, &c., DIRECTION, W. P. Dando, Canonbury.
3260. SECONDARY BATTERIES, J. Pitkin, London.

3261. Voltaic Battery, A. Khotinsky, London.

13th March, 1885.

3262. Interlocking Coupling Joint, T. G. Messenger, Loughborough.
3263. Hair Curler, J. C. Edwards, Manchester.
3264. Toe and Heel Horseshoe Pad, T. Eckford, Leith.
3265. Chains, J. Appleby, Birmingham.
3266. Fuel Economisers, J. Smethurst, London.
3267. Gas Furnace, P. Woodrow, Glasgow.
3268. Cross Spring Tip Cart, S. Collier, Birmingham.
3269. Revolving Flat Card for Carding Cotton, &c., S. Ryder, Halifax.
3270. Bicycles and Tricycles, T. Hough, Wolverhampton.
3271. Compound Pumping Engines, W. Bow, Glasgow.
3272. Movable Damper for Fires, J. H. Hindle, Accrington.
3273. Furnaces and Open Fireplaces, E. Taylor, Blackburn.
3274. Securing the Reservoirs of Lamps to Stands, &c., E. R. Baller, Birchfield.
3275. Frilling or Trimming, E. Barlow, Nottingham.
3276. Varying Speed in Velocipedes, T. J. Salwey and C. Fortey, London.
3277. Ornamenting Ruches, &c., E. Barlow, Nottingham.
3278. Snuffless Lamp Wick, F. W. Hayward and S. Taylor, Wigan.
3279. Baling Presses, H. Shield and J. Howarth, London.
3280. Mill, M. Pass, London.
3281. Arrangement of Accompaniment Strings on Cithers, E. W. Furrell.—(C. F. Haupt, Germany.)
3282. Electric Arc Lamp, A. P. Lundberg, London.
3283. Opening and Closing Fanlights, &c., R. Pease, London.
3284. Opening and Closing Fanlights, &c., R. Pease, London.
3285. Doors of Coke Furnaces, A. W. L. Reddie.—(C. Dahlmann, Germany.)
3286. Opening and Closing Roofs and Covers of Covered Wagons, &c., W. Turner, London.
3287. Electrical Markers for Billiards, &c., T. Pitts and J. Stringfellow, London.
3288. Turnip Thinning Machines, T. Wardlaw, Glasgow.
3289. Straw Hat Sewing Machines, J. H. Johnson.—(The Wilcox and Gibbs Sewing Machine Co., U.S.)
3290. Pulleys, &c., G., E., and N. Smith, London.
3291. Garden and Seaside Canopies, &c., J. J. Ince, London.
3292. A New or Improved Game, G. F. Redfern.—(P. B. Guillon, France.)
3293. Filling the Reservoirs of Lamps, C. Church, London.
3294. Decorated Earthenware, &c., E. Wardle and D. Jones, London.
3295. Gas Apparatus, T. C. J. Thomas, London.
3296. Printing Machines, T. G. and J. Dawson, London.
3297. Printing Machines, T. G. and J. Dawson, London.
3298. Measuring the Strength of Electrical Currents, G. C. Fricker, Putney.
3299. Connecting Metal Pipes, &c., N. Thompson, London.
3300. Compressing Ensilage, E. T. Blunt, London.
3301. Dredging, A. J. Boult.—(R. Guillaume, France.)
3302. Ships' Windlasses, W. Clarke, London.
3303. Bicycles, R. P. Scott, London.
3304. Feed-water Regulator, W. Ritter, London.
3305. Producing on Metal Plates a Layer of Lithographic Stone, H. J. Haddan.—(J. Wezel, Saxony.)
3306. Revolution Counter Apparatus, H. J. Haddan.—(E. Desdouits, France.)
3307. Steam Engines, W. Schmidt, London.
3308. Circular Latch Needle Knitting Machines, J. W. Watts, London.
3309. Checking Fares, A. Warner and W. H. Davis, London.
3310. Saddles for Bicycles, &c., J. A. Lamplugh, London.
3311. Steering Ships, A. E. Ridgway.—(F. Geshwend, Russia.)
3312. Double-acting Pump, H. Davey, London.

14th March, 1885.

3313. Match-boxes, M. Wiberg, London.
3314. Fixing Handles to Cast Iron Hollow-ware, S. Hale, Birmingham.
3315. Damp-proof Walls, D. Macdonald, Glasgow.
3316. Registering Apparatus for Machinery, T. Thorp and G. Marsh, Lancashire.
3317. Apparatus for Freezing Liquids, J. Csete, Birmingham.
3318. Handles of Heating Irons, F. Ryland, Birmingham.
3319. Machine for Making Sand Moulds for Metal Castings, F. Ryland, Birmingham.
3320. Bicycle and Tricycle Lamps, T. E. Bladon, Birmingham.
3321. Stoppering Bottles, D. Rylands and J. Rebbla, Barnsley.
3322. Propelling Steam Ships, J. Beatty, Antrim, and J. Young, Down.
3323. Making Oil Gas, T. and S. Alexander, and R. Paterson, Glasgow.
3324. Microphones, R. S. Dembinski, Liverpool.
3325. Fixing Metallic Whistles in Hollow India-rubber Toys, H. Hecht, Liverpool.
3326. Manufacture of Chloride of Ammonium, J. H. Wright, Liverpool.
3327. Portable Camp Bedsteads, H. Defty, Manchester.
3328. Furnaces and Burners for Hydro-carbon Oils and Gas, W. Welch, Southsea.
3329. Rotary Printing Machines, G. A. Bédart, France.
3330. Nut Locks, T. A. Ashton, H. and L. G. Vedy, London.
3331. Rotary Motion to Water Ejected from Fire-engines, H. Hudson, London.
3332. Ventilating Armature for Dynamo-electric Machines, A. L. Davis, London.
3333. Apparatus for Raising Window Blinds, J. E. Hopkinson, London.
3334. Automatic Gas Heating Apparatus, J. Humphrys, London.
3335. Steering and Stopping Vessels, J. A. Drake, London.
3336. Manufacture of Bells, J. W. Hoffman and P. Erbach, London.
3337. Harness, W. Powell, London.
3338. Supports for Obstetric or other Purposes, W. Powell, London.
3339. Ropes, J. F. Anderson, London.
3340. Pocket Ambulance for the Immediate Dressing of Wounds, J. D. Whittles, London.
3341. Biscuits, R. J. Rastrich, London.
3342. Tubular Lanterns, J. H. Stone, London.
3343. Manufacture of Beef Lard for Culinary Purposes, W. McDonnell, London.
3344. Production of Iron and Steel Strips, E. Dixon, London.
3345. Getting Gold from Wheat by Boiling and Baking, H. Fell, London.
3346. Registering the Revolutions of Wheels, C. Harle, London.
3347. Ice, H. H. Lake.—(W. Raydt, Germany.)
3348. Spring for Braces, F. J. Wollen, London.
3349. Spring Hinge, F. J. Biggs, London.
3350. Water Ballast Tanks, J. Nelson, London.
3351. Rotary Fans, F. H. Keane, London.
3352. Loom Shuttles, &c., H. H. Lake.—(P. T. Creed, United States.)
3353. Opening Electric Circuits, T. Nordenfelt.—(O. F. Johnson, Sweden.)—10th February, 1885.
3354. Cranks of Velocipedes, H. W. Godfrey, Staines.
3355. Knitting Machinery, A. Paget, London.
3356. Turning Objects in Wood, &c., W. S. Bemi, London.
3357. Watches and Clocks, R. Vigier, London.
3358. Electro-dynamic Motors and Dynamo-electric Generators, T. J. Handford.—(F. J. Sprague, United States.)

16th March, 1885.

3359. Toy Apparatus, J. A. Heaton and T. Midgley, Burnley.
3360. Stretching Woven Fabrics, W. Birch, Manchester.
3361. Reeling and Winding Frames, W. Noton, Manchester.
3362. Printing Both Sides of Paper from Type, H. Bond, Warrington.
3363. Mules and Twiners for Spinning Fibres, J. Clegg, Manchester.
3364. Retort Settings, A. G. Browning and F. G. Vivian, Llanelly.
3365. Operating Picking Sticks for Looms, J. Crosland, Halifax.
3366. Finger Rings, J. Richards, Birmingham.
3367. Structures for Rearing Cattle, W. Corbett, Birmingham.
3368. Brushing, &c., Planks, G. A. Whiteside and J. Hoyle, Halifax.
3369. Preventing Corrosion in Boilers, J. Hoyle, Halifax.
3370. Cutting, &c., Biscuits, T. Vicars, sen., J. Vicars, sen., T. Vicars, jun., and J. Vicars, jun., Liverpool.
3371. Rack Pulleys for Window Blinds, J. Hughes, Birmingham.
3372. Lawn Tennis Poles, J. Hope and W. H. Walker, Liverpool.
3373. Valve Cocks, T. Dipple, Birmingham.
3374. Hydrocarbon Oil Lamps, J. B. Fenby, Sutton Coldfield.
3375. Automatic Register, P. and M. J. Kehoe, New Ross.
3376. Thermo-regulating Apparatus, B. H. Thwaite and G. H. Taylor, Liverpool.
3377. Automatic Paper Counting, &c., Machine, S. Hall and S. Gee, Leeds.
3378. Additions to Poles for Lawn Tennis Nets, F. St. B. Sladen, Birmingham.
3379. Distributing Electricity, W. P. Thompson.—(C. Zipernowsky and M. Déri, Austria.)
3380. Condensing Lens for Lanterns, &c., W. Fletcher, Dover.
3381. Relief of Abdominal Hernia, &c., J. Reynolds, Liverpool.
3382. Printing Machinery, A. J. Sanders, Leeds.
3383. Water Slide Gasaliers, &c., W. Soutter, Birmingham.
3384. Picks, E. Davies and M. Morris, London.
3385. Singeing Fluff from Cloth, &c., W. Banks, London.
3386. Smelting Sulphide of Antimony, N. C. Cookson, Newcastle-on-Tyne.
3387. Fastenings for the Flaps of Trousers, F. Poduschka, London.
3388. Watch and Clock Dials, R. M. Robinson, Acton, and A. Kaufmann, London.
3389. Portable Rests for Books, &c., J. Frank, London.
3390. Card Lacing Machine, H. Vieth, London.
3391. Double-action Shutter Cabinets, H. F. Howard, London.
3392. Hydraulic Mains, F. Livesey and S. Tanner, London.
3393. Vulcanised Bottle Stoppers, H. J. Allison.—(M. B. Manwaring and C. B. Street, United States.)
3394. Oil Lamps, J. Roots, London.
3395. Freezing Machines, O. Koch and R. Habermann, Berlin.
3396. Hinges, H. Sans, London.
3397. Travelling Box, W. Curle, London.
3398. Centrifugal Governors, R. M. Chiswell.—(Schäffer and Budenberg, Germany.)
3399. Pressure Reducing Valves, R. M. Chiswell.—(Schäffer and Budenberg, Germany.)
3400. Drawing Off, Measuring, and Bottling Liquids, C. E. Paillet, London.
3401. Car Coupling, A. M. Clark.—(I. Linthicum, F. E. Crocker, G. L. Sharp, D. S. Harden, W. E. Cuningham, N. E. Washburn, R. H. Kirby, L. B. Sharp, and C. C. Albright, United States.)
3402. Cementing Leather, T. Carter, London.
3403. Drafting Patterns, H. Kusenberg, London.
3404. Soap Protector for Shaving Brushes, D. Heap, London.
3405. Pavements, W. R. Lake.—(H. C. Underwood, United States.)
3406. Stirrup Bar, F. V. Nicholls, London.
3407. Metal Ropes, T. C. Batchelor and A. Latch, London.
3408. Attachment to Prayer, &c., Books, E. J. Dagnall, London.
3409. Pedestal Water-closets, S. S. Hellyer, London.
3410. Advertising Device, J. W. Courtenay, London.
3411. Device for Removing the Roving from the Drawing Rollers on the Yarn Breaking, P. Jensen.—(A. Ehinger, Austria.)
3412. Compound for Preventing Corrosion in Steam Boilers, W. Gibson, G. Wilson, and W. J. Clark, Great Driffield.
3413. Operating Valves of Engines, R. L. Weighton, London.

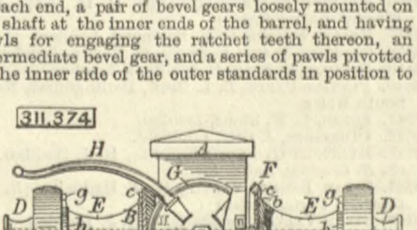
SELECTED AMERICAN PATENTS.

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

311,374. Windlass, *Samuel T. Richardson, Baltimore, Md.—Filed June 24th, 1884.*

Claim.—(1) In a windlass, the combination of a rotary shaft journalled in bearings on a main standard and supported in an additional bearing or standard at or near each end, a pair of windlass barrels rigidly secured to said shaft and provided with ratchet teeth at each end, a pair of bevel gears loosely mounted on the shaft at the inner ends of the barrel, and having pawls for engaging the ratchet teeth thereon, an intermediate bevel gear, and a series of pawls pivotted to the inner side of the outer standards in position to

311.374

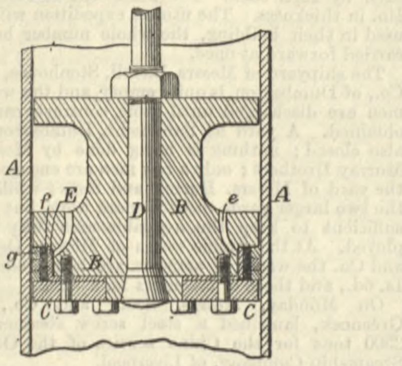


engage with the ratchet teeth on the outer ends of the barrels under back strain thereon, substantially as described. (2) In a windlass, the combination of the main standard A, having abutment *f*, the outer standards C C, provided with pawls *g g*, the shaft B, windlass barrels E E, having ratchet teeth *b h*, loose bevel gears F F, having pawls *c c*, and the intermediate bevel gear G, having detachable hand levers H H, substantially as described.

311,380. Packing for Hydraulic Pistons, *Alonzo B. See, Yonkers, New York.—Filed May 28th, 1884.*

Claim.—(1) In a hydraulic piston, the combination, with the piston body B, having water passages *e*, and the follower C, of the packing consisting of the cup leather E, and a number of compound packing rings surrounding the cup leather, one above another, and each comprising an inner ring *f*, of flexible material bearing on the cup leather, and an outer metallic ring *g*, composed of sections secured to the flexible ring, the several metallic rings forming the wearing surface of the packing, and the several flexible rings forming a yielding support to the metallic rings, and serving to transmit to them the outward pressure of the cup leather, substantially as herein described. (2) In a hydraulic piston packing, the combination, with a cup packing, of compound packing rings surrounding said cup packing,

311.380

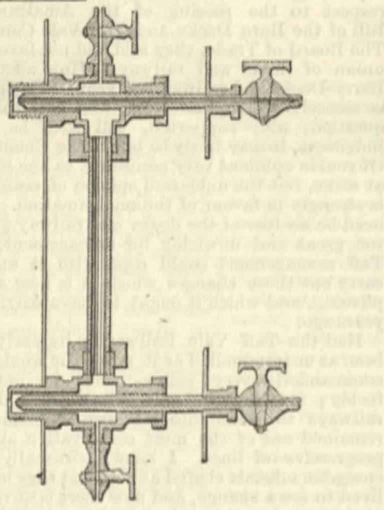


each compound ring consisting of an inner flexible ring and an outer metallic ring secured thereto, and clasps or clips connecting the several compound rings, substantially as and for the purpose herein described.

311,471. Water Gauge, *George S. Chase, Bellefonte, Pa.—Filed August 9th, 1884.*

Claim.—The combination, with the bodies of the steam cock and water cock connected by the water

311,471

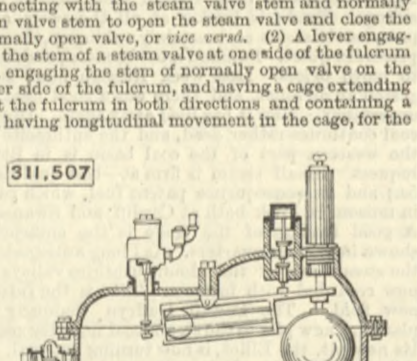


glass, of the hollow valve stems provided with valves or cocks near their outer ends, as set forth.

311,507. Return Steam Trap, *Jas. McGwin, Fulton, Mo.—Filed August 16th, 1884.*

Claim.—(1) The combination of a float having a vertical stem, to which it is rigidly secured, a steam valve having a stem, normally open valve having a stem, and a lever engaged by the float stem and connecting with the steam valve stem and normally open valve stem to open the steam valve and close the normally open valve, or *vice versâ*. (2) A lever engaging the stem of a steam valve at one side of the fulcrum and engaging the stem of normally open valve on the other side of the fulcrum, and having a cage extending past the fulcrum in both directions and containing a ball having longitudinal movement in the cage, for the

311,507

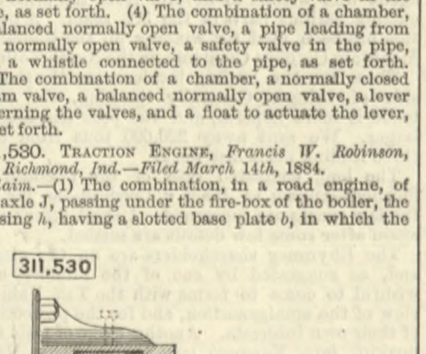


purpose set forth. (3) The combination of a chamber, a balanced normally open valve, a pipe leading from the normally open valve, and a safety valve in the pipe, as set forth. (4) The combination of a chamber, a balanced normally open valve, a pipe leading from the normally open valve, a safety valve in the pipe, and a whistle connected to the pipe, as set forth. (5) The combination of a chamber, a normally closed steam valve, a balanced normally open valve, a lever governing the valves, and a float to actuate the lever, as set forth.

311,530. Traction Engine, *Francis W. Robinson, Richmond, Ind.—Filed March 14th, 1884.*

Claim.—(1) The combination, in a road engine, of the axle J, passing under the fire-box of the boiler, the housing *h*, having a slotted base plate *b*, in which the

311,530

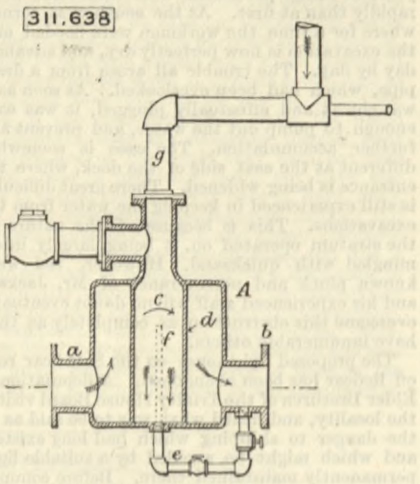


axle plays, and the spring *s*, located in a circular recess in said housing, the base plate of the housing being fastened to the boiler, substantially as specified. (2) The combination, in a road engine, of the axle J, passing under the fire-box of the boiler, the housing having a longitudinal groove *g*, on its lower side, and a slotted base plate *b*, in which the axle plays, the spring *s*, located in a circular recess in the said housing, and the bar *e*, secured under the axle by means rods *d*, passing through said bar and through lugs o the housing, the base plate of the housing bein fastened to the boiler, substantially as specified.

311,638. Condenser for Steam Pumps, *Henry T. Blackwell, What Cheer, Iowa.—Filed September 6th, 1884.*

Claim.—(1) The condenser consisting of case partition *d*, forming chamber *c*, steam pipe *g*, water connections *a b*, and pipe *e*, connecting chamber *c* t the outlet *b*, substantially as described. (2) In a con-

311.638

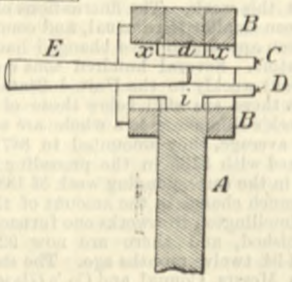


denser, the combination of the case having the inner chamber *c*, and the radial partitions *f*, with the steam pipe *g*, water connections *a b*, and pipe *e*, connecting chamber *c* to the outlet *b*, substantially as and for the purpose set forth.

311,769. Device for Removing Cross-heads, *Carl A. Mackay, Boston, Mass.—Filed October 8th, 1884.*

Claim.—(1) In a device for removing the cross-head from a piston-rod, the combination of the following instrumentalities, to wit: Two keys and a wedge adapted to fit the ordinary keyhole in the cross-head and rod, one of said two keys being provided with a flange adapted to abut against the end of the main portion of the rod within the keyhole, and two notches or depressions adapted to receive a portion of the inner end of the cross-head as it moves from the rod, and the other provided with two flanges adapted to abut against a portion of the outer end of the cross-

311,769



head within the keyhole, and a notch or depression adapted to receive the end portion of the rod within the keyhole as the cross-head moves from the rod, substantially as described. (2) The keys C D and wedge E, in combination with the rod A and cross-head B, substantially as set forth. (3) In a device for removing the cross-head from a piston-rod, the key C, provided with the flanges *x* and notch *d*, the key D, provided with the notches *f a*, and flange *i*, and the wedge E, substantially as described.

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