THE LAWS OF MOTION.

By Prof. R. H. Smith.

There is a difficulty in understanding Newton's Third Law of Motion. That is clear. So many people have said that there is a difficulty that one cannot refuse to believe them. I never had any difficulty in this matter, and, therefore, it seems unlikely that I should be able to give others any help in getting out of it. I have had many difficulties regarding the fundamental principles of mechanics, but why this particular point should be a stumbling block is not plain. I feel sure that it must arise, perhaps wholly, certainly chiefly, through misunderstanding as to the meanings intended to be conveyed by the words used. We know that "actio" and "re-actio" are ambiguous terms, because very different meanings have been given to them by eminent authorities, who, knowing familiarly the various translations that have been given, have each adopted that which seems to him most useful in building up a rational system of mechanics. We know also that there is an unfortunately persistent tendency to consider words only to the neglect of the facts of which these words are no more than more or less imperfect symbols. If more trouble were taken to understand and to teach the fundamental facts of dynamics, and less time and labour were spent in quarrelling about the most appropriate words in which to describe those facts, there would be no discussion heard of as to Newton's third law. Of course, accuracy of language is highly desirable and important, more especially in scientific matters; but accuracy of observation and of knowledge is infinitely more so. So long as students are taught mechanics only by words—by lectures and books—there is much excuse for confusion regarding Newton's third law when different teachers give perfectly different meanings to the words used. A student whose mind is afflicted with such confusion of words may read Professor Lodge's capital clearly-expressed article in your issue of 20th March with great satisfaction, and may clearly understand it; and yet he may shortly fall back into confusion, simply through forgetting that Professor Lodge uses the word "resistance" in a more restricted sense than the common one. Professor Lodge protests against the common use made of it. He would restrict its use to external forces that oppose motion. It does not appear clearly whether they must oppose motion or change of motion, and if it is change of motion that is to be opposed by the resistance, further definition is required as to whether it is positive or negative change of motion that is to be opposed, and then, again, we must be told which is the positive and which the negative change. If a cannon ball were suspended by a wire a few hundred feet long and a horizontal push applied to it, he would prohibit us from saying that the ball offered any resistance to the push. His reason is, of course, that the ball obeys rather than resists the push; it receives and absorbs the momentum delivered by the force, and neither reflects it nor transmits it onwards to some other mass in front. Many people will disagree with him as to the propriety of his use of the word. If the push were delivered to the ball through a stick, say 5ft. long, the reaction the ball offers in virtue of its inertia now becomes—according to Professor Lodge's definition—a resistance to the motion of the stick; but somehow he will not allow us to consider it a resistance to the motion of the ball itself. If we choose to consider the ball as divided in two halves by an imaginary diametral plane, he will presumably allow us to call the inertia of the forward half a resistance to the motion of the hinder half. Why, then, is the inertia of the hinder half, or of the whole, not also to be called a "resistance?" But it is of comparatively little importance what words are used if the fact intended to be conveyed be clearly understood; and surely no one could fail to understand so clear an explanation as that in the article referred to.

The same fact may be quite accurately and intelligibly described by very various sets of phrases; but improper or unusual use of words is to be avoided, because it leads to mistaken understanding of them. Thus it has been shown that there has been confusion between "motion" and "change of motion;" by the former was meant previously existing motion, and by the latter newly-arising motion, and yet they were not distinguished the one from the other. In Newton's Latin, and even in many English and French statements of Newton's laws, no word distinction is made between them, with the result of misapprehension on the part of the unwary. The word "force" is too often—nearly always—defined as the cause of new motion. Is it really the cause? I would be more inclined to say that the cause of a locomotive dragging its tender after it is the fact that the draw-pin has been previously coupled up, and that the steam valve has been opened. The force through the draw-pin is not the cause of the locomotive dragging the tender after it; the force is the dragging itself, not the cause of it. "Cause" is a metaphysical entity. It might be better to avoid all consideration of causes in physical science, but whether that be possible or not, anyone who likes to examine carefully will find that from the beginning to the end of mechanical science not once is any use made of the idea that force is a cause of anything whatever. There are two observed physical facts that invariably indicate the existence of forces, and which, indeed, are the only indications of their existence. Firstly, when one mass applies force to another—either by actual contact or by the invisible bonds called "attraction" of one or other kind—that second mass gains new motion in the direction of the force unless that new motion be counterbalanced by a simultaneous gain of contrary new motion by the forces applied by other masses. Secondly, when force is acting through a mass, that mass is deformed or strained—*i.e.*, extended, compressed, twisted, bent, &c. Whatever the material may be, strain of one kind or other is the invariable accompaniment of force action. The strain is usually partly elastic and partly inelastic. In solids it is not a continually increasing strain; in fluids it is so so long as the force exists in the mass. There is also a proportion, constant or variable, between the magnitudes of the force and of the strain—or rate of increase of strain in fluids. These are the two great physical facts from the observation of which we know all that we do know about forces. It is infinitely more instructive and necessary for a true understanding of mechanics to bring these two facts into juxtaposition than to dispute about the formal definition of force or any other term we may have to use. Bring the two facts together thus:—The transference of motion, which consists in the loss of momentum on the part of one mass and the simultaneous gain of an equal amount of momentum on the part of another mass, is invariably accompanied by strain of one or other kind in the mass through which the transference takes place; and the magnitude of the strain bears a definite proportion, constant or variable, to the rate at which the transference takes place.* The rate of transference of momentum is the measure of the force; in fact, the force is the transference of momentum, with due regard being taken of the rapidity with which the transference is effected. The force can also be measured by measuring the strain and multiplying by a physical constant called a modulus of elasticity. A force is a thing that has only a temporary existence; it exists no longer after the transference is completed and the strain has ceased. It has no permanent existence as energy has; but while it lasts it has quite as absolute and real an existence as has energy. Any view of mechanics that leaves out of account the strain that is the invariable accompaniment of force or stress is so entirely incomplete and powerless to deal with practical problems that it may, I believe, be described almost accurately as mere logic chopping, mere compilation of mathematical formulæ consistent among themselves.

To illustrate this last, consider how mass and force are commonly measured theoretically. The force is to be measured, so we are told, by the rate at which it produces momentum. To measure it thus we must of course know how to measure mass, because mass is one of the factors in momentum on which the measurement of force is made dependent. How is mass to be measured? The answer we get is—"the unit mass is that in which unit velocity will be generated in unit time by unit force." The circular argument is so delicious that it would be a pity to dislodge it from its honoured place in our text-books. The futility of this sort of stuff is not lessened by saying that the unit mass is that of the standard pound kept in the Tower of London, because we are still left with no other means of comparing other masses with this standard unit than that of measuring and comparing the effects upon them of equal forces in generating velocity. I was once told that this is not so, because Newton discovered that all masses in falling freely towards the earth have their velocities accelerated at the same rate g. What does this really prove? Simply that the attractive force is proportional to the mass *if* the general law is true that forces generate velocities at rates inversely proportional to the masses to which they are applied. It proves either that, or that *if* the attractive force is proportional to the mass, then the law must be true that at least gravitation forces generate velocities at rates inversely proportionate to the masses acted on. If the law of gravitation be assumed, Newton's observation would prove the general law connecting force and acceleration of momentum so far at least as gravity forces are concerned; or if the latter be assumed, the law of gravitation is proved by this observation. But it cannot be taken to prove *both*. What we really do in universal practice is to assume the law of gravitation; we measure masses by balancing against each other the gravitation forces acting on them at the same, or nearly the same, positions on the earth's surface. With masses thus measured we investigate the effects of other forces, and find, from accumulation of experimental evidence, that the law of motion is generally true. We then construct convenient instruments for measuring forces independently of gravity, such as spring balances or vibrating pendulums, and with their help find that the attractive force of gravity on the same mass varies with the distance from the earth's centre. The various laws of nature are not proved by isolated sets of experiments. To explain or rationally describe certain phenomena discovered by experiment we assume a general law. But it is only when we find that this same general law explains, or rather makes consistent with each other from a logical point of view, very diverse and complex experimental results, and when we find moreover that no known facts contradict our assumption, that we begin to look upon the law as proved.

I have tried to insist that the same physical fact may be explained in many different sets of phrases, all equally correct. This applies to algebraic as well as to common word language. I do not simply mean that one may use any letters one likes as the algebraic symbols, but that formulas or equations which have distinct mathematical meanings may be merely different modes of describing more or less completely one and the same fact. Thus, interpreting the "actio" and "re-actio" of the third law in his own way, Professor Lodge has pointed out that all the so-called three laws are really one and the same law; two of them are simply different modes of stating the same fact, and the other is only a special case. If he had taken "actio," according to the Thomson-and-Tait interpretation as meaning "work done," he would still find the third law simply another mode of expressing the same general fact; it would still be a purely logical or mathematical deduction from, or algebraic transformation of, the second. There is only one physical fact represented by all of them. It can be viewed in various aspects—as the conservation of momentum; as the equality of time rates of loss and gain of momentum in two masses which are exchanging momentum, *i.e.*, equality of acting force and reacting force; or as the conservation of energy, so far as mechanical work affects the distribution of energy. The fact is that velocity, momentum, and kinetic energy are merely different aspects in which the one physical fact of Motion may be viewed, and give three corresponding mathematical modes of measuring motion. Velocity takes account of quantitative speed and of direction, but not of the mass affected by the motion. Momentum takes into account mass besides these latter, and kinetic energy takes into account all these except direction. If I liked I might measure the motion by the product of the mass by the cube or the fourth power of the velocity. I do not do so because I know of no utility in that mode of measurement; but no doubt, if I took the trouble, I could find out a series of propositions with regard to these measures of motion that might form new and interesting mathematical puzzles for the Cambridge students. In the same way "force" and "work done" are merely two different measures, that is, two different modes of mathematically describing the same physical thing, namely, transference of motion. In the "force" measure the elements taken into account are the speed and direction of, and mass effected by, the motion transferred, and also the time rate at which the transference takes place. In the "work" measure the speed of, and mass affected by, the motion transferred are taken into account, and also the distance moved through during the transfer by the masses between which the transfer takes place.

The two great facts that have to be clearly comprehended and grasped, so that they may never be lost sight of, are, first, that when motion dies out in one mass or portion of matter, it will be found simply to have passed into some other mass, and to be still existent there in undiminished quantity—undiminished so long as the motion is measured with reference to the same "field" or set of axes; secondly, that during the passage of motion from one mass to another, the mass through which it is passing is strained in a manner dependent on the character of the motion that is thus flowing through it, and to an extent that has a definite relation to the rate of flow, which relation depends on the kind of material thus affected.

A force is an action between two bodies; and the one mass cannot give up its motion to the other without that other taking it from the first any more than money can be given by one man to another without the first losing it. So stated the equality of action and reaction is a mere truism; but we must remember that the motion transferred is measured with reference to a certain "field," *i.e.*, another mass or set of masses, independent of the masses between which the exchange takes place. The physical fact, that is not a truism, but, on the contrary, requires physical proof, is that the action and reaction between the two masses, or the exchange of motion that takes place between them, does not affect in any way, either with regard to amount or direction, the sum of their motions measured relatively to this independent "field."

A reform is much needed in our book and lecture-room diagrams. There we habitually represent "external forces" by means of arrows. There is nothing absolutely incorrect in this. The arrows represent the action on the machine or structure dealt with of the rest of the universe "external" to this special structure. But the arrows are decidly ghostly; they do not suggest to the learner the existence of the other "external" masses through which alone these forces can act, in consequence of whose existence alone can the forces have any real existence. Our learners are thus persistently taught to think of a mass and a force opposing each other. Such an idea, although common, is absolutely incorrect. Two masses only can oppose each other with mutually reacting forces.

Mason College, Birmingham. R. H. S.

* In gravity or other kind of "attraction" the strain exists in the ether or other medium intervening between the attracting masses.

THE INSTITUTION OF NAVAL ARCHITECTS.

The annual meeting of the Institution of Naval Architects commenced at noon on Wednesday in the Hall of the Society of Arts, John-street, Adelphi, with the president, the Earl of Ravensworth, in the chair. The attendance was not large. After some preliminary business the report of the Council was read.

From this we learn that the financial condition of the Institution continues to be satisfactory. In spite of an increased expenditure, chiefly under the head of printing, £123 14s. 9d., the balance in hand at the end of last year was £199 11s. 1d. in excess of that of the year preceding, while during the same period the Library Fund was increased by the sum of £106 18s. 8d.—a result chiefly due to the large number of new members and associates who joined the Institution in the year 1884. The satisfactory amount realised under the head "sales of volume," viz., £170 15s. 7d., shows that the value of the publications of the Institution is steadily growing in the appreciation of the outside public, the larger portion of this item having been obtained from non-members. In consequence of the heavy increase in the item of printing and engraving, the Council has made new arrangements with regard to the publication of the "Transactions," which will, it is hoped, result in a very considerable saving. In future the "Transactions" will be published in about two months after the annual meetings, instead of four months, as has latterly been the practice, or seven months, as was formerly the case. This comparatively rapid publication will render unnecessary the issue of an edition of the papers, as read at the meetings, to all members and associates. This issue constituted, in fact, a first edition of the "Transactions," and involved the Institution in an expense of about £100, which will in future be saved. In order to expedite the production of the "Transactions," new rules have been framed for the correction of reports of discussions, copies of which will be forwarded to each speaker, together with the report of his remarks. Members are earnestly invited to co-operate with the Council in their endeavours to secure an early publication of the "Transactions" by a strict compliance with the new rules. The rules for the admission of Members and Associates have been under the consideration of a committee of the Council specially appointed. The old rules were found to be somewhat difficult in application, and have never been put fully into operation. The Committee appointed on the 4th of April last to consider the method of electing Members and Associates recommend the following alterations in the rules:—"(*a*) In the second clause of Rule 38, after the words 'marine engineer,' to introduce the words, 'conversant with naval architecture'—see Rule 2; (b) At the end of Rule 39 and of Rule 40 to omit the words 'by ballot,' and to substitute the words, 'the voting to be by ballot, should a ballot be demanded.' The Committee are of opinion that advantage would result from greater strictness being exercised in respect of the 'statements' of claim submitted by applicants for membership, which should, in the Committee's opinion, always comprise words to the effect that those members who sign the statement are satisfied that the candidate is —as the case may be—either a competent naval architect or a marine engineer, qualified by his conversance with naval architecture to become a member. The Committee have suggested the adoption of a simplified 'form' of application for the admission of associates."

The names of the new Council having been announced, the President addressed the meeting at some length. He regretted that he was unable to take a cheerful view of maritime affairs. One of the curious features of the present depression was the suddenness with which it took place, and the inequality of its incidence. Thus on the Mersey the tonnage of ships launched in 1884 was 45,000, while in 1883 it was 43,000; hence on the Mersey there was a slight increase. On the Clyde in 1883 the tonnage was 417,000, while in 1884 it was only 299,000. In the North-Eastern ports the decrease was fully 30,000 tons. The total drop amounted to no less than 500,000 tons, and taking this as being worth £15 a ton, the sum withdrawn from the labour market was not less than seven and a-half millions sterling. It was not wonderful that great distress prevailed. As for the material of ships, steel was making rapid progress; no less than 131,000 tons of steel shipping had been built last year on the Clyde, 10,564 tons on the Tyne, and 22,340 tons elsewhere. The triple expansion engine was coming into favour at a rate which promised to oust all other systems. There were now afloat thirty-nine sets of these engines and forty-three were being built. A saving was claimed of 20 to 25 per cent. for these engines in fuel, a matter of vital importance, seeing the point to which freights had fallen. The Government had chartered steamers at 7s. 6d. per ton per month. Not so long ago they had paid as much as 25s. per ton per month for similar service. He attributed bad trade to the unsettled condition of politics, to wars, and rumours of wars. One good feature was that the country had at last become alive to the condition of the Navy, and had insisted that improvements should be effected in it. An Admiralty Commission had been appointed to consider the whole question of shipbuilding by private contract, and the system of repairs and refitting being carried out in our dockyards; and it was to be hoped that the result would be a large accession of work to private dockyards. He would like to see this inquiry extended even to dealing with the constitution of the Board of Admiralty itself. It was most essential that the Admiralty should supply its own guns, and not depend on the War-office for them. It was essential, however, that proper specifications should be prepared for the guidance of private shipbuilders, who ought to be secured so much regular work that they could keep up a staff of men trained to the Admiralty system of doing things. The protests of the nation had induced the Government to ask for more money for the Navy than had ever at one time before been asked for the building of ships, namely, £3,000,000, to be spent in five years. For this it was proposed to build four ironclads, five steel cruisers with steel armour belts 10in. thick, two torpedo rams of the Polyphemus class, ten torpedo cruisers, and thirty first-class torpedo boats. With the exception of two of the ironclads—one to be built at Portsmouth, the other at Pembroke—and the two Polyphemuses, all were to be built by private contract. Tenders had already been received for some of them, but not all. It was time to consider whether the Admiralty was to be the sole arbitrator as to what was and was not to be built; and he hoped that, before any new ships were put in hand, a competent committee would be called in to report on the Admiralty designs. After all, the guns lay at the bottom of the whole question, and it was the delay and uncertainty about guns that caused delay and uncertainty about ships. Not long since he saw the Conqueror, a splendid new ship, and he asked why she was not put in commission. He was told that she was quite complete in every respect, with the guns on board, but that the breech screws for the guns had not yet been furnished, and until they were the ship was useless. This was a disgraceful bit of management. It took fifteen months to make a 110-ton gun, half as long as was wanted to build an ironclad, and he would be glad if it could be shown that this monster ordnance was not wanted for sea fighting.

The President's address was received with applause, and Captain G. H. Noel, R.N., then read a paper

On a Practical Measurement of the Comparative Fighting Efficiency of Ships of War.

It is quite impossible to give an abstract of this paper. It must suffice to say that Captain Noel attaches certain co-efficients of value to certain characteristics of a ship, formulates these, and deduces figures of comparative merit. Thus, for example, he gives for speed $S = \frac{D^{\frac{2}{3}}}{250}(s-8)^2$ where s = full speed in knots on the measured mile, and D = tons displacement. For torpedoes he gives $T = t\,D^{\frac{1}{4}}$, where t = number of tubes for discharging torpedoes, and D tons of displacement. For complement he gives $H = \frac{26p - D}{200}$ where p = number of officers and men, and D displacement of tons. As an example of the comparative figures obtained, we give the table in the next column. The higher the figures in the grand total column the better the ship.

The discussion which followed was all to the same effect, namely, that the system devised by Captain Noel was very ingenious, but quite useless, except for ships which closely resembled each other in their main features. Sir E. J. Reed took occasion, in criticising this paper, to say a good deal on the burning question of armoured *versus* unarmoured ends, and he called special attention to the fact that the Admiral class of ships which the Government proposed to build cannot be inclined 5 deg. without putting the whole of the armour under water, while the heeling of the Collingwood only 1½ deg. would have the same effect. If he had 2800 tons of armour to dispose on a ship of 10,000 tons, he would at least take care that it would not all be represented by a belt 130ft. long by 1ft. above the water line. Admiral Sir Spencer Robinson agreed with Sir E. J. Reed; so did Mr. Samuda, who, pointing out that it was impossible to attach any value to armour until it was known how it was arranged, stated that the proper thing was to so arrange

Name of ship and tonnage.		Total α.	Total α + β.	Grand total α + β + γ.
	Tons.			
Lepanto (Italian)	13,850	901·4	1122·7	1142·7
Amiral Baudin (French) ...	11,441	722·6	996·7	1017·5
H.M.S. Camperdown ...	10,000	711·7	912·7	942·6
H.M.S. Edinburgh	9,150	538·9	730·1	749·1
H.M.S. Ajax	8,510	446·3	617·0	545·6
H.M.S. Nelson	7,630	447·3	638·0	666·0
Sachsen (German)	7,400	450·7	597·0	601·2
Caiman (French)	7,240	480·6	646·3	650·8
H.M.S. Conqueror	6,200	388·2	548·2	563·7
H.M.S. Orion	4,870	273·8	395·8	395·8
New belted cruiser	5,000	386·2	540·2	565·7
H.M.S. Arethuse	3,750	243·0	307·2	337·2
H.M.S. Active	3,080	174·6	208·6	208·6
H.M.S. Opal	2,120	102·4	131·7	131·7
H.M.S. Caroline...	1,420	81·6	111·0	114·2
H.M.S. Cormorant	1,137	55·0	84·2	84·2
H.M.S. Hecla	6,200	244·5	284·5	336·5

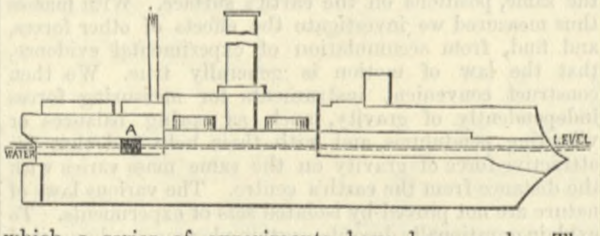
armour that it would enable a ship to keep afloat under an enemy's fire as long as possible, and this certainly could not be best done or done at all by concentrating it in thick masses on portions of the hull. It should never be forgotten that while we were always talking of the risk from shells, no shell as a shell had ever yet been fired through an armour-plate and burst behind it. The shell played the part of a solid shot if it came through at all, which it could not do if it had a charge of powder in it. In that case it burst outside, and even a thin plate would burst it; therefore he held that even thin armour all over was better than thick armour in patches only.

Mr. W. H. White found the same faults as other speakers had done with Captain Noel's paper, but he said it was useful, as showing the value attached by an able and experienced naval officer to different characteristics. In reply to Sir E. J. Reed, he would add, that it had never been pretended that the stability of the new ironclads was to be protected by armour; and he was pleased to find that Captain Noel had placed the Italia and Lepanto at the top of his list, although they had no side armour at all to protect their stability. After a few words from Admiral Sir John Hay, Captain Noel replied briefly, and a vote of thanks having been passed, the meeting adjourned.

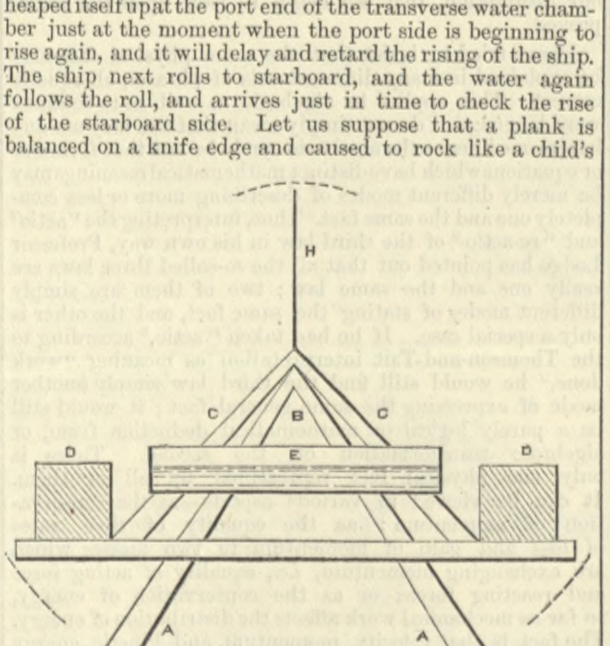
On resuming after luncheon, Mr. P. Watts read a paper

On the Use of Water Chambers for Reducing the Rolling of Ships at Sea.

This paper referred to the use of a transverse chamber containing water as a means of reducing rolling. The accompanying diagram shows H.M.S. Edinburgh, with



which a series of experiments have been made. The transverse water chamber is shown in section at A. It runs right across the ship from one side to the other. The water acts in the following way:—When the ship heels to port, let us say, the water runs down to the port side, and as it always moves after the ship has moved, it will all have heaped itself up at the port end of the transverse water chamber just at the moment when the port side is beginning to rise again, and it will delay and retard the rising of the ship. The ship next rolls to starboard, and the water again follows the roll, and arrives just in time to check the rise of the starboard side. Let us suppose that a plank is balanced on a knife edge and caused to rock like a child's



see-saw. If, now, a man run along the plank in such a way that he will always reach that end of the plank which is lowest at the moment it is beginning to rise, it will be seen that considerable effort will be required to keep the plank rocking. The water plays the part of the man. It happens, however, that just the right quantity of water must be used, which means that the tank or chamber must be just about half-full; if more or less, then it may arrive too soon or too late at the end of the chamber. Mr. Froude has carried out a series of experiments with Mr. Watts, and he showed a model in action which beautifully illustrated the theory. A A is a wooden frame with a knife edge at B, on which is carried the second frame C C; D D are two balance weights by which it can be levelled, E is a rectangular vessel with a front of glass, through which the behaviour of coloured water may be seen when C is caused to rock, as indicated by the curved dotted lines; H is a pointer.

The discussion which followed was opened by Mr. Liggins, who hoped that this device would be applied to merchant steamers to prevent rolling. Sir E. J. Reed, however, and several other speakers, regarded the scheme as of very doubtful value as applied to passenger ships, because the violent action of the water rushing from end to end of the chamber might, and certainly would in weak vessels, do a great deal of harm, and be productive of much danger. It is noteworthy that in the course of this discussion it was stated that there is now a tendency to make merchant steamers too wide for their depth—possibly as a reaction from the Austral type, which is crank—with the result that they roll fearfully, and two or three wide ships have already been lost, it is assumed, from the straining caused by excessive rolling. Certain explanations were given by Mr. Froude, and after a reply from Mr. Watts, and a vote of thanks, the meeting adjourned until yesterday—Thursday—at noon.

The proceedings on Thursday commenced with the reading of a paper by Mr. J. H. Heck, on "A Mechanical Method of Measuring a Vessel's Stability." After some discussion, this was followed by three papers, as follows:— "The Stowage of Steamships," by Mr. F. P. Purvis, Member; "Method of Arranging the Coal Bunkers of a Steamer so as to Reduce the Ballast to a Minimum," by Mr. John Nicholson; "On Yacht Measurement and Time Allowance for Racing," by Captain J. C. Tuxen. This completed the proceedings for the day. In the evening the Institution assembled at seven o'clock, and proceedings commenced with the reading of a paper on "The Most Suitable Propeller for Shallow Draught," by Mr. J. I. Thornycroft, followed by other papers.

THE LATE MR. MICHELL.

We regret to announce the death of Mr. William Marwick Michell, of the Patent-office. Mr. Michell entered the service of the Commissioners of Patents in 1853, having previously filled the post of assistant-editor of *Newton's London Journal*, a periodical of repute in its day, devoted to the description of patented inventions. His literary experience and his wide knowledge of patent law and inventions were of great value in the office, and about the year 1856 he started the useful series of "Abridgments," by preparing in his leisure time, after official hours, the volumes relating to "Sewing Machines," "Drain Tiles and Pipes," and "Aids to Locomotion." He also compiled the catalogues of the Patent-office Museum, and of the collection of portraits of inventors formed by the late Professor Woodcroft. During the preparation of Mr. Chamberlain's Patent Bill, which became law last year, he was constantly consulted by those who had charge of the measure, and his intimate acquaintance with the practice under the old law, and with the various attempts at reform which had been made from time to time, enabled him to render valuable service. His services were, however, not recognised, the post of deputy-controller, to which he aspired, and to which he was justly entitled, being conferred upon a clerk from the Board of Trade without any previous experience in patent matters. His death took place at Kew, on the 19th inst.

THE REMSCHEID WATERWORKS.

On page 244 will be found the second page engraving illustrative of the Remscheid Waterworks. A description of the works will be given in another impression with further engravings.

TENDERS.

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G. A. Smith, Dorking	9,390
R. C. Trimm, Walton-on-Thames	9,342

Engraving by Electricity.—Our Birmingham correspondent says:—An invention which should be of much practical utility in many manufactories has been brought under the notice of several firms here by Lieut. Buller Carter, of Bow-lane, London. It is a new engraving machine, in which electricity has been introduced into the mechanism with great success. It is chiefly intended for decorative engraving upon metal work, and is capable of producing highly finished results with a celerity in which manual work is completely outdistanced. The words or designs to be engraved are first furnished by a setting of ornamental types or a stereotype plate. Over this is passed, in parallel lines, an arm of the machine, to which is attached a fine protected platinum point. The motion of the arm is responded to by that of a table, which carries the metal to be inscribed or decorated beneath the point of the engraver. The types or stereotype plate, by raising the platinum point, puts into circuit a current of electricity, which, acting upon an electro-magnet, raises or depresses the graver, and produces an enlarged or reduced engraved copy of the types upon the metal on the table with perfect accuracy.

RAILWAY MATTERS.

A TRANSVAAL railway scheme, from Kimberley to Pretoria, has been mooted.

THE Bugsworth "straightening" on the Midland Company's Manchester line is now completed. The new works will avoid subsidences, and other troubles, which on the old route have caused a large annual expenditure.

AMONG the plant required for the Suakim and Berber Railway, Messrs. Lucas and Aird have specified a number of Norton's Abyssinian tube wells, with pumps and driving apparatus. They have received orders to prepare these for immediate dispatch to Suakim.

ABOUT 6800 tons of steel work for the Forth Bridge superstructure of the large spans are in various stages of preparation in the shops. The portions most advanced are the bed-plates, skewbacks, tubes, and girders for the North Queensferry cantilevers, but the steel work for the South Queensferry and Inch Garvie cantilevers is also in hand.

FOR the supply of water to their men, and for the locomotives for the Suakim-Berber line, Messrs. Lucas and Aird have decided to employ a portable arrangement of the Kirkaldy condensing machine for obtaining distilled water from sea water, the water even for locomotives having for the greater part of the line to be obtained this way.

AT Manton, on Saturday morning, a connecting rod of a goods engine broke and pierced the boiler. The driver and fireman were soon enveloped in steam; the former jumped off the engine, which was going fifteen miles an hour, and was not hurt. The fireman was picked up insensible. He had received a severe shaking and a slight scalp wound. He did not know how he got off the engine.

A CONSIDERABLE quantity of material is being made with the utmost despatch for the railway wagons and carriages for the Suakim-Berber Railway. The work consists of tires, axles, and springs. There is also a good deal of work doing for the frontier railways of India, and this is being got out of hand with great expedition. Messrs. John Brown and Co. have the work in both cases.

THE Hull and Barnsley Railway Company's contracts for rolling stock have been given out. The work, which consists of 479 wagons and carriages, has been divided between Messrs. Charles Roberts and Co., Wakefield; Messrs. Craven Brothers, Darnall, Sheffield; the Ashbury Carriage Company, Manchester; the Lancaster Wagon Company; the Railway Carriage Company, Oldbury; and Messrs. Brown, Marshall, and Co., Birmingham.

THE railway wagon builders in the Birmingham district note with satisfaction the Indian inquiries which are being made. The Nizam's Guaranteed State Railways Company is inquiring for low-sided and covered goods wagons wholly of iron, and for brake vans. The wagons and vans are of 19ft. lengths, and are for a 5ft. 6in. gauge. The work is to be supplied in parts for putting together in India. The Southern Mahratta Railway Company is also inquiring for similar ironwork, and for wheels and axles, ironwork for trolleys, and axle-boxes.

WRITING of street tramways for China, an American paper says: "India, Japan, the East and West Indies, Mexico, Brazil, the States of South America, &c., are all endowed with these conveniences of modern civilisation, but the tinkle of the bell-punch has never yet been heard in populous, ride-loving China. We can state, however, upon good authority, that parties are here arranging for such plant and appliances as are necessary, and that Yankee street cars will soon be rolling through the streets of at least one city in the Celestial Empire."

THE railway rates question has this week been again considered by the Wolverhampton Town Council, and they have determined, subject to the sanction of the Home-office and to subsequent confirmation by a town's meeting, to defray the cost of opposing the London and North-Western, Great Western, and Midland Company's Bills out of the Borough Fund. Leading members of the Corporation, who are also manufacturers, expressed the strong opinion that after the opposition offered by Mr. Chamberlain the Bills will not be presented for second reading. They also deprecated the reference of the Bills to a Royal Commission, as is proposed by the President of the Board of Trade.

THE Paris correspondent of the *Times* announces the death on Friday last of Mr. Faulin Talabot, an eminent engineer, at the age of eighty-five. "From 1825 to 1830 he was a surveyor of roads and bridges in the service of the Government. On the introduction of railways he threw himself with enthusiasm into the movement, was manager of the Avignon and Marseilles line, and became manager of the Paris, Lyons, and Mediterranean. He also formed a company for cutting through the Isthmus of Suez, but the time was not then ripe for such an undertaking. From 1863 to 1870 he was a Deputy. Though blind for some years, he continued to the end of his life to interest himself in railways, and was ever ready with advice on new schemes."

SOME rapid tunnel driving has lately been done on the Mersey Tunnel Railway, by Colonel Beaumont's boring machine. The distance accomplished last week, through the red sandstone under the Mersey, was 87 yards, which is the "fastest on record." The heading now being driven, and which is nearly completed, has a total length of about 950 yards; and this, as well as the previous heading of about 700 yards in length, are intended for effecting the ventilation of the main tunnel. The total distance driven by Colonel Beaumont's machine—which cuts a circular heading rather over 7ft. in diameter—in connection with the Mersey Tunnel, is about 2250 yards, which includes the first operation, viz., the boring of the drainage heading.

THE Midland Railway from Woodlesford, near Leeds, to Barrow-in-Furness was obstructed throughout Sunday. A correspondent says:—Messrs. Cammell and Co., of Sheffield, recently completed an immense steel propeller for a steamship, which is being constructed at Belfast. The blades of the propeller—one of the largest yet made—were so wide that they overlapped the opposite line of rails to that on which the propeller was being transported. On Sunday arrangements were made for the conveyance of the propeller from Woodlesford to Skipton, and in order to effect this the passenger trains along the route were shunted and blocked to allow the special train to pass. At the stations and junctions the propeller excited great interest. The train journeyed to Skipton safely, where it was intended that it should remain until next Sunday, but it afterwards proceeded to Carnforth, and subsequently to Barrow, where it arrived on Sunday night.

AT the half-yearly meeting of the Caledonian Railway it was stated that the receipts from all sources of traffic had fallen, there being a decrease under every head excepting that of live stock. Coaching receipts were less by £4600, although they had carried 183,259 more passengers and run 45,000 more train miles than last year. Third-class passengers yielded £2300 more, but first and second-class passengers had both fallen in numbers by 6000 and 13,000 respectively, and in money in the aggregate by £5327. Merchandise had brought in upwards of £10,000 less than last year. The receipts from minerals were only £1000 less. There was an increased train mileage of goods and minerals together of 116,000, which meant a large addition to the running charges. The tonnage carried during the half-year had been of goods almost identical with that during the half-year ending July, 1884, and only some 9000 tons less than that carried during the half-year ending January, 1884. That of minerals was 10,000 tons more than at the corresponding period of last year. Turning to the expenditure side, the cost of working and maintaining the line was some £8000 less than last year. Maintenance of way, &c., had cost more by £9000; but the cost of locomotive power was reduced by £3000.

NOTES AND MEMORANDA.

IN London last week the annual death rate per 1000 from all causes was the same as the previous week, 21·4.

IN Greater London during the week ending the 14th inst. the death rate was equal to 20·7 per 1000 of the population.

THE production of manufactured iron in France during the latter half of 1884 was 455,977 tons, being a decrease of 17,133 tons on the quantity produced during the second half of 1883.

THE deaths registered during the week ending March 14th in twenty-eight great towns of England and Wales corresponded to an annual rate of 22·1 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 Birkenhead, Portsmouth, Hull, Brighton, Derby, and Salford. The death rate of Birkenhead was 13·5; that of Sunderland 48·3.

DIFFERENT views are held with regard to the agents to be used in cleansing machinery such as beer pumps, and opinion seems principally divided between steam and alkaline solutions. Experiments conducted by Herr Kohlmann show that the steam process does not always sufficiently do the work required, while very good results were obtained with a cold 2 per cent. solution of caustic soda. This latter method is also cheaper than that of steam.

AT the Greenwich Observatory last week the mean reading of the barometer was 29·87in.; the highest reading was 30·38in. at the beginning of the week; and the lowest 29·41in. on Wednesday at noon. The mean temperature of the air was 41·9 deg., and 0·5 deg. above the average in the corresponding week of the twenty years ending 1868. Rain fell to the aggregate amount of 0·05in. The duration of registered bright sunshine in the week was 29·7 hours, against 28·1 hours at Glynde-place, Lewes.

FROM a recent paper on the manufacture of gas from oil and the bye products from Pintsch's gas, read before the Society of Chemical Industry by Professor H. E. Armstrong, F.R.S., it appears that the yield of about 80 cubic feet of gas per gallon of oil is considered a very good yield, but the yield depends very much upon the temperature of distillation. There are now about 2400 railway carriages in the United Kingdom fitted on the Pintsch system, and the gas consumed in total is enough to yield a large quantity of valuable and interesting bye-products.

AT a recent meeting of the Chemical Society, a paper was read on "Toughened Filter-paper," by E. E. H. Francis. Filter-paper which has been immersed in nitric acid, rel. den. 1·42, and washed with water, is remarkably toughened, the product being pervious to liquids, and quite different from parchment paper made with sulphuric acid. Such paper can be washed and rubbed without damage, like a piece of linen. The paper contracts in size under the treatment, and the ash is diminished; it undergoes a slight decrease in weight, and contains no nitrogen. Whereas a loop formed from a strip 25 mm. wide of ordinary Swedish paper gave way when weighted with 100—150 grams, a similar loop of toughened paper bore a weight of about 1·5 kilogs. The toughened paper can be used with the vacuum pump in ordinary funnels without extra support, and fits sufficiently closely to prevent undue access of air, which is not the case with parchment paper. An admirable way of preparing filters for the pump is to dip only the apex of the folded paper into nitric acid, and then wash with water; the weak part is thus effectually toughened.

IN the monthly report on the London water supply, by Mr. William Crookes, F.R.S., Dr. William Odling, M.B., and Dr. C. Meymott Tidy, M.B., it is stated that:—"Of the 168 samples examined, the whole, excepting two which were recorded as 'very slightly turbid,' were found to be perfectly clear, bright, and well filtered. The month of February was characterised by a heavy and more or less continuous rainfall, and by the prevalence of river floods, conditions eminently unfavourable to the quality of the water supply. In regard to freedom from turbidity, however, the subsidence and filtration arrangements of the companies sufficed to meet any extra strain put on them by the prevailing conditions, only two of the 168 samples examined during the month being found to present even that low degree of turbidity denoted by the expression 'very slightly turbid.' Thus the mean quantity of organic carbon in the water supplied by the Thames companies during last month was ·182 part, as against ·137 part in the preceding month, and as against a five years' average for the month of ·190 part, in 100,000 parts of the water. The mean amount for February, 1883, was ·238 part, and that for February, 1884, when the river was in an exceptionally excellent condition for the time of year, only ·140 part in 100,000 parts of the water."

THE returns of the census taken in 1882 give the population of Russia in Europe as numbering 77,879,521, of whom 38,651,977 were males and 39,227,544 females, making, with the Grand Duchy of Finland and other parts of the empire, a total of over 102,000,000 souls. Classified according to provinces, the population is largest in the province of Viatka, 2,740,953; and then come the provinces of Perm, 2,539,874; Kieff, 2,507,231; Tamboff, 2,490,319; Pultava, 2,473,958; Voronega, 2,433,657; Kursk, 2,314,300; Podolia, 2,276,518; Samara, 2,224,093; Moscow, 2,137,179: Kharkoff, 2,160,263; Saratoff, 2,113,077; and Volhynia, 2,062,270. These are the only provinces in which the population exceeds 2,000,000, the minimum being reached in the province of Archangel, which has only 315,367 inhabitants. The population is densest in the provinces of Moscow—73·1 inhabitants to the square verst—and of Podolia—61·7 inhabitants per square verst—while there are from 50 to 60 inhabitants per square verst in the province of Pultava, Kursk, and Kieff; from 40 to 50 in the provinces of Tula, Riazan, Orel, Kharkoff, St. Petersburg, and five others. The provinces most sparsely inhabited are Perm, 8·7 to the square verst; Orenburg, 7·2; Astrakhan, 3·8; Vologda, 3·3; Olonetz, 2·9; and Archangel, 0·4. The urban population is 9,263,100, and the rural population 68,616,418. The number of illegitimate children is much greater in the towns than in the country, being 113·2 per 1000 births in the former and only 17·7 per 1000 in the latter. The mortality is greater in the country than in the towns, being 39·5 per 1000 inhabitants, as against 34·4.

IN a paper read before the Statistical Society on the 17th ult. Sir Richard Temple endeavoured to check the various official returns of the population of China by applying the results obtained from the population statistics of British India. The various statements made by the Chinese Government as to the numbers of people under its rule show violent fluctuations, those of the last century and a-half varying between 436 and 363 millions. These returns, as Professor Douglas pointed out, varied with the purposes for which the enumerations were made. China proper and India, said Sir Richard Temple, are about the same area—a million and a-half of square miles. Both countries are under similar conditions—physical, technical, climatic, geographical. In both there is a strong tendency to multiplication of the race. In both the population loved to congregate in favoured districts, to settle down and multiply there till the land could scarcely sustain the growing multitudes, and to leave the less favoured districts with a scanty, though hardy population. The average population of the whole of India is 184 to the square mile, and if this average be applied to China—exclusive of the Central plateau—it gives a population of 282,191,600 souls. The writer then compared, one by one, the eighteen provinces of China proper with the districts in India corresponding nearly in physical characteristics and cultivable area, and, summarising these computations, he found that, over a total area of 1,500,650 square miles, the population, according to this estimate from the Indian averages, would be 282,161,923, or, say, 183 persons to the square mile; while the latest official returns obtained from China show 349,885,386, or 227 inhabitants to the square mile. The general conclusion, he said, might be that the latest Chinese returns, though probably in excess of the reality, did not seem to be extravagant or incredible on the whole if tested by the known averages of the Indian census.

MISCELLANEA.

WILLIAM C. KINGSLEY, the originator and builder of the Brooklyn Bridge, died on the 21st ult.

THE death is announced of B. B. Hotchkiss, the inventor of the world-famous Hotchkiss machine gun.

THE number of men employed on the Forth Bridge works is about 2000, including the Italians engaged in the compressed air sinking arrangements.

A NEW iron bridge, designed by Mr. Kinniple, C.E., is being erected at the mouth of the West Harbour of Greenock. It will cost upwards of £9000.

ALNWICK seems to be going for medicinal supply on a large scale, for last week the Local Board adopted a proposal to obtain its water supply from the Senna Wells.

IT is stated in Vienna from Rome, that the Italian Government has concluded a treaty with the Eastern Company for the laying down of a cable from Massowah, *viâ* Assab to Perim.

A LECTURE on "Calculating Machines" is to be delivered before the Physical Society in the Physical Laboratory of the Science Schools, South Kensington, on Saturday next at three o'clock.

SOME idea of the extent of the electric lighting at the Inventions Exhibition may be gathered from the fact that the Henley Telegraph Works Company has supplied the Exhibition with ozokerited india rubber electric light cables to the value of £800.

SEVERAL overhead wires fell during last Sunday, and though no personal injuries resulted, some of the wires could not have fallen on a week-day without something of the kind. We have had so little snow for years that the wires have not been tested, and the small fall last Saturday night was sufficient to break a good many.

THE ss. Etruria, a sister ship to the Umbria, built by Messrs. John Elder and Co. for the Cunard Company, is now ready to leave the Clyde. Built of steel, her tonnage is 8000 tons; she is 520ft. long, 57¼ft. broad, and 41ft. deep, the engines being of 12,500 indicated horse-power. The Etruria is expected to leave Liverpool on her maiden Transatlantic trip about three weeks hence.

WE hear that at the special desire of a foreign Government, and with a view to meet on equal terms the competition of French and German firms, Messrs. Yarrow and Co. have in contemplation the establishment of a branch factory on the Continent. A similar course will probably be adopted by a large firm on the east coast, whose name we are not at liberty at this moment to mention.

OUR Birmingham correspondent says: "Urgent orders have just been placed by the Government with Birmingham gunmakers. They embrace thousands of Martini-Henry rifles, carbines, and revolvers. The men at the three leading factories, and also at a number of private establishments, will be employed night and day, and some hundreds of hands discharged during the bad trade have been re-engaged. The arms have to be shipped to Bombay as fast as they can be manufactured."

A SMALL vertical boiler recently exploded in a foundry in Cork. In a Board of Trade report on the subject, Mr. Traill says:—"This explosion appears to have been due to the fracture of the uptake tube at the root of the upper flange, which was probably injured in flanging. Flanged uptake tubes are very liable to give way at the roots of the flanges, as in this case, and, therefore, should not be regarded as stays. Such a boiler should be sufficiently strong without relying on the uptake as a stay."

IN answer to a question in the House on Monday, Mr. Hibbert said:—"The estimate for the pier at Easky was £4000, and the contract has been let for £3553; the corresponding figures for Aughris are £2000 and £1898. The contractors are under bonds to commence the works during the present month and complete them by November 1st and October 1st next respectively. As regards Pullendiva no final recommendation has yet been received from the Fishery Piers and Harbour Commissioners."

THE new screw tug Condor, built by Messrs. Morton, of Leith, had a trial trip on the river Thames on 12th March. The Condor was built to the order of, and was designed by, Messrs. Watkins and Co., Fenchurch-street, London, and fitted with their sluice keels to facilitate turning. The dimensions and power of the Condor are as follows:—Length, 90ft.; beam, 19ft.; depth of hold, 11ft. 3in., fitted with engines of the compound surface condensing type; cylinders, 20½in. by 40in. by 24in. stroke; large multitubular boiler, working pressure 100 lb.

A SET of machinery for manufacturing lead and composition pipes from ¼in. to 6in. bore, as illustrated in our impression of the 12th October, 1883, from drawings supplied by the makers, Messrs. J. and W. Weems, has been erected in the Imperial Arsenal, Constantinople, and tested, in the presence of his Excellency the Imperial Minister of Marine, and principals of the Admiralty Council, and a certificate bearing the Sultan's Imperial insignia in gold states that the working of the whole plant was highly satisfactory, the whole of the various sizes of piping being turned out true and uniform.

BY the Northfleet Docks Bill for which the Standing Orders Committee of the House of Lords refused, on Tuesday, to dispense with the Standing Orders, powers were sought to incorporate a company for the purpose of constructing a main dock, with an entrance from the river Thames at Northfleet, near the Rosherville Gardens. 417 yards in length and 200 yards in width, with two branch docks each 400 yards long, and about 83 yards wide. It was also proposed to construct railways to connect the docks with the South-Eastern and London, Chatham, and Dover Railways.

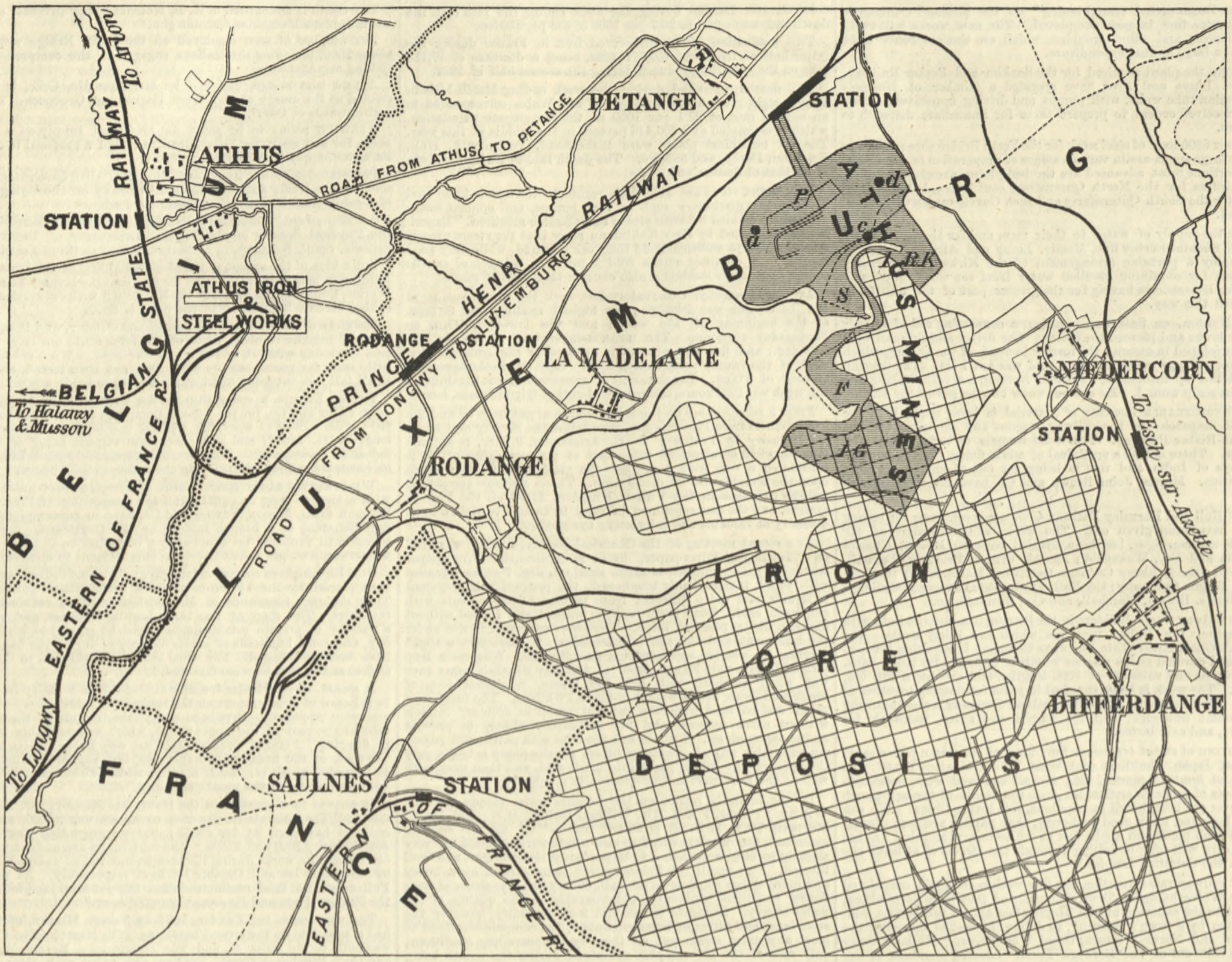
ON Saturday, the 21st instant, the ss. Eastwood, built by Messrs. Earle's Shipbuilding and Engineering Company, was taken on her official trial trip. The dimensions of the vessel are as follows:—Length, 256ft.; breadth, 34ft.; depth of hold, 17ft. She is built to the highest class in the Liverpool Registry. She has been fitted by the builders with their triple compound three-crank engines, steam for which is supplied from a large single-ended steel boiler made for a working pressure of 142 lb. per square inch, this being the tenth set of triple compounds completed by Messrs. Earle's Company.

MESSRS. JOHN BROWN AND CO. have just completed the roller plates for the batteries of the Doria and the Morosino, for the Italian Government, which are now being despatched to Spezzia and Venice. Several leading officials of the Japanese Government railways visited Messrs. Brown's works on Thursday, when there was also a vigorous deputation of forty members of the Manchester Geological Society, who witnessed the process of rolling armour plates, and other industries, and afterwards inspected the company's colliery at Aldwarke Main, where they witnessed the process of getting coal by means of lime cartridges.

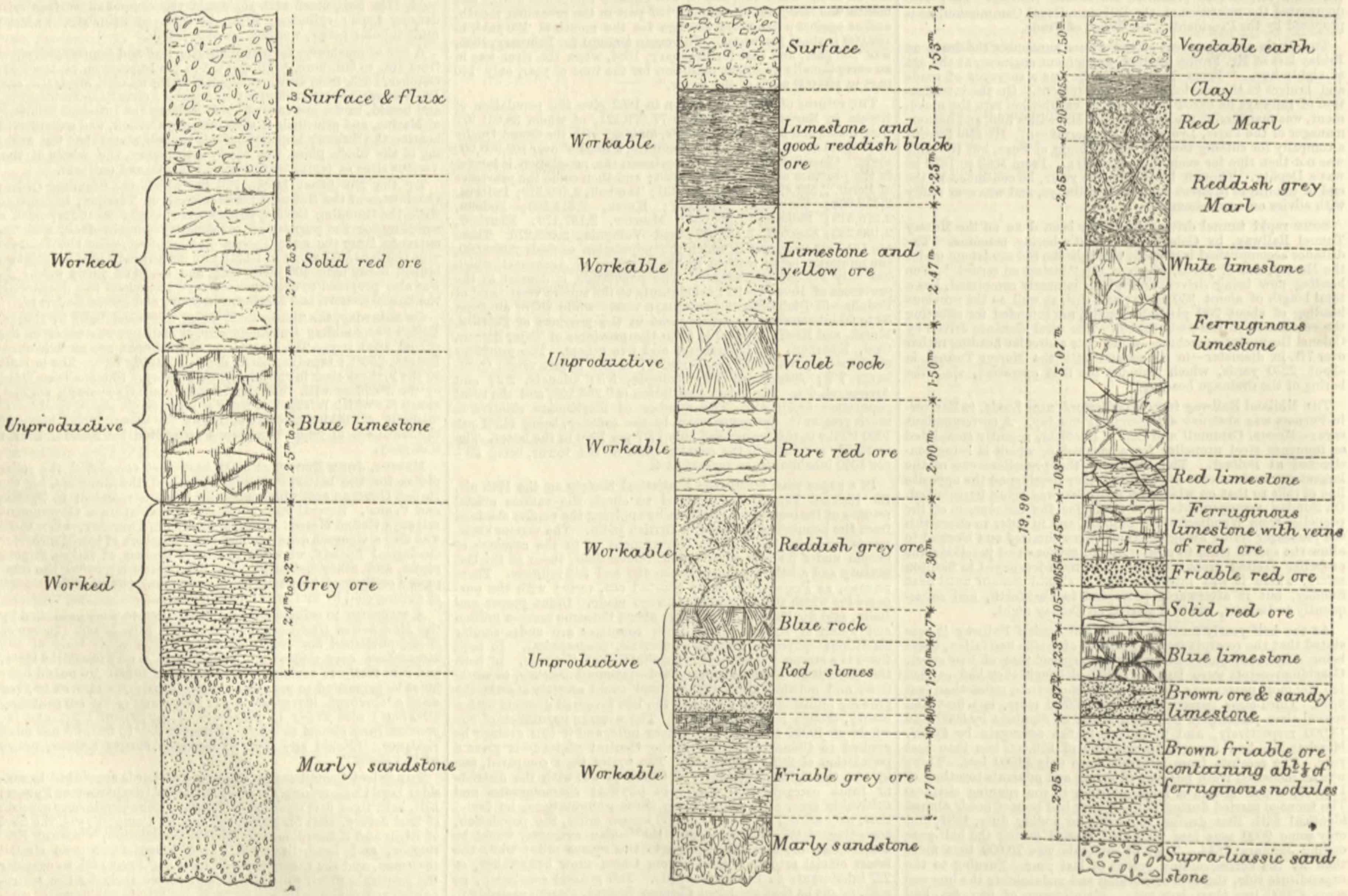
A WARNING to colliers is being from time to time published by the *Manchester Guardian*, guided by Mr. Ellis Lever. In one of these, published last week, he says:—"The whole body of the atmosphere over north-west Europe is in a very unsettled state, and it is likely to remain so for some little time. No naked light must be permitted to pass into the workings. *No shot to be fired until a thorough investigation has been made of the surrounding workings; shot firing is dangerous at the present time, and the greatest care should be used.* If the weather be fine, do not relax vigilance. Should any signs of increased danger appear, notice will be given."

THE Select Committee of the House of Lords appointed to consider Lord Camperdown's Water Companies' (Regulation of Powers) Bill, held their first meeting on Tuesday. The Committee consists of Earl Jersey, Earl Stanhope, the Earl of Camperdown, the Earl of Elgin and Kincardine, the Earl of Normanton, Viscount Barrington, and Lord Bramwell. Lord Camperdown was elected chairman, and the Committee will meet on April 14th to consider the proposals which will then be laid before them by the metropolitan companies. By the terms of the reference the water companies and other petitioners against the Bill may be heard by themselves or their agents, but not by counsel.

GENERAL PLAN OF ATHUS DISTRICT, SHOWING POSITION OF MINES AND WORKS.

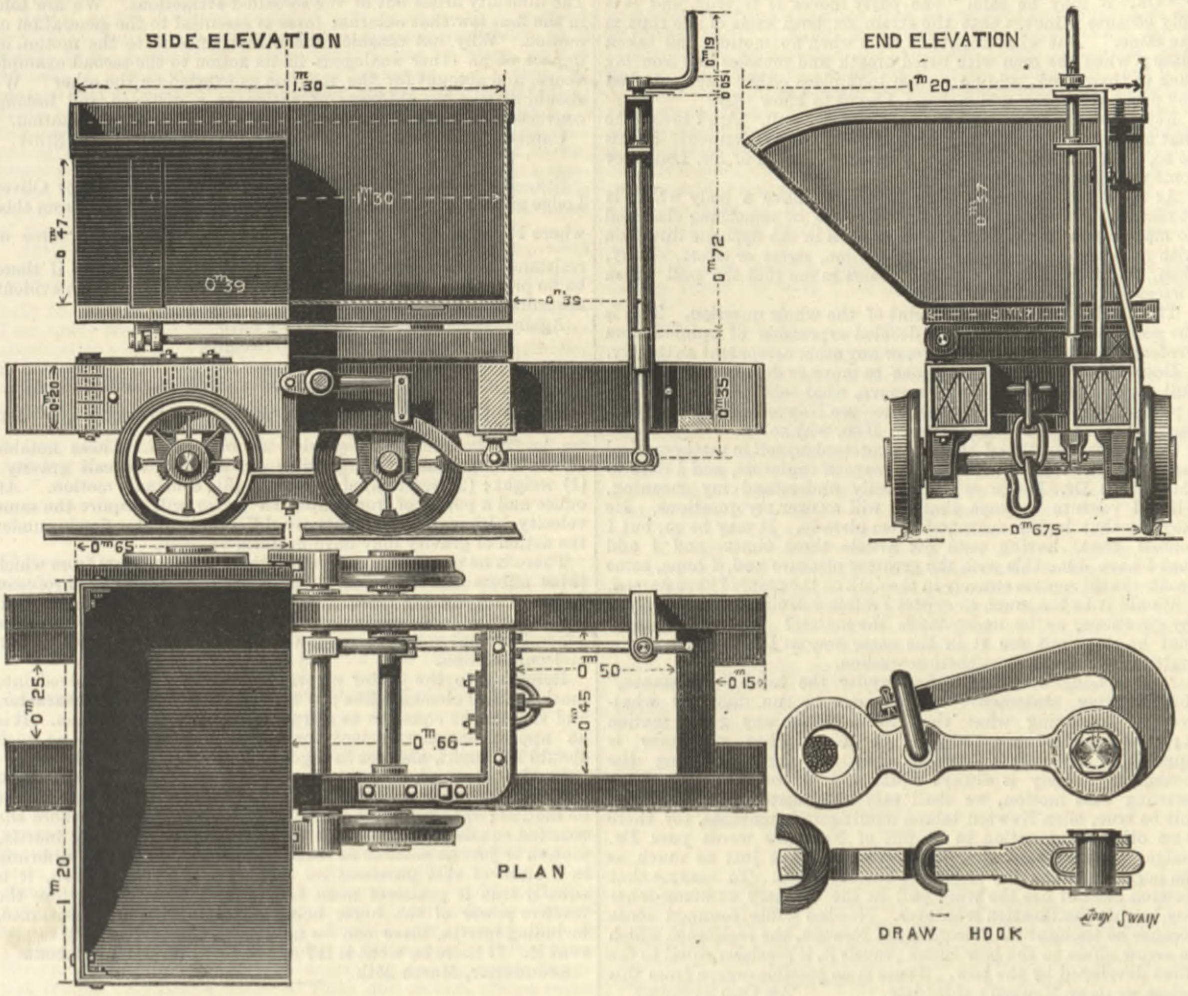


DISTANCE BETWEEN WORKS AND MINES, ABOUT THREE MILES.



SECTIONS OF BORE HOLES, MARKED ON PLAN A, D, AND F RESPECTIVELY.

ORE WAGON AND DRAW-HOOK, ATHUS.



THE ATHUS IRON AND STEEL WORKS.

No. I.

THE Barons d'Huart, an old French family, have during many generations made iron, when they could find leisure from actively serving their country in the field. The present barons, M. Fernand d'Huart and M. Hypolite d'Huart—in France, Belgium and Germany all the sons of an hereditary baron bear the title—possess an old blast furnace at Senelle, near Longwy, and potteries at Longwy-bas, besides being largely interested, in conjunction with the Société des Usines de Maubeuge, in two blast furnaces near Longwy, one of which has been in blast for six months. They have also a considerable interest in, and are the *administrateurs délégues* of, the Société des Hauts Fourneaux et des Aciéries d'Athus, in Belgium.

Athus, the name of which betokens Roman origin, is a small village in the extreme south-east of the Belgian province of Luxemburg, at the junction of Belgium with France and the Grand Duchy of Luxemburg, as shown in the accompanying general plan. There are some deposits of alluvial iron ore in the immediate neighbourhood of the furnaces, but not of good quality; and small quantities are still extracted from the Bois d'Athus and smelted, with a mixture of other ores, at Charleroi. Although blast furnaces formerly existed at Aubange, but a short distance off, it was not the presence of iron ore which led to the erection of blast furnaces at Athus in the year 1872, but rather their proximity to the larger and richer deposits in the Grand Duchy of Luxemburg, with convenient means of transport by the Prince Henri Railway, while being situated in Belgian territory, with the prospect of a market at the Charleroi rolling mills, without the customs due of five francs a ton levied on all pig iron entering Belgium. The basic steel works were added subsequently, and began to work regularly at the beginning of last year.

Mines.—The ore supply is entirely derived from the Grand Duchy of Luxemburg, where the construction of the Guillaume-Luxembourg Railway revealed the existence of valuable oolitic deposits, to develop which the Prince Henri line was subsequently formed, following the contour of the line of hills, so as to convey the ore away directly, with a minimum of haulage and barrow work. The Luxemburg ore beds run east and west, the content of metallic ore being tolerably uniform, 35 to 40 per cent.; but the ore in the east is much more valuable than that in the west, because it is intimately associated with lime, and this to such an extent that no further addition of flux is necessary for smelting. In the west, however, the lime is generally replaced by silica, the former diminishing and the latter increasing with remarkable regularity from east to west. It therefore happens that, while possessing mines at Pétange, in the west of the ore-bearing ground, the company finds it advisable to purchase supplies from Esch-sur-Alzette, the centre of the iron district, as well as from Differdange. Another reason for this is that the hands employed at Pétange are not regular miners, but chiefly farm labourers, who are fully occupied at harvest time, so that extraneous supplies are necessary to keep the furnaces going.

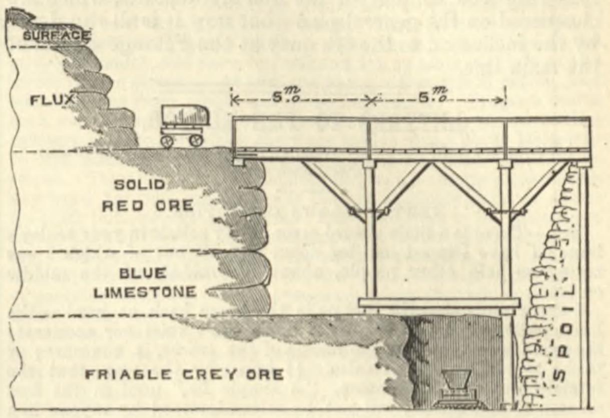
The mining law of Luxemburg differs from that of the neighbouring countries, having been carefully deliberated when the ore was discovered which has proved quite a national fortune. All that can be worked open-cast belongs to the surface proprietor, subsequent provisions allowing him even to work by drivings in certain cases; but all the ore below a certain geological level—represented by the chequered portion of the general plan on the opposite page—is reserved to the State, to be granted in concessions to ironmasters who shall erect blast furnaces, and railway companies who shall form means of communication. It is thus that the Prince Henri Company, in return for valuable iron ore property—indeed, the most valuable in the Grand Duchy—made and work the unremunerative lines in the north, as well as the paying mineral line in the south. As its furnaces are not in Luxemburg, the Athus Company was not entitled to an ore concession. It has, however, acquired the mining property—shown hatched in the general plan—connected by an incline with the Pétange station of the Prince Henri Railway.

The most northerly, as well as the most important, is the Prinzenberg royalty—marked P—45 hectares, or 111 acres in extent, about 27 hectares, or 66½ acres, of which may be worked open-cast. The second royalty in a southerly direction is the Schlammenberg—marked S—of 1¾ hectares, or 4 acres, with the Rothe Köpgen—R K—of 3·8 hectares, or 9 acres; then comes the Fuchsbusch—F—of 9 hectares, or 22 acres, in extent, and then, most southerly of all, the concession known as "Im Gärtchen,"—I G—27½ hectares, or 67½ acres, making a total area of 87 hectares, or 215 acres. The last-named royalty was granted by the Grand Ducal Government to the Société des Chemins de fer Sécondaires, in return for their making two railways, and was by them sold to the Athus Company; but all the other royalties are simply surface property purchased by the company from their owners. Sections of bore holes *a* and *d* in the Prinzenberg and of another a little to the north of F in the Fuchsbusch royalty are given below the plan on the opposite page. All the royalties contain two principal seams between 5 m. and 6 m. thick, while the Prinzenberg royalty has, in addition, over about half its area, a third seam, varying from 2 to 3 metres in thickness. These three seams yield on an average 40 per cent. of metallic iron in the furnace, while, with the exception of the black or top seam, they also contain 5 or 6 per cent. of lime, which materially assists in the reduction.

The following results were obtained from an analysis, made last December, of the three seams at Pétange:—

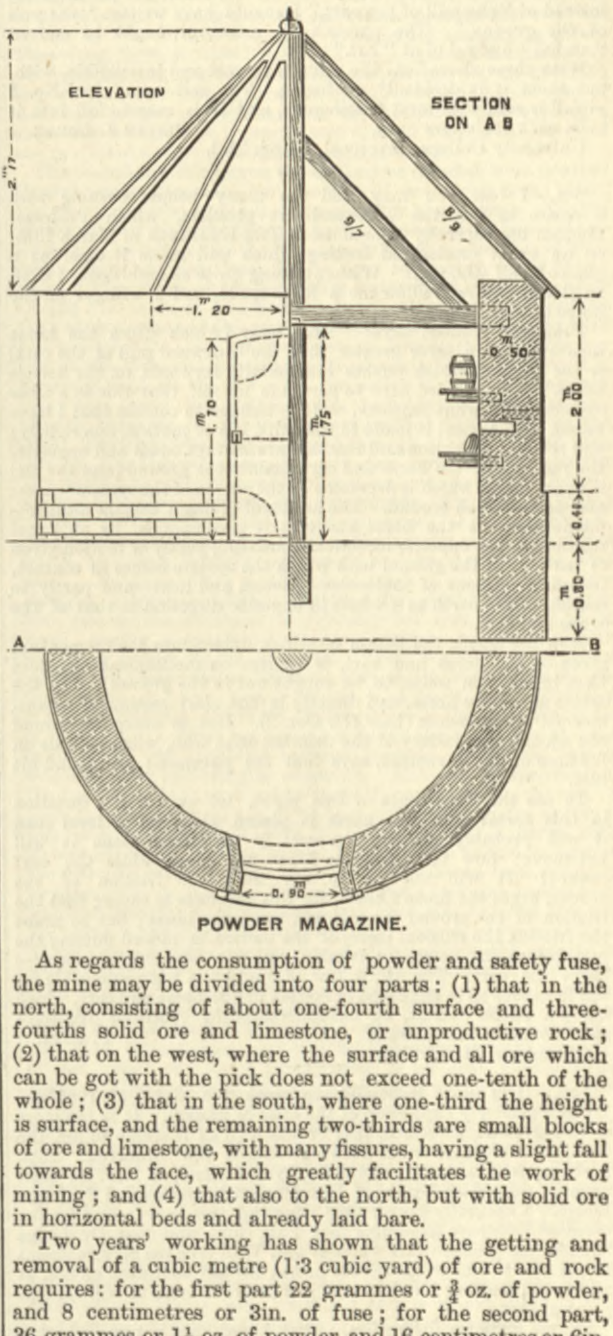
	Upper red ore.	Main red seam.	Friable grey ore.	Average lime-stone nodules in the three seams.
Volatile matters	15·48	14·38	13·84	23·34
$Si\ O_2$ = silica	11·03	12·34	13·62	13·04
$Al_2\ O_3$ = alumina...	5·79	7·78	7·18	7·19
Ca O = lime	6·32	4·62	2·26	19·56
Mg O = magnesia	0·93	0·33	0·82	0·73
$P\ O_5$ = phosphoric acid ...	1·83	1·79	1·72	1·39
Fe_2O_3 = sesquioxide of iron	59·14	59·27	59·82	36·70
P = phosphorus	0·79	0·78	0·75	0·60
Metallic iron...	41·40	41·49	41·87	25·55

The Prinzenberg Royalty, the most valuable of the whole mining property, is the only one as yet turned to account. It is worked entirely open-cast; and nearly all the ore may be extracted in this manner. The annexed figure gives a transverse vertical section of the face, showing the method of working in large steps. A double line of tramway, 0·8 metre, = 2ft. 7½in. gauge, is run from the top of the incline—the centre line of which is shown at P on the general plan—all along the working face, the rails being moved further in from time to time as the ore is worked out. While the ore is run along by the wagons to the incline, the unproductive portion is wheeled beyond the tramway and thrown out to spoil; and, at intervals, the pieces of rock are piled up regularly to form piers for supporting temporary timber bridges, like that shown in the section, thrown across the tramway for conveying the rock from the upper strata to the spoil bank, in wooden trucks smaller than those used for the ore. As the work proceeds, the bridges are taken down and re-erected at other points. The ground is marked out on the surface in small allotments; and the working of the whole vertical slice is let by



SECTION OF WORKING FACE.

contract to the chief of a gang. The measures are worked downwards in steps, powder but not dynamite being used where the rock is solid. The following sketch shows the arrangement of powder magazine adopted.



POWDER MAGAZINE.

As regards the consumption of powder and safety fuse, the mine may be divided into four parts: (1) that in the north, consisting of about one-fourth surface and three-fourths solid ore and limestone, or unproductive rock; (2) that on the west, where the surface and all ore which can be got with the pick does not exceed one-tenth of the whole; (3) that in the south, where one-third the height is surface, and the remaining two-thirds are small blocks of ore and limestone, with many fissures, having a slight fall towards the face, which greatly facilitates the work of mining; and (4) that also to the north, but with solid ore in horizontal beds and already laid bare.

Two years' working has shown that the getting and removal of a cubic metre (1·3 cubic yard) of ore and rock requires: for the first part 22 grammes or ¾ oz. of powder, and 8 centimetres or 3in. of fuse; for the second part, 36 grammes or 1¼ oz. of powder, and 16 centimetres or 6in. of fuse; for the third part, 43 grammes or 1½ oz. of powder, and 18 centimetres or 7in. of fuse; for the fourth part, 53 grammes or 1¾ oz. of powder, and 22 centimetres or 8½in. of fuse. At the rate of 1·1fr. per kilogramme, or 5d. per lb., of powder, and 40 centimes for 10 metres (or 1d. for 8ft.) of fuse, the getting of the cubic metre (1·3 cubic yard) on an average of the four parts, requires 38 grammes (1¼ oz.) of powder, costing 4·1 centimes, and 16 centimetres (6¼in.) of fuse, costing 0·6 centime. It will not be far wrong to add 5s. per cubic metre for the cost of labour in getting the ore and putting it into wagons.

When first established, the incline, 245 metres or 267 yards long, was sunk so as to be worked by a pair of horizontal-floor carriages, on which three wagons were placed at a time. But the present mining engineer, M. T. Heuskin, from the Ecole des Arts et Manufactures, Liége, and the Ecole du Génie Civil, Ghent, filled up the incline to the height of the carriages, which he suppressed, retaining the gradient of 0·24m. per metre, or nearly 1 in 4. The three wagons are now run in tandem directly off the tramway, with a saving in labour of two men at the top and two at the bottom, each of whom was paid about 3f. 50c., or 2s. 9d. a day. Above is shown the wagon, the body of which, made of plate iron, tips sideways from the quay wall into the railway trucks on the siding. An enlarged view is given of the draw-hook, devised by M. Heuskin, for preventing the necessity of running back the wagons a little way, to slack the rope, and so release them at top and bottom of the incline. The tongue of the hook is jointed to the shank and held by a shackle, which is secured by a cotter, and that by a split pin. The wagons are released, while the rope is tight, by simply taking out the split pin and cotter and knocking off the shackle. The ore was originally taken away by the purely mineral branch of the Prince Henri Railway—shown by the black line following the contour of the iron ore deposits, which are chequered on the general plan—but now it is all run down by the incline on to the ore quay at the Pétange station of the main line.

LETTERS TO THE EDITOR.

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

NEWTON'S LAWS OF MOTION.

SIR,—There is a little absurd error in my article in your to-day's issue; I have slipped one leg down the pit out of which I was trying to help other people, about the middle of the middle column.

I there imply that if a cart pulls the horse back as hard as the horse pulls the cart forward, the horse can't start nor accelerate the cart; which, barring the inertia of the traces, is nonsense; or to be more accurate, is false. [I hope, by the way, that the forcible and accurate phrase, "a simple lie," used in the first column of that article, will not be misunderstood by anyone in a personal sense; I was making no quotation, nor referring to any special or individual statement, I was simply denying a statement of my own, made for the purpose of denial.]

I will ask your readers, therefore, to be kind enough to substitute for the words "if the cart pulls the horse back as hard as the horse pulls the cart forward," these other words, "if the ground (or anything else) pulls the cart back as hard as the horse pulls it forward." And about ten lines further on, inside the parentheses, instead of "the pull of the *cart*," I should have written "the pull of the *ground*." The parenthesis, moreover, ought to end at "stated" instead of at "rut."

With these alterations the thing is correct and intelligible, without them it is decidedly confusing. The soil round this No. 2 pitfall is evidently most treacherous, and it is easy to fall into it even with one's eyes open. OLIVER J. LODGE.

University College, Liverpool, March 21st.

SIR,—I fear you may find too many people burning with a desire to put the horse-and-cart problem, which Professor Hudson has carefully expounded in THE ENGINEER of March 13th, on an exact mechanical footing, which will make it clear at a glance to all who read. Without being quite so ambitious, I shall be glad if you will allow me a little space, and I will get on the horse at once.

Professor Hudson says: "This body [which urges the horse forward with a force greater than the backward pull of the cart] is the ground, which pushes horizontally forwards on the horse's hoofs." I have tried hard to persuade myself that this is a clear statement of what happens, and am obliged to confess that I have failed. The appeal is made to the third law of motion, and rightly; and seeing that action and reaction are always equal and opposite, the reaction of the horse and cart against the ground [and the air] is the reaction which is overcome by the action of the system—horse and cart—on the ground. The action of giving a certain motion—momentum—to the horse and cart is accompanied by an equal reaction in the opposite direction, consisting partly of motion given to portions of the ground with which the system comes in contact, including motions of molecules—friction and heat—and partly to motion of the earth as a whole in opposite direction to that of the horse and cart.

Now the agent, the action of which determines the momentum given to the horse and cart, is no less on mechanical principles than in common sense, to be sought not in the ground but in the active agent the horse, and directly in the *vires tendinum ad animalium ossa movenda* (Law III. Cor. 2). But to make the ground the agent is the fallacy of the drunken man who, when he falls on his nose on the pavement, says that the pavement got up and hit him.

To see the importance of this point, let us ask the question in this form: If a live horse is placed alone on a level road it will probably move; if a cart is so placed alone it will not move; how is it that the horse can move while the cart cannot? It will not do to say that the friction of the ground urges the horse's hoofs, for this amounts to saying that the friction of the ground can and will move the horse; but to make the friction the efficient cause of the motion is indeed putting the cart before the horse, for friction will not—apparently *cannot*—move the cart. The third law of motion is not responsible for the inference as to the cause of motion of the horse and cart, which many a reader would, by misunderstanding Professor Hudson's statements, be led to draw. P. T. M.

Cambridge, March 21st.

SIR,—It is quite impossible to speak too highly of Professor Lodge's masterly exposition of the laws of motion. It is the more to be regretted, therefore, that he has left, as it seems to me, the problem connected with Newton's third law unsolved. This, perhaps, is due to my stupidity, yet I must, I fear, be most uncommonly thick-headed if I have failed to understand Professor Lodge. I naturally shrink from regarding this as true, and for the moment I venture to assume that I am right, and that Dr. Lodge has left the problem just where it was. Will it be too presumptuous to ask him to add to the favour he has already conferred on me, at all events, and beg him to write just as much more as will set this point at rest.

Let me state my difficulties. First, then, I am not sure whether Dr. Lodge draws a distinction between reaction and resistance so marked that resistance can never according to this distinction be reaction and *vice versâ*. Will he kindly make this quite clear.

If I have a rope, which I shall suppose to be without weight, lying on the ground, and I take hold of one end of it, and draw it toward me, the other end being free, I do not feel what I call resistance. If I fasten the previously free end to a stone, and pull once more on the rope, I feel what I call resistance. Now this indicates that something is now taking place which did not take place while the rope was free, and if I refer to my text-books I am told that I am now doing work by overcoming a resistance. Whether this be right or not, my experience tells me in a very tangible, practical way, that something is resisting the pull of my muscles. Now is this something resistance, or is it reaction, or is it both?

Whatever it is, I gather from Newton's third law, Professor Hudson, and Dr. Lodge, that the stone resists me, or reacts against me with precisely the same energy of pull that I exert. To put this into plain language, which can be understood by everybody, if I pull the stone with a stress of 1 lb., it pulls against me with a stress of 1 lb.; if I double my pull it doubles its pull, and so on. This is Newton's third law.

For the moment let it be considered that I am in a state of mental equilibrium—I neither believe the law nor disbelieve it. I am told about it for the first time, and it is the business, let me suppose, of Professor Hudson or Dr. Lodge to make me believe it.

Now I have all my life—and so has everyone else, I suppose—thought that when I pulled a thing to me it came because I pulled harder one way than it pulled the other. Take, for instance, the well-known game, the tug of war. Here two groups of boys or men pull at opposite ends of a rope against each other, and the world believes to this moment that the group which pulls hardest drags the other across the line or "scratch."

But by Newton's third law nothing of the kind takes place. At all times the pulls of the two groups are exactly equal and opposite, and to prove that they are, we have only to refer to the rope, the strain at one end of which in one direction is exactly equal to the strain at the other end in the opposite direction.

"Oh," it may be said, "one party moves it is true, and it is only because it moves that the strain on both ends of the rope is the same." But what about the time when no motion had taken place; when the men with bated breath and muscles like iron lay back to their work, and no motion took place either way? At last one party gives way and moves. I want to know why?

Return to the stone and the rope which I pull. Am I to assume that the pull is not the real cause of the stone's movement? If this be so, let it be plainly stated by Professor Hudson or Dr. Lodge, or some one else in authority.

As the matter presents itself to me, we have a body which is at rest, but it is pulled by me or some one or something else, and no matter how hard I pull it *always* pulls in the opposite direction with quite the same force—I beg pardon, stress or effort. Why, then, does it move? It certainly seems to me that the pull which I exert on it does move it.

This, then, is the crucial point of the whole question. This is the point on which I ask for a decided expression of opinion from Professor Hudson, or Dr. Lodge, or any other competent authority.

Does the pull cause the stone to move or does it not? If the pull does not cause the stone to move, what sets it in motion? If a pull is only equal to a resistance—see Newton's third law—can the pull cause the stone to move? If so, why so?

I am quite sure that I have not expressed myself in mathematical language, but I have used the language of engineers, and I dare to think that Dr. Lodge will perfectly understand my meaning, while I venture to hope that he will answer my questions. He may say that he has answered them already. It may be so, but I confess that, having read his article three times—and I add that I have done this with the greatest pleasure and, I hope, some profit—I still remain entirely in the dark on the points I have named.

Would it be too much to expect Professor Hudson also to answer my questions, as he understands the matter? It is quite evident that he does not see it in the same way as Dr. Lodge. In the multitude of counsellors there is wisdom.

In Dr. Lodge's article I find under the head "Resistance," the following statement:—"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." If this be true, then Newton talked unmitigated nonsense, for there is no other explanation to be put of Newton's words *pace* Dr. Lodge. Newton says as plainly as possible that just as much as the horse pulls one way the cart pulls the other. To assume that Newton did not use the word pull in the ordinary common-sense way has no justification whatever. Newton wrote common sense because he thought it. According to Newton, the resistance which an arrow offers to the bow which propels it, is precisely equal to the effort developed by the bow. There is no possible escape from this unless we deny Newton's third law. AN OLD STUDENT.

London, March 23rd.

SIR,—As this subject is now attracting and receiving so much attention in your pages, perhaps you will permit me to make a few remarks and ask a question or two.

When I learned dynamics a quarter of a century ago, when people did not know much about anything, I was taught that Newton's third law applied more particularly to cases where two bodies moved further apart than when they approached each other. Thus, for example, the discharge of a gun was always pointed out as an example. The action of the exploding powder against the shot was always said to be exactly equal to its reaction against the breech of the gun. Whitelaw and Stirrat's turbine, on the principle of Barker's mill, was another example. The water rushed out one way, the wheel recoiled the other, the action and reaction being equal and opposite. I think these examples are quite to the point.

Permit me now to ask a question bearing on them. It is a kind of axiom that equal forces operating for equal times produce equal effects. That is taught in all treatises on dynamics, and seems to me to be quite consistent with reason and with Newton's third law. However, be this as it may, it is, to use Professor Lodge's forcible form of expression, a lie.

I have a gun which weighs 1000 lb. Into it I put a charge of powder and a ball which weighs 10 lb. I fire it, and the ball goes one way and the gun the other. It is obvious that the force, or effort, or stress, or whatever it may be called, operates as long on the gun, and no longer, as it does on the ball, and it is also obvious that by Newton's third law it operates with the same force on the gun that it did on the ball, no more and no less. The ball gets a velocity of, say, 1000ft. per second. The gun having a mass 100 times as great gets a speed of recoil of 10ft. per second, and the speed of the ball is highest just when it leaves the muzzle, and the speed of recoil is also highest at the same moment.

Now if like causes operating for like times produce like effects, then the work in the gun at the instant I have selected should be the same as the work in the shot. But it is nothing of the kind. The work in the shot in foot-pounds by the formula $\frac{M v^2}{2 g} = \frac{10,000,000}{64} = 156,250$ foot-pounds, but the work in the gun is $\frac{100,000}{64}$ 1562·2 lb. The momentum, however, of the shot and the gun is the same in each case.

Now I want to know why it is that a given force operating for a given time on two bodies does ten times as much work on one as it does on the other? And I want to know, further, whether the statement that the magnitude of a force is known by its results, time being constant, does not need a good deal of qualification?

Again, let the shot strike a mass, say, a sphere, weighing 1000 lb. The shot will lose the whole of its motion, and the mass will then move at precisely the same speed as the gun did, and through the same distance—this is according to the mathematical theory—assuming, of course, that nothing is lost in the shape of heat; and this sphere will have no more foot-pounds capacity for work than the gun had, namely, one-tenth of that in the shot. What has become of the difference? The momentum is the same in the gun, the shot, and the target or sphere; but the energy or work-performing capacity is totally different. Why? How is this to be reconciled with the law of the conservation of energy? Is momentum anything but a name for an arbitrary quantity? Has it any real existence as an entity useful in the arts like *vis viva?*

Westminster, March 20th. J.

SIR,—Allow me to add a few remarks to the discussion. Instead of the horse, cart, trace, and road, conceive a mass resting on a rough horizontal plane, and connected by a flexible cord passing over a pulley to a weight, exactly equal to the friction between the mass and the plane. Suppose the system at rest, then the action of the weight on the mass is equal to the reaction of the mass on the weight, for if it were not so the whole system would move in the direction of the greater force in virtue of the residual force, as pointed out by Newton. Likewise the tensions at any two points in the cord are equal. Communicate motion to the system by an impulse, and uniform motion will result, but the action and reaction are still equal, and also the stresses at any two points in the cord, whilst the velocity is uniform and not variable. In itself the system is the same as at rest.

In the case of the impact of a moving body on a slower moving one the action and reaction are perfectly intelligible; the increase of the momentum of the one body is exactly equal to the decrease of the momentum of the other.

Let us return to the former example and increase the weight to exceed the friction of the mass, then a change of motion or accelerated velocity will ensue. Here seems to be the whole difficulty—the discovery of an equal and opposite reaction to this residual force or action, which is generating motion in the system. The difficulty arises out of the so-called attractions. We are told in the first law that external force is essential to the generation of motion. Why not consider the attraction due to the motion or impact of an ether analogous in its action to the second example above, and account for the reaction as exerted on the ether? We should dismiss our old ideas of action at a distance, and become converts to the doctrine that the only cause of motion is motion.

Camborne, March 24th. S. EDDY.

SIR,—In THE ENGINEER of the 20th March, Professor Oliver Lodge gives the general law of motion $m\,d\,v = F\,d\,t$. From this, where $F = o$, also $F\frac{d\,t}{d\,v} = o$, and $m = o$—that is, the force of resistance m is a consequent of the accelerating force; so if there be no propelling force, there can be no mass or inertia—an evident absurdity.

Again, taking mass = inertia, we have

$$\begin{aligned} m &= \text{volume} \times \text{weight}, \\ &= \text{cubic space} \times \text{weight}, \\ &= \text{cubic space} \times \text{effect of gravity}. \end{aligned}$$

Consequently, where $F\frac{d\,t}{d\,v} = o$, the effect of gravity is *nil*. But we know that effects of gravity never are *nil*. These notable effects are produced by gravity—or a force we call gravity: (1) weight; (2) accelerated motion; (3) constant motion. An ounce and a pound of iron falling *in vacuo* will acquire the same velocity, although the weights are different. Water flowing under the action of gravity may have uniform velocity.

There is no equation extant expressing a general law from which these effects can be deduced. The equation given by Professor Lodge is for specific cases, just as Newton's three laws are, and are but anticipated deductions—excuse the expression—of some general law not yet discovered, and which probably lies hidden in molecular action.

Referring to the factor m, we find it cannot be resolved into mathematical elements like $v = s\,t$. It has an empirical character, and vitiates the equation as a true mathematical expression. It is an approximation sufficient for our requirements, but as such should be taught, and not as a general and absolute truth.

In the case of the horse *v.* cart — action and reaction being equal and opposite—it does not follow there cannot be motion; that would be a one-sided deduction. For where the reaction equals the sum of the resisting forces, including inertia, motion is just as possible as rest. For since a body in equilibrium in a state of rest possesses no functions to cause motion, it is equally true it possesses none to oppose motion. Therefore the tractive power of the horse being equal to the total resistance, including inertia, there can be motion, as there is nothing to prevent it. If there is, what is it? W. H. LONGMORE.

Leominster, March 25th.

SIR,—I had hoped on seeing Professor Lodge's paper on "Dynamics" that he would really clear away some of the difficulties of young people in that badly taught and little comprehended subject, but if he found confusion, I think he has left "confusion worse confounded" in its place. Now, Sir, I suppose Professor Lodge is willing to sit at the feet of Newton, the man of whom it is recorded in Trinity Chapel, that "he surpassed the human race in his intellect," for it was he who made dynamics possible to us. Taking that for granted, he sets out by totally disregarding Newton's definition of the word motion, which he gave thus:—"Change of motion is to mean rate of change of momentum"—or the amount of momentum added on to a body's momentum in a unit of time. Professor Lodge makes the, to my mind, great mistake of calling velocity motion, but there is no reason why we should not call acceleration motion.

I quite admit that half the difficulties of beginners in this subject are owing to their misapprehension of the terminology of it, and we teachers cannot be too careful how we use those terms. I would advise all learners to expunge the word motion absolutely from their vocabulary, so far as dynamics are concerned. Newton practically did so, for in his notable second law, having used the word motion, he immediately goes on to define the meaning to be attributed to it, and in its place gives terms about which no person need entertain the shadow of a doubt, since by definition momentum is simply the product of the number of units of mass of a body and the number of units of velocity with which it is moving.

In the next place, Professor Lodge fancifully divides the forces acting on a body into three families, named respectively, Force, Action, Reaction. I confess to only knowing one kind of force, and its definition is, I fear, a lame one, since it defines not what it is, but what it does. This definition runs thus:—"Force is that which moves or tends to move matter;" and why one part of the force acting on a body should be called a Force, and another part an Action, and a third a Reaction, I fail to see. The definition given above includes all equally well, and further, the acceleration of the mass is equally due to them all. In fact, the equation $m f = \lambda P$, which is the analytical expression of the second law—λ being a constant—takes no cognisance whatever of the distinctions between the parts of the resultant force which acts on the mass, and the symbol P is simply the resultant of all the forces which act on the mass m, provided only that f is its resultant acceleration.

Now to take the example which Professor Lodge cites of the horse and cart. People who entertain the well-worn Action and Reaction difficulty in that problem, forget some of the forces acting on the horse and cart. If we consider the mass of the horse separately, then the forces on the horse horizontally are the force which the cart exerts on him backwards, the force which the ground exerts on his hoofs forwards, and if the latter is equal to the former there will be no resultant horizontal force on the horse, and he will either remain at rest or will move with uniform velocity either backwards or forwards, according to which way he happens to be going at the instant when the horizontal force on him vanishes. Next, if we consider the mass of the cart separately, the horizontal forces on it are the force exerted on it by the horse forwards, the force exerted by the ground on the wheels backwards. But if we are to consider the horse and cart jointly as one mass, which we can clearly do, since they move with the same velocity or acceleration, as the case may be, then we have not to consider the force that the horse exerts on the cart or that the cart exerts on the horse, for these now become internal forces and not "impressed" or external forces to the mass considered, and we have as the forces acting on the mass—*i.e.*, the mass of the horse + the mass of the cart—horizontally, the force exerted by the ground on the horse forwards, and the force exerted by the ground on the wheels backwards, and the P which appears in the equation $m f = \lambda P$ will be the resultant of these forces, reckoned in the same direction as that in which the acceleration f is taken, m being the sum of the masses of the cart and horse. I find repeatedly with students, that they have great difficulty in distinguishing between external or impressed force and the forces between the different parts of the same mass, which, of course, cannot affect the velocity of acceleration of the centre of gravity of the whole mass. This difficulty will crop up again and again to the end of time, and in my opinion teachers do not direct sufficient effort to clearing away this particular fog.

"The momentum of a body means its velocity multiplied by its inertia or mass." These, Sir, are, perhaps, the most remarkable words in Professor Lodge's paper. At last we have the definition of the word inertia! According to Professor Lodge it is the same thing as mass! I should like to know then what the unit of inertia is? Now I confess to a great desire to expunge this word also from the science, for we do not need it. Professor Lodge can evidently do without it, I myself never met with the term used in a scientific sense until I read Dr.

Routh's most delightful treatise on "Rigid Dynamics," and there on page 2 you will see these words:—"If the mass of every particle of a material system be multiplied by the square of its distance from a straight line, the sum of the products so formed is called the moment of inertia of the system about that line."

Now if we are to attach the same meaning to the word moment here that one does in other scientific investigations, such as is meant by the moment of a force about a line or plane, or the moment of momentum about a line or plane, &c. . . then it is obvious that a "moment" is the product of some quantity and a line; hence by the above definition of "moment of inertia," inertia must be something of the nature of mass multiplied by a line, which does not agree with the idea that it is simply mass. The word inertia, however, is a mischievous one unless it be always written as a compound thus, "moment-of-inertia," and even then the three words taken together should only be considered as the name of the sum of those products quoted above from Dr. Routh's book.

Again, Professor Lodge says: "I call P − R the total impressed force F, and $m\frac{dv}{dt}$ the reaction." That $m\frac{dv}{dt}$ is equal numerically to the measure of the whole force on m in the direction of v I am quite ready to admit; but is the product of a mass and an acceleration a force? Perhaps Dr. Lodge would call this "quibbling about words," but I think we cannot be too careful in our use of words when dealing with an exact science, and it is simply absurd to say that a mass multiplied by an acceleration is a force.

In one of Professor Lodge's opinions I can entirely concur, and, in fact, I always tell my pupils the same thing, viz., that Newton's first law is entirely contained in the second. The second is

$$m\,dv = \lambda\,P\,dt; \text{ or}$$

$$\frac{m\,dv}{dt} = \lambda\,P.$$

If $P = o$, than $v = C$, a constant, which may or may not be zero; and there is no necessity for using the first law in arriving at this result.

One word, and I have done. Professor Lodge has invented still another term to bewilder the young, viz., mass-acceleration. What is this hybrid? We do not want it. JAMES LYON, B.A.,
Superintendent, Engineering Department,
Cambridge, March 24th. Cambridge University.

SIR,—It is a pity that the only result so far of my attempt to state certain mechanical ideas in new language is that I am regarded as an unbeliever in Newton, Mayer, Joule, Clerk-Maxwell, Rankine, Tait, and Thomson, one who should be handed over to the secular power under the writ *de heretico comburendo*. Whereas really the above named eminent men have no more docile disciple than myself, and all I want to do is to interpret their ideas. Two things, however, I do regard with jealousy. One is the increasing use of symbolic reasoning in physics, and the other is the attempt to include statics in dynamics. Applied mathematics are to physics very much what bookkeeping is to business. Pretty equations and a clean ledger are both attractive and agreeable things, but, &c. &c. Dynamics relate to force and motion, statics relate to force and stress. In problems of the former work is done, but not so in problems of the latter. The real working parts of a machine give dynamic problems, its other parts give static problems. To regard static problems as if they were balanced dynamic problems is pretty mathematics but bad physics—hence the confusion. Action and reaction is static as well as dynamic. It is the static aspect of it that presents difficulties to the student. —difficulties that my "right angled sliding action theory" surmounts. Professor Lodge deserves thanks for his clear and able dynamic paper, but I hope to try a fall with him on his statics soon. WM. MUIR.

9, Angel-place, Edmonton.
March 24th.

THE FRICTION OF SLIDE VALVES.

SIR,—I read with much interest your article on "The Friction of Slide Valves" in your issue of the 6th ult., because it has always seemed to me most desirable that something definite should be known as to the actual power absorbed in the actuation of them; and I hope that your remarks may prompt experiments which will throw light upon our darkness. It has often struck me as most curious that while valuable experiments have been made by the Royal Agricultural Society by means of the dynamometer—the only true test of efficiency in the steam engine—and when our coal is so rapidly being exhausted, no test of the same reliable character has been made in marine engines. It has always been an open question in my mind whether the present marine engine is as efficient as it might be, and whether the Corliss engine would not beat the compound if the two principles were properly tested from the same boiler and by the aid of the dynamometer. Such a trial as this would probably suggest further trials on the subject of loss by friction, in which the friction of the slide valve would not be likely to be overlooked. I fear the love of gain is the sole motive of our engineers, and that they all forget that gain is more likely to come to the truly scientific man than to the man who lives only by the ideas of others. But I have trespassed too much upon your patience, and so will say what more I wish to say with more brevity.

The subject of your leader of the 6th is, without doubt, most important, and if proof of this were asked it might be pointed out that a new slide valve, having for its object the great reduction of friction, was no doubt at the time your article was being written occupying the mind of Mr. Peck—see your journal of the 27th ult. Whatever may be said against this valve, it cannot be said that it does not reduce the friction in a very great degree.

The remarks of "Marine Engineer," as to the unequal wear to be anticipated in its use, are of value, but I have more than once found that imaginary imperfections were imaginary only, and in one important instance I found that an imaginary imperfection turned out to be a perfection, and saved the invention from damnation; so that without a trial I am slow to condemn. I could not understand the other arrangement spoken of in your notice of Mr. Peck's valve, but it appears to me that this other arrangement would not have suggested the remarks of "Marine Engineer." I should feel obliged to Mr. Peck if he would, by your permission, publish a sketch of it.

The test of the slide valve friction suggested by "Volvox"—see page 163—is, in my idea, excellent, and one or two experiments with it would be most interesting; but are there engineers who will try it, simple and valuable as it is? I doubt it! E. D.

March 23rd.

SMITH'S AND MARSHALL'S GLAND PACKING.

SIR,—We observe in your issue of yesterday's date an article on "Smith and Marshall's Gland Packing," and stating that it is being introduced by the above-named gentleman in Euston-road. Mr. Smith's connection with the patent ceased in December last, and a notification to that effect was published in the *Gazette*, and the title and address of the patentees and sole manufacturers of the packing you describe in your article is now "Marshall and Thunder," and lest the notice you kindly gave it should lead to confusion, we shall feel much obliged by your giving publicity to the fact. We have much pleasure in supplementing the information you gave. It is now in use on rods of 10in. diameter with 160 lb. pressure, and several locomotives, and in all cases has given unqualified satisfaction. Some of the first supplied have made already three voyages to Calcutta and back, and are as good as new.

121, Fenchurch-street, London, MARSHALL AND THUNDER.
March 21st.

BOILER FURNACES.

SIR,—In your issue of to-day appears a letter from Messrs. Hawksley, Wild, and Co., Sheffield, in answer to which I may just say, by way of explanation, that a paper which occupies one hour to read cannot be expected to appear in full in any engineering journal. The sentence to which they take exception appeared in your issue somewhat incomplete; it should have been: "When repairs are required necessitating the renewal of a full ring of plate and seam, the front end plate must be removed before furnaces can be drawn out." I admit Hawksley-Wild's patent flange can be repaired more readily than the Adamson flange or Bowling hoop, and, in my opinion, is a better construction throughout; but I fail to see how the entire furnace can be drawn out for renewal, or how the large rings can be renewed except by putting in, say, two or three plates to form a ring, or with a great amount of springing which boiler engineers would be likely to object to. With the cone furnace mentioned in my paper the entire furnace can be drawn out for renewal of any portion of it, or repairs to shell. As the Association of Employers and Foremen are having the paper published, I hope to forward a copy to Messrs. H. W. and Co. shortly.

I may just mention that in the conclusion of the report on my paper the word "theological" should have been "theoretical." S. BOSWELL.

Salford, March 21st.

TANKS FOR SUAKIM.

SIR,—Seeing a paragraph in your last issue, in which reference is made to the tanks made and fitted by a well-known firm to the steamer Woodcock for service at Suakim, and as the statement is calculated to mislead, I think, in fairness to myself and others, the actual facts should be known. The order for the tanks in question was given on the 28th of February, and instead of the whole being delivered and completed on the 14th of March, as stated, some of the tanks were not actually shipped till Thursday, the 19th of March, and the work was not completed till Saturday, the 21st inst., or exactly three weeks after receipt of order.

I may add, that I made and fitted the tanks to another vessel, the Camel, for the same service, the order being placed in my hands on the 16th of February, and the work was completed to the satisfaction of the Government Surveyors on the 2nd of March, just seven days less than the time taken for the Woodcock. The tanks in the Camel, moreover, were individually larger, and also were specially made to fit the vessel; they were also fitted with strong internal bulkheads, and with an elaborate arrangement of valves and pipes.

In the face of these facts, the makers of the Woodcock's tanks can scarcely claim any credit for having performed a particularly expeditious feat. JOHN BELLAMY.

Byng-street, Millwall, London,
March 25th.

RAILWAY SIGNALS.

SIR,—In reply to your correspondent, "North-Eastern Goods Driver," if he thinks that the above invention referred to by "Express Driver" is not a good one, if he will write to one of the patentees, Mr. Croft, 9, Charles-street, Eccles, he will forward to him or anyone else a diagram of the above patent, so that they can judge for themselves the merits of the same.

S. A. CROFT.

FEED-WATER FOR BOILERS.

SIR,—In following the interesting discussion now going on in your columns on the above important subject, I cannot discover that any of your correspondents have proposed anything more efficient or simple than Stollwerck's patent water purifying process, as described in your columns of the 18th July last year. I have since then had repeated opportunities of observing the excellent results obtained by this arrangement. A. B.

March 25th.

STEAMERS ON THE NILE.

THE chief engineer on the Yarrow stern-wheel steamer Lotus, who left Korti on the 17th ult., gives an account of the remarkable voyage of his vessel to that place from Semneh, which shows the fitness of this kind of craft for the navigation of a river so difficult and dangerous at all times, but especially when the stream is low, as the Nile. With a light draught of only 18in., a flat bottom, and stability gained by a breadth of beam—18ft.—proportionately great for her length, which is about 75ft., the boat passed without injury up the long and almost continuous series of rapids and cataracts between Semneh and Abu Fatmeh, a distance of over 200 miles by the river. What proved of greatest moment in the behaviour of the steamer was the rapidity with which she answered to the wheel and the action of the twin rudders. This perfect manageableness, which Mr. Stanley found in an equal degree in a Yarrow boat of the same type now running on the Congo, it will be readily understood is of the first importance in the navigation of a tortuous and swift stream with a rocky bed. The steersman placed forward on the over deck can, with a single turn of the wheel, so instantaneous is the action of the balance rudders, avoid a sunken rock, and it is noticeable that the good steering qualities of the boat are not less marked when the engines are reversed and she is going astern. If it is remembered that nearly all the steamers which have been wrecked on the Nile between Semneh and Khartoum have been lost in coming down stream, the value of these characteristics of the stern-wheel Yarrow steamers will be appreciated, for there can be little reason to hope that, even with high Nile, the dangers will be much diminished, although extreme lightness of draught may cease to be an essential condition.

The Lotus, or, as it was officially called, Yarrow boat No. 1, was sent out in sections or pieces of easily movable dimensions, the heaviest indivisible portion of the machinery being the large paddle-wheel shaft. This, which weighed about 6 cwt., had to be slung to poles between two camels when land transport became necessary. The difficulties of one kind and another proved so great, however, that it was decided to put the Waterlily, the second boat of this type, together at Alexandria. This was done under the superintendence of Mr. Broadmeir, one of Messrs. Yarrow's engineers, a young German, who has had some experience of these boats on South American rivers. He took the Waterlily to Wady Halfa, making the quickest run on record from Cairo to Assouan. The Nile was too low, however, for the steamer to pass the second cataract, and the Waterlily has since been employed in running between Wady Halfa and Philæ. The work of putting together the Lotus had been in part carried out, when the engineer in charge, Mr. C. C. Wigg, fell sick of gastric fever, and was invalided home. Mr. Broadmeir then directed the work on the Lotus until the boat was ready for the voyage. She was placed under the command of Lieutenant Stanhope, R.N., who had ten or a dozen blue-jackets with him, Mr. Broadmeir, two engineers, and four stokers. There were four Canadian voyageurs, of whom two left the boat at Dal. They also had the services at times of Nubian pilots. For fuel, wood was used, logs and old pieces of timber from wrecks of nuggars or other waste being picked up occasionally. There are large stores of coal at Assouan and at other points on the lower reaches of the Nile, but all the available transport service having been employed in the forwarding of ammunition, provender, and stores for the troops, the coal supplies were not accessible. It is intended to make arrangements for wood stations if the natives can be induced to bring wood suitable for fuel from the interior.

Leaving Semneh on January 2nd, the first serious difficulty was encountered at the succession of rapids forming the Ambigole Cataract, where the stream has a fall altogether of about 10ft., lengths of broken water intervening between the four gates, which have, one after another, to be passed through. Of these the last offered the most serious difficulties. The water, pouring over a rock near the middle of the river, has hollowed out a cravity in the rocks below, and over this hole, which has been deepened by the constant circular action of the pebbles, there is a strong whirlpool. Above this perilous spot ledges of rock jut out from the banks on either side, and between them the stream pours in a rushing torrent athwart the bed of the river. At first an attempt was made to pass up to the left of the whirlpool, 300 Egyptian soldiers, in equal parties on either bank, hauling at the hawsers, and the engines working with full steam on. When, however, the bows caught the full force of the cross current above the rock in mid-stream, the stern was swung round, and the vessel was saved only by instantaneous obedience to the reversed action of the wheel, which brought her astern and out of harm. It was then deemed advisable, in order to avoid risk of life, to take the crew off and to haul the vessel through without steam. Three hawsers were used, manned by 700 Egyptian soldiers. The three ropes broke at the critical moment, and for a few minutes the steamer was left at the mercy of the stream. At last she was got through in safety, and with but one dent, which was of no importance. Progress under such conditions was necessarily rather slow. They called at the military stations, of which there are twelve from Wady Halfa up to and including Dongola, taking instructions and occasionally stores. They had to stop whenever they saw a chance of obtaining any wood for fuel, and before it became suddenly dark, or about 6 o'clock in the evening, wherever they happened to be, they made fast to the bank for the night, starting again about eight in the morning. On January 12th they were at the Lower Tanjour cataract. This system of natural weirs has, like that of Ambigole, four gates or passable waterways in the successive ridges over which the river falls. They ran to bank, and examined what was literally the ground they had to get over, for there was very little water and a great deal of rock. Having decided upon their course, they got up steam and tried to take the first gate. They very nearly succeeded, but when halfway over they stuck, poised in the rapid, and had to fall back. Another hawser was run out, and a second rush proved successful. "The whole time we were passing this cataract," Mr. Broadmeir says, "it felt as if we were going overland, the steamer bumping and scraping on the stones for twenty minutes." How severe this trial of the strength of the boat was may be inferred from the fact that the floats of the wheel, which do not go so deep as the bottom of the hull by 4in., were actually knocked in towards the centre of the shaft to the extent of 3in. There were, as may be supposed, many dents, but there were no holes. A better proof of the wisdom of using a tough and elastic material like steel for vessels on this service, instead of wood, could scarcely be given. These long, light, shallow boats, with the weights of the machinery divided by placing the boilers in the fore part and the direct-acting engines near the wheel at the stern, are so braced by the use of steel rods to take any strain, after the method of constructing a suspension bridge, that it may be said Messrs. Yarrow have devised and perfected a marvel of lightness and strength.

The second and third gates in the Tanjour cataract were steamed through without trouble, but the fourth was a very nasty place, and two days were spent in preparing for the passage. At the second attempt they got through, and on January 16th found themselves in a wide reach of the Nile, locally known as the Bay of Tanjour. They had now been fifteen days in making about thirty miles. The owners of the few native boats which ply on the river at high Nile as far as Abu Fatmeh do not attempt to navigate the river at this season of the year. Taking in cargo and stores which had been brought round the cataracts on camels, they left Tanjour Bay on the 19th, and, passing the Akasha cataract easily, they ran, steaming hard all the time, up the series of rapids, about four miles long, called the Dal cataract, the bottom of the boat continually bumping on the rocks, and reached Upper Dal on the 20th. Five days later they steamed through the Kaibur and then through the Hannek cataracts with few noteworthy incidents. The latter is another succession of rapids about two miles in length, the last gate alone causing them any trouble. Twice they essayed to pass, and the third time they succeeded. At Abu Fatmeh, thirty miles above Kaibur, they reshipped the cargo and stores which had been brought on camels and by carriers from that place. Dongola—that is, the place marked on the map New Dongola, where the Mudir resides—was reached on January 31st, and on the afternoon of February 3rd they steamed up to Korti, towing a couple of whalers bringing provisions which they had picked up at Dongola. Lord Wolseley and many officers, with some 400 or 500 men, were on the river bank to see them come in, and naval officers who knew the difficulties of the undertaking expressed their surprise at the successful issue of the venture. After her arrival at Korti, the Lotus was at once employed to run regularly between Dongola and Korti, taking wounded down and bringing stores up. Although by specification the Lotus was only required to carry 25 tons of cargo, she has, in fact, been taking up loads of 46 tons, comprising grain, ammunition, and provisions. Towing at the same time a barge with 20 tons on board, she has proved her ability to maintain against the current a mean speed of seven to eight miles an hour, a highly satisfactory performance. Two of Mr. Cook's steamers having been wrecked, the Ghizeh at Tanjour and the Nasif Kheir at Abu Fatmeh, the Lotus is now the only steamer larger than a pinnace at Lord Wolseley's command, and in view of this fact it would seem to be making only necessary provision against contingencies to continue to push on as rapidly as possible the construction of additional steamers of this type which have been ordered. In Messrs. Yarrow's yard at Poplar there are being built five stern-wheel steamers, all larger than the Lotus. Of these there are two which have about twice the capacity of that vessel, and three having about 20 per cent. more carrying space. With s patriotic regard for the needs of the service Messrs. Yarrow have given the War-office authorities facilities for placing additional contracts in the hands of other firms for the construction of boats on the model of theirs, and Messrs. J. Elder and Co. have orders in hands for ten stern-wheel steamers of this type. The two larger boats which Messrs. Yarrow are building are so divided by transverse and longitudinal bulkheads as to have 26 water-tight compartments; the three smaller will each have 13 compartments. With a view to economising fuel, all five will be fitted with compound condensing engines. Mr. Broadmeir reports that the railway round the second cataract has been extended rather more than 20 miles beyond Sarras, past Ambigole, and to within about 20 miles of Akasha. Taking the distance by river from Semneh to Korti at 400 miles, it will be seen that the Lotus, all stoppages included, made on an average only about 13 miles a day, and this indicates sufficiently the present difficulties of steaming up the Nile.

DURHAM AND CHURCHILL'S PISTONS.—We are requested to state that the piston illustrated in our last impression, page 231, is supplied by Messrs. Durham and Churchill, 23, Leadenhall-street, E.C.

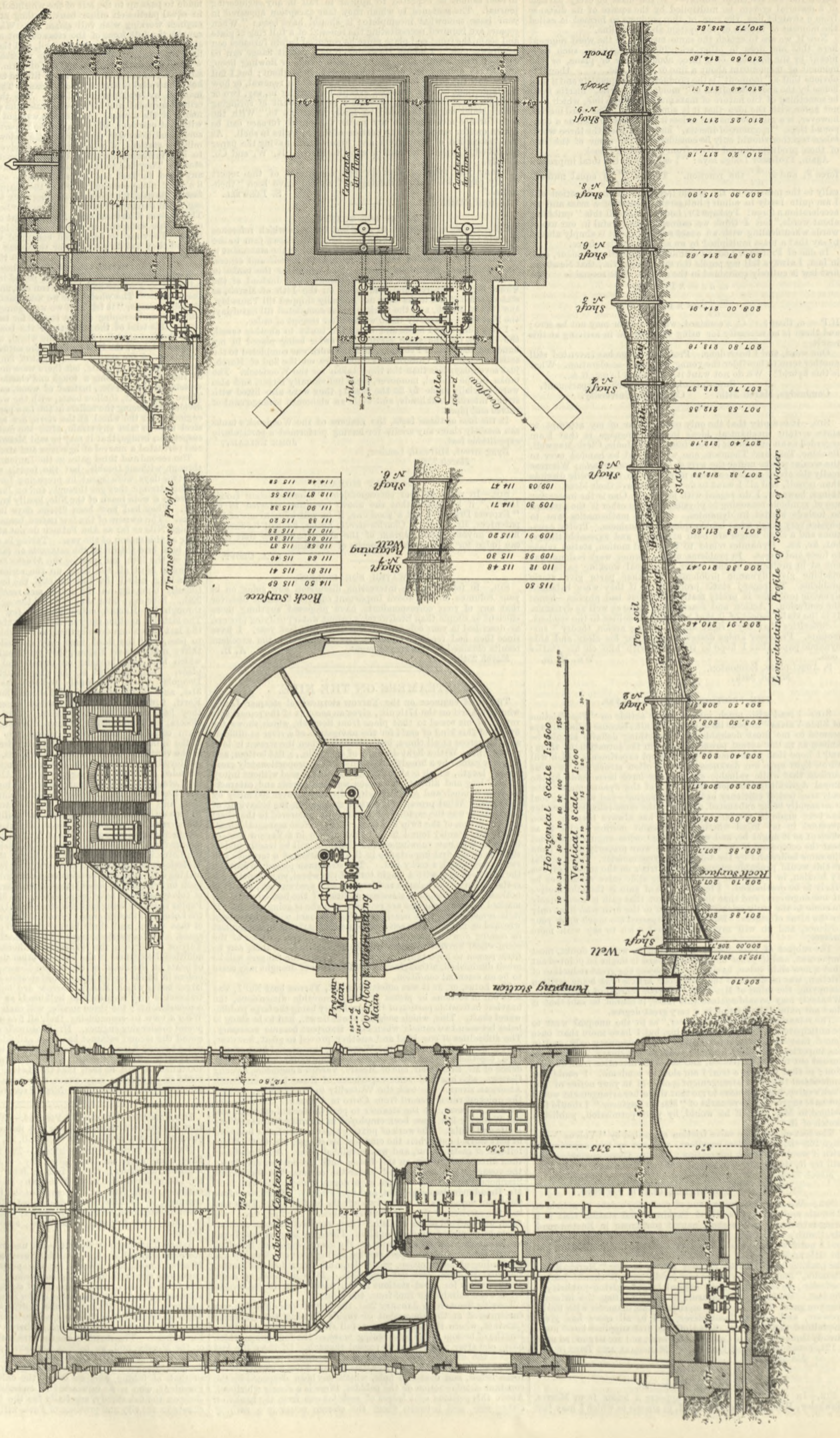
NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—John T. Harris, chief engineer, additional, to the Indus; John Pitt, chief engineer, to the Indus, for service in the Hyacinth; Frederick S. Turner, chief engineer, to the Nankin, for service in the Howe; William Milton, engineer, to the Asia, for service in the Calliope; William J. Black, assistant engineer, to the Polyphemus; George V. Cawley, George W. Noll, and Bertram J. R. Guise, assistant engineers, to the Tamar.

STEAM TRAWLING IN BRAZIL.—We understand that a concession has been granted by the Provincial Government of Para, Brazil, to Messrs. Castel and Pontet for the purpose of supplying this important city with fish. The concession, which is for a considerable term of years, involves the use of steam trawling vessels with necessary refrigerating apparatus of the most modern and improved quality. Captain Pontet, of the above-named firm, is now in England arranging matters, and we are informed that he has placed the order for his steamers with Messrs. Cochran and Co., of Birkenhead. The steamers are the first boats built for this purpose on the Mersey, and, we believe, the first vessels of the kind built of steel in England. It speaks well for the enterprise of the Provincial Government of Para to encourage an industry so important as that of fishing, and no doubt the enlightened policy of the President, who is so unwearied in endeavouring to increase and cheapen the fish supply, especially for the benefit of the working classes in the city and province of Para, will be highly appreciated,

THE REMSCHEID WATER WORKS—TOWER AND RESERVOIR.

HERR L. DISSELHOFF, ENGINEER.

(For description see page 238.)



PUBLISHER'S NOTICE.

*** *The Publisher begs to announce that next week* THE ENGINEER *will be published on* THURSDAY *instead of* GOOD FRIDAY. *Advertisements intended for that Number must be forwarded not later than Six o'clock on Wednesday evening.*

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.*

EXPANSION.—*The receiver has nothing to do with the matter, because the admission port to the low-pressure cylinder is always closed before the exhaust opens.*

VULCAN.—*The screwing mixture may be obtained of W. S. Astbury,* 104, *Corporation-street, Manchester. A reply has been sent to your address and returned by post.*

W. H. D.—*We are not aware of the existence of any book which tells directors how to cut down railway expenses. We can only advise you to consult with some competent and skilful traffic manager and locomotive superintendent.*

ERRATA.—THE ENGINEER *March 20th, p.* 224, *3rd paragraph, 2nd line, for "curvature a fourth dimension" read "curvature or fourth dimension;" 7th paragraph, 3rd line, for "connected with" read "converted into."*

TRICYCLE MAKING MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers give me the names of makers of a machine for grinding balls for bicycle bearings, and also a draw bench for spokes and vice for heading same? Had we sketches of these we might make them ourselves. TRICYCLE.

London, March 23rd.

GUTTA-PERCHA.

(*To the Editor of The Engineer.*)

SIR,—Will you permit me to inquire of your readers connected with telegraphy, whether the light specific gravity of gutta-percha is an advantage or disadvantage in submarine cables? Supposing all its other electrical and physical properties to remain unaltered, but its specific gravity to be slightly increased, so that it would just sink instead of just float in water, would it not, with the weight of the copper conductor added, enable deep-sea cables to be spun out, spider-like, from the sterns of ships, and their possibly shorter life from want of a protective sheathing, which also helps to sink them, be more than balanced by the absence of the cost of that sheathing?

What is the reason why gutta-percha bought in the shops usually sinks in water, although all text-books say that it but just floats in water? Indeed, in the good days of old, when gutta-percha was new to the public, and when incautious people with hot engine-rooms bought driving bands made of it, and when I, as a boy, bought gutta-percha balls, the substance floated in water, but now it sinks. Have the increased age, and presumably the increased gravity of the trees since then, anything to do with the increased gravity of their hydrocarbon product? The slender literature of gutta-percha throws no light on these scientific problems. A. B. C.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 31st, at 8 p.m.: Ordinary meeting. Paper to be further discussed, "The Electrical Regulation of the Speed of Steam Engines and of other Motors for Driving Dynamos," by Mr. Peter William Willans.

CHEMICAL SOCIETY.—Monday, March 30th, at 8 p.m.: Anniversary meeting. Election of office bearers and Council. Thursday, April 2nd, at 8 p.m.: Ordinary meeting.

THE ENGINEER.

MARCH 27, 1885.

THE INVENTIONS EXHIBITION.

IT has been finally decided that the International Inventions Exhibition will open on Monday, the 4th of May. The interval between this day and that would appear to be all too short to permit chaos to be reduced to order; but it is always the rule at exhibitions to drive everything off to the last, and there is no reason to conclude that this will supply an exception to the general practice. Indeed, chaos has not yet commenced at South Kensington. The buildings and gardens are being cleaned and put in order; but the exhibitors have made no sign, if we except Mr. Webb, of Crewe, who has got the most powerful compound locomotive yet built, the Dreadnought, in place in the main hall, about one-third of the length of the building from the principal entrance. The engine stands on a couple of lengths of rails supported on Mr. Webb's patent wrought iron sleepers. Close by, the foundations are being got in for a horizontal engine by Messrs. Adamson, of Hyde, Manchester. A few show cases are being put up, and this seems to be about all that has yet been done by exhibitors. This main or south gallery has been really doubled in width, and practically trebled. The portion occupied last year by the working dairies and dining rooms is now thrown open to the main gallery, and on the garden side of this last a new gallery has been constructed. The improvement in appearance is very marked. The main gallery looked at all times too narrow and cramped. The three galleries together side by side form a really imposing structure of great area. Along the centre line of the new gallery iron columns are being put up to carry a line of shafting, for one of the most valuable features of the exhibition will be the large quantity of machinery shown in motion.

The electric light will be used more extensively than ever, and to the almost total exclusion of gas. The additional space to be lighted will demand more lamps, both arc and incandescent; and besides this the oil lamps which have hitherto been used to decorate the gardens at night will be superseded by incandescent lights. The total power required will exceed 2000-H.P. indicated. Mr. Gooch is now actively engaged with his assistant, Mr. Schultz, in carrying out the necessary alterations. The Paxman engines used last year will be retained. The two double-cylinder horizontal engines, one indicating 340-H.P. and the other 360-H.P. remain in the same positions as those occupied last year. The compound engine has been turned at right angles to its former position, and some modifications will be made in the position of the shafting. Additional boilers are being supplied by Messrs. Davey, Paxman, and Co., of Colchester, and the concrete foundations for them are well forward. The whole of the steam plant is being overhauled, refitted, and cleaned, under the direction of Mr. J. Hammond, Messrs. Davey, Paxman, and Co.'s representative. The new boilers are intended to supply steam to a number of high-speed engines, which will constitute one of the most interesting features of the Exhibition. These engines will all be coupled direct to dynamos. They will be by Mr. Willans, Mr. Westinghouse, the Coalbrookdale Company, Messrs. Armington and Sims, Mr. Brotherhood, Messrs. Elwell, Parker, and Co., the Hon. R. Parsons, and Mr. Towers. It is intended to carry out competitive trials of these engines during the Exhibition, to test them for economy. They will, of course, be tested to some extent for durability as well.

The water arrangements will be modified and, it is hoped, improved, though it is difficult to see how Col. Sir Francis Bolton can improve on the beautiful display of last year. Several new buildings, mostly, however, of small size—if we except a concert room—are being put up. At the present moment, however, it is impossible to have an adequate idea of what the Exhibition will be like. "Old London" remains, and the whole of it has, we understand, been taken by a group of exhibitors whose specialities are art workmanship in plate and metal of various kinds, so that this section of the Exhibition will be as attractive as ever. New brick pathways are being laid down in the street and certain improvements of various kinds are being carried out. The Albert Hall will not, we believe, be included in the Exhibition this year; last year it performed the part of white elephant to admiration—its special *rôle*, we need scarcely observe. That the Exhibition of Inventions will be a great success there is no possible reason to doubt. There were at least eight times as many applications for space as could be entertained in the first instance; and even after these had been carefully and judiciously weeded, there remained enough to fill twice the space available. It is to be regretted that a few important firms, finding that they could not obtain as much room as they wished for, have withdrawn, and will not exhibit at all; but this was to a large extent unavoidable. The public are promised more attractions than ever, both within and without the buildings, and nothing is wanted to render it even more popular than Exhibitions that have gone before, save fine weather.

The Metropolitan District Railway Company is pushing on rapidly with the subway from South Kensington Station to the Exhibition. This subway will be entered direct from the station. It will run for a short distance parallel with the railway, and then turn sharp to the left up Exhibition-road. The notion of a narrow passage is often associated with the word subway, but this will really be a covered footway, wide enough to permit two vehicles to pass each other, and lined with white glazed bricks. It is so nearly complete that the roadway is being rapidly re-made over it for a considerable distance, and it will no doubt be quite ready for use by the 1st of May.

THE OFFICIAL EXAMINATION OF PATENTS.

UNDER the patent laws existing previous to Mr. Chamberlain's Act, the provision for the official examination of patents applied for was a dead letter; and intending patentees or their agents, had to make personal search in order to ascertain with some accuracy whether their inventions were distinct from those for which patents had already been granted. The new law of 1883 has altered this, and given vitality to the system of official examination. Doubtless such an examination is right in principle; indeed, it is a logical and necessary consequence of any legislation having for its object the granting of monopolies; for if a monopoly in the sale of a specific article is granted to A. to-day, a granting, or rather an attempt to grant B. a monopoly of the same to-morrow stultifies the whole affair. Unfortunately, however, here, as in many other mundane affairs, while the principle is excellent, its practical application is not easy; neither do the examiners appear as yet to have succeeded even in applying it as well as is possible. In two essential points they need to improve their procedure. In the first of these, namely, their interpretation of claims, they seem to be in danger of confounding their functions as judges of mechanical construction with those of the judges of law. With the latter, so far as we can perceive, they have nothing to do. As we interpret the new Act, the sole business of the official examiners is to see that patents are not, as it were, granted in duplicate; and if our interpretation is correct, they have simply to notify to any applicant for a patent that which indeed they do, viz., either that his application has been granted, or else that his proposed patent infringes that of another. If the examiners stopped here all would be well, but they do not stop here; they, as a correspondent lately pointed out, take upon themselves to alter claims, indicating to the individual exactly the claims he must make. No one but the intending patentee can, save in cases of exceptional simplicity, perfectly comprehend the exact working of an invention till he explains it and illustrates it more fully than it is usually possible to do in a patent specification; and the alteration in the wording of a claim demanded by an Examiner may destroy the entire principle of the scheme. Examiners not only may, but should, examine for priority; but they will and do altogether mistake their functions when they send draughted claims to inventors to sign. Besides the inappropriateness of such a course, what benefit is given to the inventor? Examiners are not as a body a tribunal empowered to decide disputed points of law. The claims they draught for a patentee to sign will not prevent subsequent law proceedings arising out of disputes, nor influence the decision of the presiding judge. Another point connected with the new system of examination which may well form a ground of complaint against it is the often contradictory action of the Examiners. On the one hand, Mr. Chamberlain's Act and its interpretation draws a very hard-and-fast line, regulating, or, to be more correct, attempting to regulate, distinct inventions; while on the other, the cases are, we believe, frequent where the Examiners report that A.'s proposed patent appears to them to be the same as one granted to B. Now, if both these specifications were submitted to an unofficial expert mechanic, or expert in the subject dealt with in them, his decision might just reverse that of the Examiners. If the Examiners content themselves with reporting, they do some good; they have spared the patentee or his agent the trouble of making searches themselves, and so far save him expense; beyond this neither they nor the Comptroller have any jurisdiction; the cut-and-dry claims sent to a patentee are altogether valueless in a court of law.

The question of what constitutes distinctness of invention has always been vexed; but the action of the official Examiners appears likely to increase grounds of litigation greatly. On the one hand, as we have observed, they report that one application appears similar to another already granted; on the other hand, they will report of another specification that, in their opinion, it contains, not one, but two distinct patents. Either of these reports might be cited—at all events, unofficially—in a court of law as evidence for or against infringement actions. We are of opinion that if Examiners through the Comptroller have power to reject an application, on the ground that more than one invention is described, as well as to warn an applicant that his specification infringes that of another, they should frame some general rules as to what in their opinion constitutes distinctness or similarity, as a sort of guide for patent agents and inventors. Thus, for example, they might rule that the reciprocating of a piston, valve, or other part, if effected by a rocking crank, would be deemed a distinct invention from that wherein the same reciprocation was effected by a shorter crank set into rotation. But these rules should form the basis of the Examiner's own judgment also. If Examiners lay down certain rules for framing claims, as they have been attempting to do, in order to be consistent, and to gain respect for their reports, they must themselves work to rule also. As it is, inventors have reasonable ground for suspecting that the answers to either of the two highly important questions—(1) What constitutes infringement? (2) What constitutes a single invention, and for what must more than one patent be sought?—depends very much upon the individual opinion of the particular Examiner handling the subject. In the former of these cases, unless the infringement be very obvious, the patent will be probably granted with the previous caution; in the latter case the applicant may be absolutely refused a patent, save for either of the parts of his specification adjudged by the Examiner to be distinct. The Patent-office authorities themselves by amending claims tacitly admit the possibility of framing rules on which to base judgments.

Another point in the administration of the new patent law greatly needs amendment, namely, the long delays between the lodgment of applications and the reports of the Examiners thereon. When first published, every one thought that under the new Act a patentee would enjoy an entire year of provisional protection wherein to perfect his invention, but a perusal of its clauses soon showed that the net useful period of protection at best was but about eight instead of twelve months. At the expiration, or before it, of nine months, the complete specification must be lodged. Now, however fit and reasonable such a condition may appear to legal minds, common-place laymen may naturally ask what earthly use is there in the odd three months? If the final is not lodged before the end of the ninth, the patent is lost at the end of the year; and, on the other hand, if the final is lodged in time and the patent granted, the greater, as every mathematician knows, includes the less, and three months are wasted. It is, therefore, absurd to any but the official mind to tell an inventor he is safe for a year. The clause in the Bill enacting that the duration of the patent shall date from day of application is also contradictory of the clause granting twelve months' protection; it is only under very exceptional circumstances indeed that Acts of Parliament are made retrospective; but the granting a man protection a month or two months after he has asked for it is essentially retrospective. During the time the authorities are deciding whether he ought to have a patent or not, he can do nothing with his invention. Under the old law he was put out of doubt in about a fortnight. Three times that period is now absorbed. This delay is a decided hardship on an inventor, for he can do nothing safely after he has lodged his application; he knows not what alteration, emendation, or so forth, the examiners may demand. There is no reason, save securing priority, for dating the patent from the day of application; and, so far as the interests of those in whose behoof the Act was framed are concerned, there are the reasons above given against it. The inventor might, at all events, be given the option of choosing the date of his patent. But the evil does not end here. It is ruled that if the applicant does not receive any notification within twelve months from the date of his application, he may deem that it has been rejected. The words of the Act are, Clause 4, Section 9:—"Unless a complete specification has been accepted within twelve months from the date of application, then—save in the case of an appeal having been lodged against the refusal to accept—the application shall, at the expiration of these twelve months, become void." Therefore, if an inventor lodge an application for a complete patent in the first instance, he may remain an entire year in ignorance as to whether his application will be granted or not, and during the whole of that time his invention will be useless to him. This is certainly taking away with one hand that which was given by the other. Under the old Act three years' protection were given without any material delay; under the new, it is possible that the whole of the additional year conceded by it may be lost to the inventor. Under the circumstances, the wisest course for the intending patentee is to apply for a provisional protection, and if he be not ready to apply for his final, he can simply, before the expiration of the nine months, lodge a fresh application for another provisional. In this way he gets eighteen months' protection for two pounds. This has been done under the old Act, and the new contains nothing contrary to a continuance of the practice.

METEOROLOGICAL PROGRESS.

THE annual report of the Meteorological Council, addressed to the Royal Society, comes rather late to hand, nearly eleven months being consumed in making up the history of the previous year. We presume this is unavoidable, and that on the whole there is a substantial equivalent for the time consumed. The information collected from the logs, prepared by ships' officers, necessarily reaches England considerably after date. The investigation of the weather over the North Atlantic is an extensive affair, the data for a period of thirteen months being contained in 10,502 forms received from 2563 ships. A reduced copy of one of the charts thus prepared is given in the report, furnishing various particulars as to wind, weather, and barometric indications, while another chart for the same date gives air and sea temperature as well as the weather. The charts for the month of August, although limited to the Atlantic, are founded on as many as 80,000 observations. The Indian and Pacific Oceans are also under surveillance, though not with the same minuteness as the North Atlantic. The Meteorological Council likewise have an eye on the Arctic regions, and there is a Circumpolar Committee engaged in the discussion of a mass of observations relative to meteorology and magnetism. The weather forecasts are said to exhibit an increased measure of success, fulfilment being claimed in 81 per cent. of the predictions, as compared with 79 per cent. in the year preceding. The greatest proportion of successful forecasts occurs in the Eastern Counties and the South of England. Agricultural interests are consulted in the shape of "hay harvest forecasts." In some districts these have been very satisfactory, and on the whole they have answered well. Actual storm warnings form another feature, and these are a little unlucky. The warnings have been justified by the event three times out of four, and in some years the proportion has been higher. A sudden and severe storm in the North Sea was not anticipated, and we think there are reasons for the oversight. The conditions under which it occurred are said to have been "very unusual," but we fear that even under ordinary circumstances an easterly gale, with a touch of north about it, is not to be easily foreseen. Observations on Ben Nevis, 4000ft. above the sea, carry us into the upper regions. Another mode of approaching the heavens is afforded by the skill of the artillerist, and we find Captain Andrew Noble desiring a bombardment of the higher strata of the atmosphere, the explosion of shells being employed to detect the course of elevated currents.

Coming down to earth again, we are introduced to an "inquiry into the causes and prevalence of London fog." Here the men of science have been baffled by the circumstance that of late the London fogs, with rare exceptions, have modestly declined to be interviewed. Nevertheless, we learn from the researches of Dr. Russell, extending over a period of two years and a-half, that during the prevalence of a fog there is a great increase in the amount of carbonic acid in the metropolitan atmosphere. The average proportion of carbonic acid present in the air of London is slightly below four parts in 10,000, and it is singular that this is rather less than the proportion found in the air of the few other towns where observations have been taken. Pure country air has three parts of carbonic acid in 10,000, so that under ordinary circumstances London is not much worse than the country in this particular. But when the fog comes the case is altered. The average then reaches 7·2 parts of carbonic acid, and this was very nearly doubled during a protracted fog in December, 1882. With the disappearance of the fog, the amount of carbonic acid speedily declines. On bright summer days this gas falls to a minimum, the lowest point on record being reached on the Bank Holiday in August, 1883. This was no mere casual coincidence, for we are told that the amount of carbonic acid in the air of London is always considerably below the average on a Bank Holiday. Hence a sanitary virtue attaches to this modern institution. We should presume that the same result would be generally exhibited on a Sunday. It is important to observe that the variation in the quantity of this gas must indicate corresponding fluctuations in the amount of many other impurities in the air. London rain, as well as fog, has been placed under examination. The amount of sulphates and chlorides in the rain has been determined, and the average serves to show that the rain of the central part contains twice as much impurity as that of the suburbs. Of course the impurities in the rain, as found in the samples collected, have been washed out of the atmosphere. Wet days in London are not pleasant, but it is satisfactory to know that they make the air the sweeter. So also it appears that a suburban residence has some sanitary advantage. We should add, that the moisture of air condensed by the application of cold is found to contain impurities similar to those of rain. It is interesting to know—and to some people the knowledge may be serviceable—that at Kew there is a greater chance of rain in the afternoon than in the early morning or during the night. This is not a general rule, for at Valencia the minimum of rainfall occurs about three o'clock in the afternoon.

A curious chapter in the Meteorological Report is that which has reference to the "Krakatoa wave." It is stated that on the receipt at the office in September, 1883, of the photographic records for the latter part of August, it was noticed that at all the observatories, without exception, peculiar barometrical disturbances had occurred during the last five days in the month. These disturbances were nearly simultaneous, and were unaccompanied by any change of weather. The daily curves published by the Brussels Observatory showed a similar state of things, and on inquiry it was found that the barometric records at St. Petersburg on the east, as well as Coimbra on the south-west, displayed the same results. A careful consideration of the data led to the conclusion that a connection existed between the violent eruption of Krakatoa in the Straits of Sunda on August 26th and 27th, and the oscillations of barometrical pressure in Europe. The explanation given by General Strachey, and now accepted as correct, was that the phenomenon was produced by the passage round the earth of a series of concentric aerial waves, travelling at the rate of nearly 700 miles an hour from the scene of the eruption, and returning in the opposite direction, after having met at the antipodes of Krakatoa. Also that a succession of such waves was three or four times repeated. Records obtained from stations in various parts of the world were found to confirm this hypothesis, and we are promised something further on the subject. It is a marvellous testimony to the tremendous nature of this volcanic outbreak, that it should have affected the atmosphere over what appears to have been the entire surface of the globe. The fact may be taken as correlative to the abnormal tints of sunset and sunrise which for a considerable length of time attracted notice in various parts of the world. The alliance which is found to exist between phenomena apparently distinct and remote from each other gives especial interest to physical research. That unwonted hues in a British sunset should be kindled by a volcano on the coast of Java sounds like a romance, but is made to appear as a sober reality. Meteorology is a wide-spreading science. There is some sort of weather everywhere, and the weather affects everybody. The difficulty has been to deduce general principles from the myriad of facts ever presenting themselves. We are getting on by degrees, and by piecing our knowledge together we may hope to make an ever-increasing total. That the science of meteorology in its practical aspect has proved worthy of regard in the estimation of ordinary people, is shown by the conduct of the fishermen at Hull, Scarborough, and other places on the north-east coast, who refused to go to sea on a recent occasion, and kept their fleet idle because of a weather telegram from America predicting a storm. That weather forecasts have saved lives and property need not be questioned, though the forecasts may sometimes fail. Meteorological science may go on to win fresh conquests, and certainly the field is a large one. We should like to know a little more as to the apparent connection between the display of the aurora borealis and the fall in temperature which generally follows. There was a brilliant exhibition of this beautiful phenomenon at Kirkwall on the evening of Sunday, the 15th inst. A week later, a snowstorm of unexampled severity swept over a great part of England, and extended to France. If in the midst of the mildest weather of early spring, when we are dreaming of summer rather than of winter, the Northern Lights make their appearance, we may rest assured that there is a cold "snap" coming on. The rosy flush, streaked with gold and emerald, is a trustworthy token of something at the back of the north wind.

HOUSE-TO-HOUSE ELECTRIC LIGHTING.

WITHOUT entering now upon the question of how far the Act of 1882 has or has not checked the development of electric lighting in this country, we may yet notice a movement which is now proceeding to effect substantial alterations in that statute. Finding that there was extensive dissatisfaction with the measure passed three sessions ago—and possibly also feeling that the hopes created by that Act had not been realised—the President of the Board of Trade suggested the formation of a Committee to take the matter in hand, to prepare amendments to the Act, and to confer with him upon the subject. A Committee, with Lord Thurlow as chairman, was thereupon constituted, and they have just completed a draft Bill embodying their views and proposals. Their general object is to amend the Electric Lighting Act, 1882, in such manner as to place electric lighting undertakings in the same position in regard to privileges and obligations as gas supplying concerns. They propose, first, that where electricity is not ascertained by meter the consumer shall not use any lamp which has not been approved, if not supplied by the producers, or any lamp which is calculated to expend more electricity than the consumer has contracted to pay for. Then they seek to repeal section 27 of the Act by which, after the expiration of twenty-one years, local authorities may purchase an electric undertaking on paying the then value of all suitable lands, buildings, works, &c., of the undertaking without any addition in price on account of compulsory purchase, good-will, or profits. The profits of an undertaking are limited to the rate prescribed by the Provisional Order or Special Act, or where no rate is prescribed, to 10 per cent. per annum. The principle whereby dividends are increased or diminished in inverse ratio to increase or diminution of price is introduced on the method of the sliding scale applied to gas undertakings, except that, having regard to the small price charged per electrical unit as compared with the price charged for 1000 cubic feet of gas, the dividend is increased or reduced by 5s. per £100 in respect of every ¼d. instead of 1d. as in the case of gas. Other provisoes are that new or additional capital shall be offered to the public by auction in accordance with the usual auction clauses applied to gas undertakings; that the undertakers shall furnish a sufficient supply of electricity to owners or occupiers within twenty-five yards of the main; that they shall supply electricity for public lamps; that they shall keep the mains fully supplied; that penalties similar to those under the Gas Acts shall be imposed for default by the undertakers; and that local authorities shall have similar powers of acquisition by agreement to those given in regard to gas undertakings by the Public Health Act of 1875. In support of these proposals—to which, of course, Mr. Chamberlain will have something to say—the Committee quote Mr. Preece, the eminent electrician of the Post-office, to show what great advance America has made in electric lighting, as well for private as for public purposes. They point out that electric lighting has been highly successful here for lighting ships, especially those of the Royal Navy, and they show that, owing to the restrictions laid down in the Act of 1882, those who obtained provisional orders, and spent many thousands of pounds in the expectation of establishing valuable undertakings, have been unable to carry out their intentions, and so there is not even yet a single central station in operation in London, or in any of the large towns in the United Kingdom, to furnish a house-to-house supply, as is done on an extensive scale in America.

A FREE GIFT OF A WEEK'S WORK.

AN incident altogether unparalleled in the iron trade, and, so far as we know, in any branch of English industry, is reported by our Sheffield correspondent. Messrs. William Cooke and Co., of the Tinsley Iron, Steel, and Wire Works, have from 120 to 150 puddlers and millmen in their employ. Their wages are governed by the South Staffordshire Board of Conciliation and Arbitration, and the men are therefore powerless to grant any concession in the way of wages reduction, even if the employers were to demand it. Some six years ago an attempt was made to compel a reduction at these works, and the result was a strike, during which feeling ran so high that one workman who would not go with the majority had his hand chopped off with a butcher's cleaver. A very different feeling prevails among the workmen now. On Monday they held a meeting, at which they calmly considered the condition of the iron trade, with special reference to the position of the company in whose service they were engaged. Fully realising the extraordinary hardness of the times, they regretted they were not in a position to take action except in one way, and that was to offer the company the free gift of a week's work. This decision was arrived at from a conscientious feeling that it was their duty to do something to assist their employers in tiding over the time of depression. The manager, Mr. Thomas Wilkinson, was startled by the offer, which was conveyed to him by a deputation representing the workmen. He very properly told them that the money value of the offer, though that was considerable, was nothing compared to the nobility of the spirit which it indicated. So long as such a feeling of sympathy and interest was shown by the employés, the company—he felt—must surmount all difficulties which seasons of adversity brought upon them. The incident has created much interest everywhere in industrial circles. Not only is the offer absolutely novel, but puddlers and millmen are among the last class from whom such an offer would be expected. None of England's toiling millions work harder than they do. In front of the furnace, the very breath of which would slay ordinary mortals, they stand for eight and nine hours, the sweat exuding all over their bodies, for some 5s. 6d. a day. How they bear the heat passes comprehension. Winter or summer they are condemned to these fiery prisons of theirs, labouring with little more about their bodies than the full uniform of one of the Mahdi's soldiers. These men rarely get credit for considerate conduct, and it has been left for them—perhaps the least thought of in the great army of workers—to show an example of self-sacrifice and generosity to the rest. Their offer is all the more commendable as it comes at a time when they are themselves pinched by want. Recently they have had no more than three days' work a week, and they have therefore no superfluous cash to justify them casting away a week's wage with a light heart. May the long lane soon show a turning, and men of this stamp be early rewarded for doing what they could in the time of trial.

SLIDING SCALES IN IRON MINING.

THE notice to terminate the sliding scale in the Cleveland iron mining industry is not due to discontent with the sliding scale system, but it is due to a desire on the part of both parties to it to improve that scale. During the period of the currency of the three scales in the industry, there have been very many fluctuations in wages both upwards and downwards, but in all cases the parties concerned have willingly accepted the award that flowed from the accountants' figures; and there has been a large number of local reductions and increases of wages, so that the fluctuations in the market and in the price of iron have been from time to time adjusted to the rates, or rather the wages have been made to follow, both in local matters and in the general mining rates, the course of the trade so far as it has affected the prices. In no industry has the fluctuation of price led to such willing acquiescence in the adjustment of wages thereto as in the Cleveland iron mining industry, and therefore it may be fairly hoped that the renewal of the scale in some modified form is a matter of certainty. The period during which the three scales in the iron mining industry have been in operation has been amongst the most eventful in the history of that trade in the North of England; the labour employed in it is often recruited from those not very skilled or highly educated; and thus the fact that there has been so marked a success, and that there are to be negotiations for the formation of another scale, is one of the most telling of the testimonies to the value of the system, and to its adaptability to many industries. It is somewhat singular that whilst in the coal trade many districts have followed Durham in adopting the sliding scale system, there has been, as far as we know, no attempt to introduce the sliding scale system into any other of the large iron mining districts; but it is probable that in the future there may be a change in this respect.

SUBSTITUTES FOR HARD WOOD.

THE enormous advance which has of late taken place in the price of some of the hard woods required in various special branches of trade has directed attention to the possibility of producing some less expensive material as a substitute, and in one branch of trade this has been carried out with very successful results. For the manufacture of loom shuttles boxwood has hitherto been very largely used, but the price of this description of wood has become almost prohibitive, and it has been found that by the compression of cheaper classes of timber—teak being about the most suitable for this purpose—a substitute meeting all the requirements can be obtained. For carrying out this process, Sir Joseph Whitworth and Co., of Manchester, have just completed for Mr. Robert Pickles, of Burnley, a powerful hydraulic press to be used in compressing timber for loom shuttles. This press consists of a strong cast iron top and bottom, with four steel columns and steel cylinder, with a large ram. In the centre of this ram is fitted a smaller ram, with a rectangular head, fitting into a die which is placed on the top of the large ram. The timber is put into this die, and a pressure of 14 tons per square inch is applied. The pressure is then relieved, and the large ram descends. The top pressure block, which fits the die, is then removed, and the small ram rising pushes the timber out at the top of the die. The timber so treated is made very dense and uniform, and so close grained that it is capable of taking a very high finish. For the manufacture of shuttles it has been found as good as box wood, and there is no doubt that a similar process might be applied with advantage to other branches of industry where expensive hard woods have to be used.

LITERATURE.

Report on the Manufacture of Coke. By J. D. WEEKS. New York: Williams. 1885.

THIS is one of the special reports published in connection with the United States Census of 1880, and contains complete statistics of the production of coke during that year, together with such information descriptive of the works, of the raw materials used, and of the labour employed, as could be obtained in addition. From the general abstract given on page 3 of the Report, the following statistics are taken:—

Number of coke works in Census year 1879-80		127
Total capital invested...	(dols.)	4,769,858
Total number of ovens built, May 31, 1880 ...		10,116
Ditto ditto building, ditto		2,163
Total number of hands employed, ditto... ...		3,140
Total wages paid...	(dols.)	1,197,744
Value of materials used	(„)	2,995,441
Tons of coal used...		4,360,110
Value of ditto	(dols.)	2,761,657
Tons of coke produced		2,752,475
Value of ditto	(dols.)	5,359,489
Acres of coal land connected with coke works		140,922
Capital invested in working coking coals	(dols.)	10,903,531

The average value of coke per ton at the ovens was therefore 1·94 dols. (8s. 1d.) per ton, and as the yield on the coal carbonised 63·1 per cent.; or 1·58 tons of coal were required to produce a ton of coke, the average cost of the coal in a ton of coke would be about 4s. 2d.

Having regard to the enormous extent of the United States coal-fields, the area within which coking is carried on is extremely restricted, the coke-producing belt being substantially synonymous with the bituminous coal measures of the Appalachian chain. Beginning very nearly at the extreme northern point of the Allegheny Mountains in Pennsylvania, the coke ovens follow this range of the Appalachians nearly to their southern limits at Huntsville, Alabama, a distance of about 750 miles, the production of localities outside of this line having been, in 1880, less than 1 per cent. of the total. The distribution of the works is, however, very unequal; for by far the greatest development of the manufacture is in the Connellsville region of Western Pennsylvania—a small trough fifty or sixty miles long, and about three miles wide—69 per cent. of the total make of the year having been produced in that region. The subsequent increase has been very great, and it is estimated that at the present time the number of ovens is now 9000. The coal from which the Connellsville coke is made is got from the Pittsburg seam, which is from 8ft. to 18ft. thick, with only one small shale parting. It is very regularly bedded, and can be easily dug at a cost of about a shilling a ton, the average output per man being from eight to ten tons daily. The coke produced is of silvery lustre, cellular, with a metallic ring, and capable of bearing a heavy burden in the furnace. The bee-hive oven is exclusively used, the average time of burning being 48 hours—though 24-hour coke is sometimes made—and 72 hours for that left over Sundays. The latter is denser, but it is doubtful if it is better furnace fuel than that coked in the shorter period.

Next in importance to Connellsville is the Allegheny region. Here the coals are somewhat drier, and the three methods of open heaps, bee-hive, and Belgian ovens are in use. Third in order comes the New River coal-field in Western Virginia, which extends for about eighty miles through one of the most picturesque regions of the Appalachian chain, and is traversed by the Chesapeake and Ohio Railway. This valley has, since the date of the Report, become an important iron-producing district.

In the Western States, coking coals of cretaceous or tertiary age are found in Colorado, at El Moro, near the New Mexico boundary line, in a basin about eighty miles long and ten miles broad. These have, since the author's Report, been largely developed, and produce the greater part of the fuel used at the Leadville, Pueblo, and Denver smelting works. Another interesting discovery of the same kind has been made at Crested Butte, high up in the Elk range of the Rocky Mountains, where coke of a very high quality is made from cretaceous coal. The same coal is, within a very short distance, transformed into a dense anthracite.

The second half of the Report, dealing with the details of manufacture, gives a review of the coking processes followed in Europe, a chapter on coal washing, including some valuable detailed drawings of jigging machinery used in America, and another on coke burning proper, with drawings of plant. These are mostly from European sources, those of American ovens being mainly a very simple bee-hive type. The question of the utilisation of the waste products of coke ovens does not seem as yet to have been studied to any great extent in America, and the author's references to the subject only come down to 1882, concluding with a description of the Carvès oven.

EXPERIMENTS WITH A CORLISS ENGINE AT CREUSOT.

(*Continued from page* 218.)

M. DELAFOND proceeds to show that the results of these experiments prove that steam behaves very differently in the cylinder of an engine from the way in which it would behave in a non-conducting vessel, and he goes on to consider what actually took place in the cylinder of the Creusot engine. We have to ascertain (1) what was, in each experiment, the amount of condensation during the period of admission, and (2) what was the condensation and evaporation during the period of expansion. The condensation during admission was ascertained in the usual way. The pressure at the moment the steam was cut off was got from the diagrams, and by means of Zeuner's tables the corresponding density of saturated steam was ascertained. Knowing the volume of the steam and its density, it was easy to calculate its weight. This weight, less that of the steam in the clearance spaces, would be, if it were not for cylinder condensation, precisely the same as that of the feed-water pumped into the boiler. Thus, if the feed-water used in an hour weighed 2000 lb., then the weight of the steam—obtained as we have stated—should also be 2000 lb. It is, however, always less, and the difference is due to condensation; that is to say, at the moment when the cut-off valve closes there is not steam, but a mixture of steam and water in the cylinder. Let the weight of the steam be x and that of the water y, while that of the feed-water is W. Then $x + y = W$ and x and y may vary in many ways, but their sum must always equal W. Furthermore, it must be observed that y may or may not be all due to cylinder condensation, according as the steam supplied from the boiler is or is not quite dry. It may be assumed that unless a superheater is used the steam will carry over with it from 5 to 8 per cent. of water in the case of Lancashire boilers. The Table No. 6 gives the result of M. Delafond's calculations.

TABLE 6.

With Condensation; without Jacket.

No. of experiment.	Condensation during admission per stroke.		Condensation during expansion per stroke.		
	Absolute weight in grammes.	Percentage of the weight of feed-water.	Evaporation in grammes.	Condensation in grammes.	Percentage of evaporation or condensation of feed-water.
Pressure, 110 lb.					
1	84·7	53	0·60	—	+ 0·4
2	83·0	45	6	—	+ 3·2
3	87·0	40	4	—	+ 1·8
4	104·0	39	10	—	+ 5·9
Pressure, 88 lb.					
5	73·6	43	4	—	+ 2·3
6	73·6	42	—	2	− 1·1
7	68·8	35	—	3	− 1·5
8	77·2	34	—	4	− 1·7
9	90·7	36	—	10	− 3·9
Pressure, 64 lb.					
10	44·7	39	8·5	—	+ 7·5
11	37·6	27	6·5	—	+ 4·7
12	41·7	24	4·0	—	+ 2·3
13	30·5	15	1·2.	—	+ 0·6
14	29·2	13	—	1	− 0·4
Pressure, 50 lb.					
15	42·0	43	21·0	—	+21·6
16	38·9	33	15·5	—	+12·8
17	34·8	25	5	—	+ 3·5
18	36·3	22	6	—	+ 3·5
19	30·5	14	—	9·5	− 4·5
Pressure, 33 lb.					
20	40·9	31	18	—	+13·0
21	28·1	13	3	—	+ 1·3
22	18·0	7	—	6	− 2·1
23	nil	—	—	—	—

With Condensation; with Jacket.

No. of experiment.	Absolute weight in grammes.	Percentage of the weight of feed-water.	Evaporation in grammes.	Condensation in grammes.	Percentage of evaporation or condensation of feed-water.
Pressure, 110 lb.					
24	50·5	39	20	—	+12·9
25	50·5	31	15	—	+ 9·2
26	45·2	29	13	—	+ 8·1
27	61·1	26	11·5	—	+ 4·7
Pressure, 88 lb.					
28	44·5	36	24	—	+19·2
29	43·5	33	18	—	+13·2
30	45·6	24	16	—	+ 8·5
31	50·3	24	20	—	+ 9·4
Pressure, 64 lb.					
32	35·3	34	19·5	—	+18·5
33	36·4	28	17·0	—	+12·9
34	28·3	17	9·0	—	+ 5·4
35	32·2	16	8·0	—	+ 4·0
36	24·3	10	3·5	—	+ 1·5
Pressure, 50 lb.					
37	27·6	34	20·5	—	+24·7
38	33·7	30	23·0	—	+19·8
39	26·5	19	16·0	—	+11·5
40	27·2	15	—	2·50	− 1·4
41	26·3	12	—	5	− 2·2
Pressure, 33 lb.					
42	30·4	23	24	—	+17·6
43	25·6	12	5	—	+ 2·2
44	12·8	4	—	5	− 1·7
45	nil	—	—	—	—

With Condensation; without Jacket.

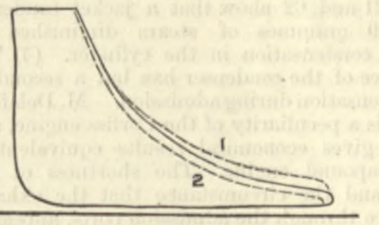
No. of experiment.	Condensation during admission per stroke.		Condensation during expansion per stroke.		
	Absolute weight in grammes.	Percentage of the weight of feed-water.	Evaporation in grammes.	Condensation in grammes.	Percentage of evaporation or condensation of feed-water.
Pressure, 110 lb.					
46	94·7	37	—	15	− 5·8
47	104·6	35	—	17·5	− 5·8
48	96·3	29	—	4	− 1·2
Pressure, 75 lb.					
49	53·7	26	4	—	+ 1·9
50	49·0	22	—	7	− 3·1
51	47·5	17	—	7·5	− 2·7
52	38·0	12	—	4	− 1·2
Pressure, 50 lb.					
53	25·9	14	6	—	+ 3·3
54	19·1	8	1	—	+ 0·4
55	8·1	2	—	9	− 2·7
56	nil	—	—	—	—

With Condensation; with Jacket.

No. of experiment.	Absolute weight in grammes.	Percentage of the weight of feed-water.	Evaporation in grammes.	Condensation in grammes.	Percentage of evaporation or condensation of feed-water.
Pressure, 110 lb.					
57	54·2	27	21	—	+10·3
58	62·8	27	17·5	—	+ 7·3
59	65·2	26	13	—	+ 4·8
60	60·3	20	10	—	+ 3·2
Pressure, 75 lb.					
61	32·1	16	9	—	+ 4·5
62	22·1	9	6	—	+ 2·4
63	15·4	5	—	1	− 0·4
Pressure, 50 lb.					
64	16	9	6	—	+ 3·5
65	15·7	7	7	—	+ 3·1
66	6·7	2	—	1	− 0·3
67	nil	—	—	—	—

The sign + stands for evaporation, and the sign − for condensation.

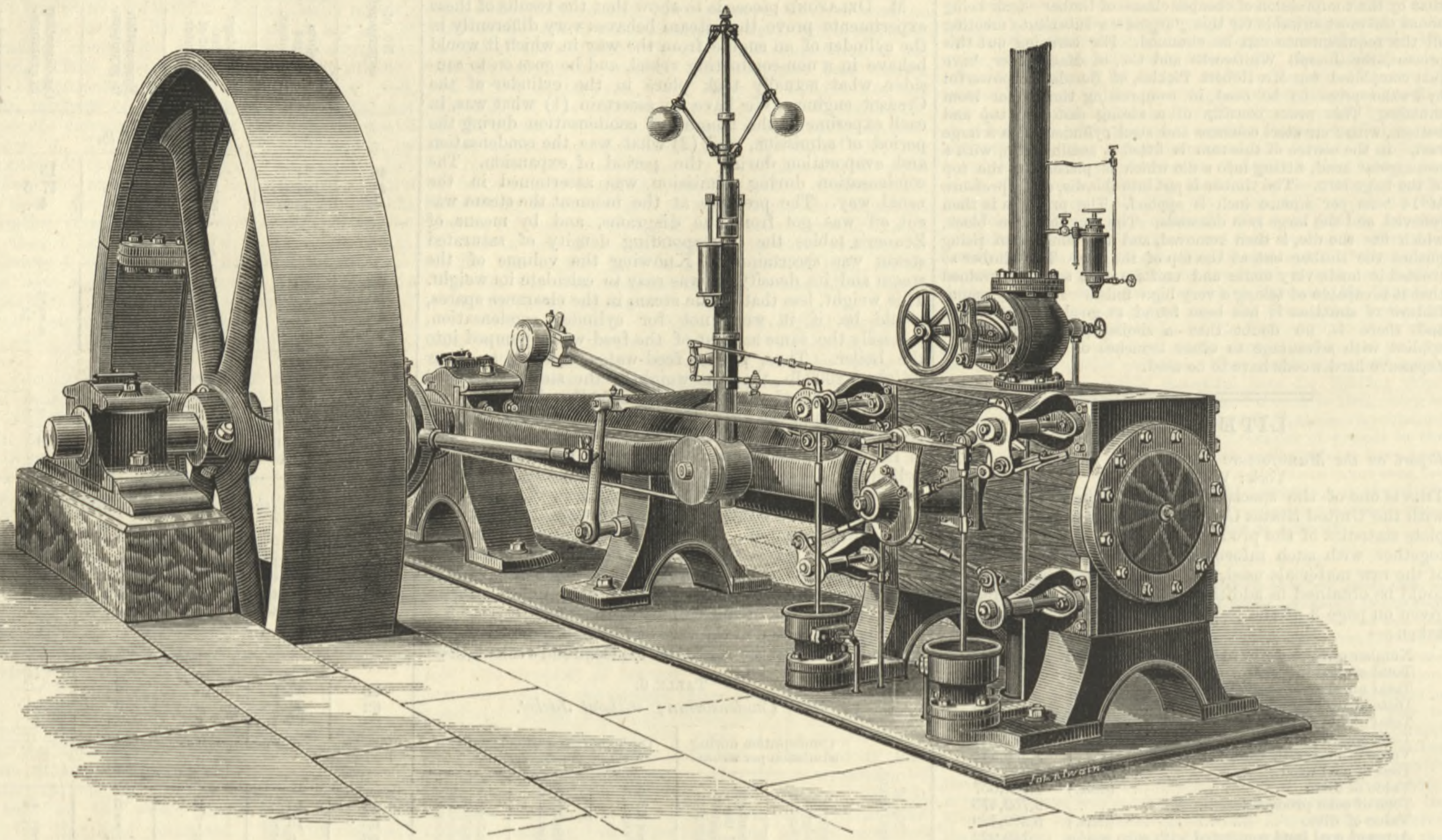
The weights of water condensed or evaporated during the period of expansion is calculated in the same way by taking the weight of steam proper to the pressure at the end of the period of expansion—that is to say, just as the exhaust port opens—and comparing it with the weight of steam at the moment the cut-off valve closed. If there is an augmentation, then that is obviously due to the reconversion of some of the water into steam, which produces an effect well known to English engineers as "raising the toe of the diagram."



Here the dotted line 1 shows the effect of re-evaporation. If, on the other hand, the weight of steam is less at the end of the stroke than it was at the time the cut-off valve closed, then there has been still further condensation, and the effect on the diagram would be as shown by the dotted line 2. M. Delafond warns his readers that these calculations of the weight of steam are extremely delicate, and that, especially as regards evaporation or condensation during the period of expansion, they can only be regarded as approximate. The table gives the condensation during admission, and the condensation or re-evaporation during the period of expansion. We have not converted the figures into English units because the conversion would involve numerous fractions. It will be enough to say that the gramme is equal to 0·564 drams avoirdupois. Thus, for example, in Experiment No. 15 the total condensation was 1 oz. 7·7 drams per stroke. The principal value of the figures is, however, as a means of comparison, and for this purpose it is not necessary to affix any definite weight value to them. Thus, we see that in Experiment 1, the condensation was represented by the figures 84·7, while in Experiment 22 the condensation was represented by 18, or less than one-fourth of the first quantity. The results in column 2 were calculated after allowing for the condensation in the jacket, which took place when steam was admitted to it. In the experiments Nos. 24 and 25 it is assumed that the jacket condensation was the same as in run 26, that is to say, about 5 grammes per stroke. In like manner the jacket condensation in run 38 is taken as identical with that in run 32. There was, it will be seen, no condensation when the steam was admitted full stroke. Indeed, the weight of steam is apparently slightly in excess of that of the feed-water. This is no doubt due to some minute error in observation. The results of this calculation are set forth graphically in Figs. 3 and 4 published in our last impression, page 218.

M. Delafond considers at some length the laws of thermo-dynamics as applicable to steam. We need not reproduce what he has said, as he only goes over old ground. It is more interesting to follow him in his deductions from the results of his experiments. Some of these we have already given. The table above and Figs. 3 and 4 show clearly—(1) That for pressures above 64 lb. the weight of steam condensed is, other things been equal, the greater the higher the pressure. For pressures less than 64 lb. the condensations present little difference, and the law of these variations is not clearly shown by the diagram. (2) For the same pressure, as the admission

CORLISS ENGINE—NEW ORLEANS EXHIBITION.



augmented from about 4 per cent. of the stroke, the condensation diminished. With admission for the whole stroke there was no condensation. It appears that the condensation augments with the ratio of expansion. (3) The jacket diminishes the cylinder condensation, and its benefits are most apparent when the initial cylinder condensation is greatest. The benefits conferred appear at first sight out of proportion to the amount of heat given up in the jacket. Thus, if we compare Experiments 8 and 31, it will be seen that the condensation in the jacket of 3·1 grammes of steam per stroke diminished by 27 grammes the weight of steam condensed in the cylinder; and, again, runs 21 and 62 show that a jacket condensation of but 2·9 grammes of steam diminished by 25 grammes the condensation in the cylinder. (4) The presence or absence of the condenser has but a secondary effect on the condensation during admission. M. Delafond implies that this is a peculiarity of the Corliss engine, and explains why it gives economical results equivalent to those of the compound engine. The shortness of the admission ports, and the circumstance that the exhaust does not take place through the admission ports, appear to be the factors in favour of the Corliss engine.

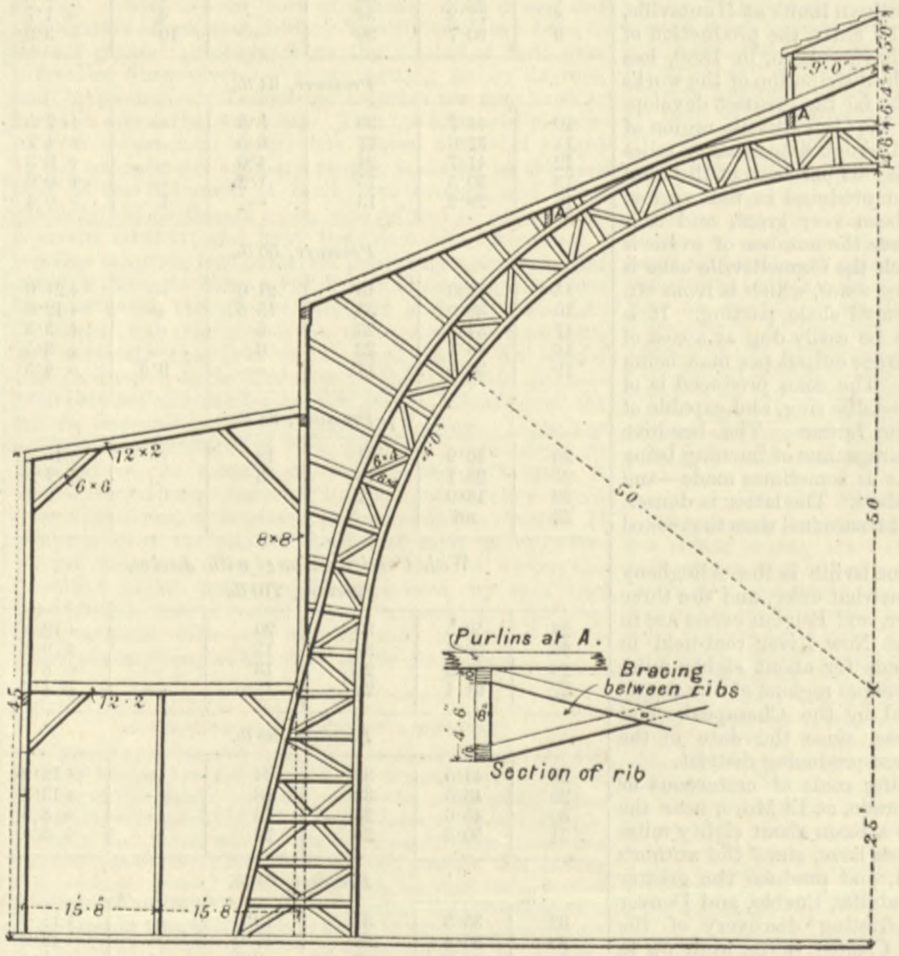
(To be continued.)

THE NEW ORLEANS EXHIBITION.

No. I.

AMONG the great Exhibitions which have been held since that of 1851 in London, this present one in New Orleans will hold a memorable place. There has, doubtless, been a growing feeling among manufacturers and others that there have been too many of these big shows; there is certainly a tendency to multiply them unnecessarily, and some justification may be demanded when a remote city like this announces that it is about to hold a bigger Exhibition than any that has preceded it. The bigness may be excused. It is usual here to advance by big strides, and no true Southerner, strong in the manifest resuscitation of his country—so long under a cloud—and sanguine of the future, would think of having anything less than, and must needs surpass, the Philadelphia Exhibition of 1876. And though an impartial observer, as he wanders over the vast area, may think that some of the money spent in the buildings might have been better applied to a completer equipment on a smaller scale, still the energy applied, and the great success in the essential features of the affair, disarms criticism, and leads one to congratulate the promoters on their efforts. A few words as to the motives that led to the Exhibition may not be out of place. The collapse of the Confederate cause after the great war left the Southern States apparently ruined. After the vast expenditure of money and credit, and the decimation of the population, the freeing of the slaves without compensation to the owners was a revolution that involved ruin to most concerned. The voting power was transferred to the negroes, who, it naturally was expected, would always vote with the party who had freed them, and the victorious Northerners, holding the South firmly in their grasp, had no inclination to let them grow strong again. But times have changed. The whites have during the last ten years regained their natural ascendancy, and now, for the first time since the war, the Democratic or Southern party are in a majority. They have elected Mr. Cleveland as President, and now to a large extent control the immediate future of the United States. The Southerners, at any rate, feel that their interests will receive fuller consideration than hitherto. This is acknowledged also in the North, and capital, which is so much needed, may be expected to flow here from the richer States of the Union and from Europe. Under these circumstances, the project of an Exhibition was well received, and is but a natural expression of advancement and a desire to set forth the resources of the country.

To engineers there are three aspects of the case that are of special interest—one, the growth of railways, the opening-out of new districts, and the consequent increased purchase power; secondly, improvement of the port by Captain Eads' jetties, which have deepened the approaches from the sea; and thirdly, the extraordinary development of the hitherto dormant mineral resources of the Southern States, and the probability that it is in the latter quite as much as, or even more than, in Pennsylvania that the future of the iron and steel trades of the United States will be found. New Orleans is not only the natural outlet for the greatest system of river navigation in the world, but is also virtually the only good port for the State of Texas, which is in itself as large as France. As one example of the value of the river for transport, it may be mentioned that the supply of coal for this city, port, and district is floated from Pittsburg 2000 miles down the Ohio and Mississippi, in huge rafts or groups of lighters, holding in all 20,000 tons or upwards, and so cheaply that the coal fetches about the same price here as does coal in London. New Orleans has a population of about a quarter of a million, but it is isolated, being 800 miles from any other city having more than 100,000 inhabitants. In this respect, and in regard to the consequent probable financial results of the Exhibition, it differs much from Philadelphia, which has within twenty-four hours' by railway more than half the population of the United States. The Exhibition has been established on a site abutting on the river about five miles from the centre of the city, and in its very situation brings into prominence some of the peculiar characteristics of New Orleans. Surrounding the building are pleasant groves of oaks, relics of the original Spanish settlement. The city is situated close upon the river, and the huge high-storied steamboats, our knowledge of which has been revived by Mark Twain's recent descriptions, crowd along the levee or river embankment at the end of the main street. The streets are level with, and in some cases below the level of the river. In the northern cities of the Union the street paving is bad; here criticism is simplified by the fact that, except in a few of the central thoroughfares, there is no paving at all. The streets have been cut through the fields, a single tram track laid along the middle, and except stepping stones or planks at the crossings, the rest is mud, which becomes chaos, as at the Kilburn Show, when it rains. This is pre-eminently a city of tramways, and there is practically no other means of locomotion away from the river. On a track free from gradients the cars run easily, drawn each by a single mule, even when loaded, as is the custom here, with from five to twenty passengers standing up in addition to the proper complement of twenty. As is usual in this country, cabs are practically non-existent, and were it not for the steamboats, access to the Exhibition would be greatly limited. But the steamboats, leaving for the time their proper function of long river voyages, carry to and fro 2000 passengers at each trip.

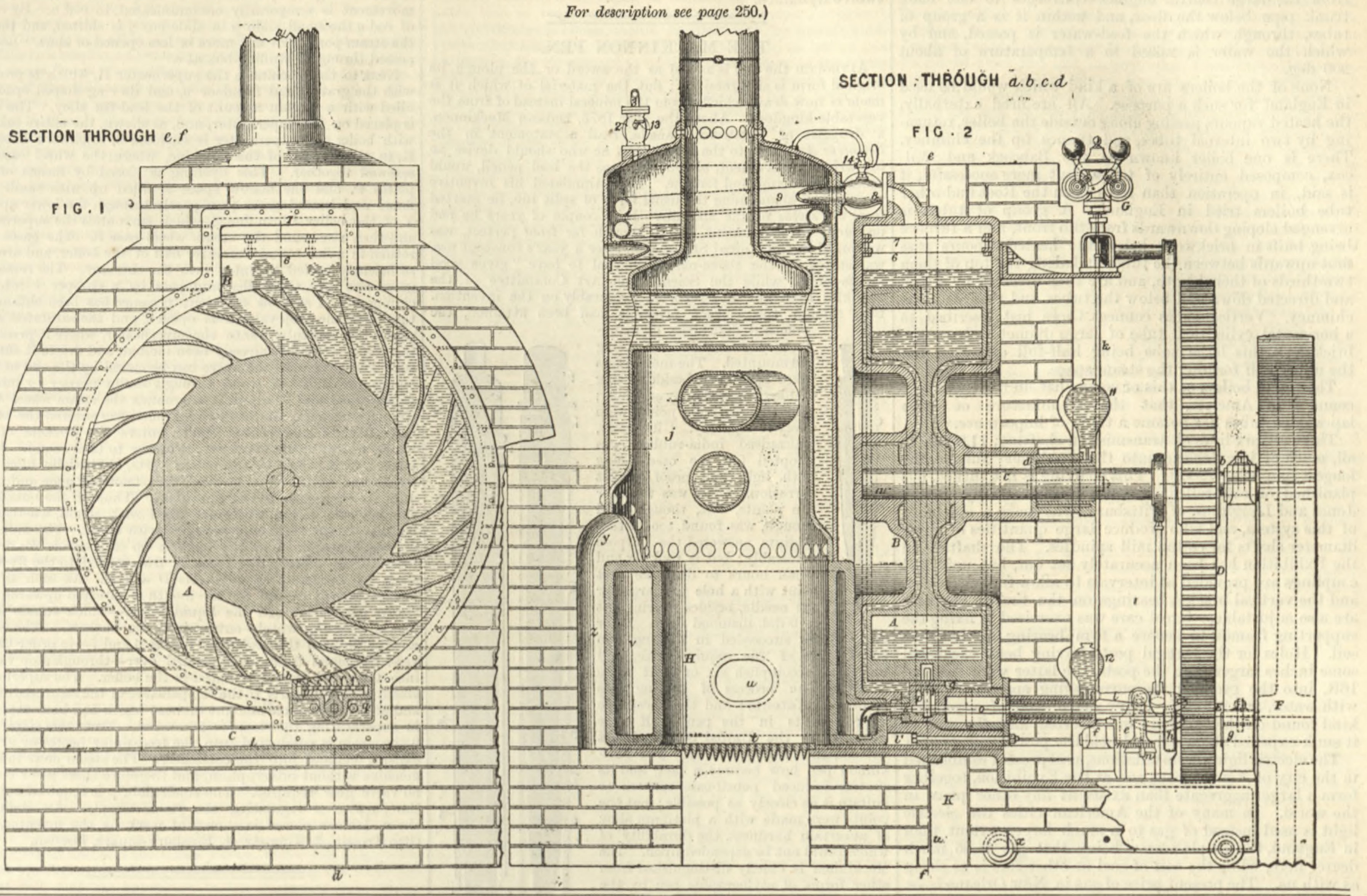


SECTION OF MUSIC HALL.

As every Exhibition may be supposed to have its special points, so has this one at New Orleans. One must not look for many novelties, though these are not wanting, but one may regard with interest the alterations in American methods and types since the Philadelphia Exhibition in 1876; may study with advantage the development of machines and appliances adapted for the wants of the Southern States; or look with astonishment on the complete

TROSSIN'S SUPERHEATED STEAM ENGINE.

For description see page 250.)



and extraordinary State Exhibits of natural products, agricultural and mineral; and in respect of these latter English engineers may compare, with feelings somewhat mingled, from a national point of view, the potential future prospects of this country with those still left in Great Britain. The contiguity of Mexico, its development by railways, the access thus given to its mines, and the opening it presents, unimpeded as it is by protective tariffs, to English manufacturers, are also subjects for investigation. The Exhibition buildings themselves, the utilisation of local materials in their construction, and the unprecedented extent of the electric lighting, are also points of interest.

The Exhibition buildings are constructed entirely of wood in a simple but efficient manner, the design and construction being the sole work of the superintending architect, Mr. G. M. Torgerson, who has utilised the local material, pitch pine, which grows within a few miles of the city. This timber is heavier and stronger than that bearing the same name in England, and as the trees grow to a great size, there is no difficulty in obtaining the massive and lofty supports which are necessary to the design. At the same time, as the buildings are but temporary, the highest quality wood has not been selected as may be seen by comparing it with that in the permanent buildings in the city, which are largely constructed of timber. The main building measures 1378ft. by 905ft., exclusive of sundry extensions, and the Government and State Exhibition building 885ft. by 565ft. These are similar in construction, being divided into spans varying from 50ft. to 75ft., timber roof principals being supported on vertical posts. Both buildings have galleries 50ft. wide. The covering is mainly of tinned iron on boarding, with side windows and lanterns of glass. Part of the main building is set apart as a music hall, about the size of the Agricultural Hall at Islington, having, like the latter, a roof formed of arched ribs, and side aisles, but no galleries, the side spans serving as abutments for the ribs. The construction is entirely of wood, and is neat and effective, as shown by the accompanying illustration.

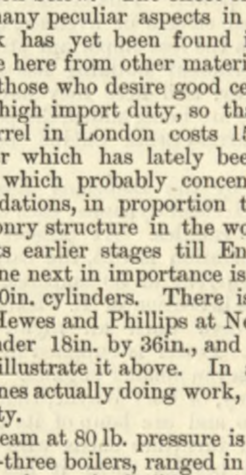
This music hall in the main building is 210ft. long by 50ft. span. The structure is entirely of wood, with iron tie-bolts at each of the vertical posts in rib. The arched top and bottom members of the ribs are interesting in that they are each formed of laminated boards, ten boards, 8in. by 1in., being bolted together. This is the plan that was adopted for each of the two 90ft. ribs of the Great Northern terminal station at King's Cross. Some ten years ago this roof showed signs of deterioration, and iron ribs were substituted; but on removing the first of the two spans, it was found not to be so bad as was expected. The second span was therefore left standing, and now remains in wood. In the New Orleans roofing the inner end is hipped with arched ribs, and enclosed with boarding, to receive the orchestra and organ. There are numerous other buildings for special exhibits, the total area being about 2¾ million square feet, the quantity of timber employed being equal to 17 million square feet of boarding 1in. thick—the unit of measurement here—and the average cost £7 10s. per square of 100 superficial feet. So accustomed are the people here to the use of elevators, that it was deemed necessary to erect twenty-six of these to lift visitors to the galleries, and only a few staircases are provided. The water supply is obtained from the Mississippi river and is filtered, and 4,000,000 gallons per day are forced through a standpipe 100ft. high to supply force for the elevators and for fire extinction. In the form and arrangement of the buildings, the mildness of the climate has evidently been taken into account. Neither snow nor high winds are to be anticipated, and light buildings and roofs sloping but slightly are permissible. Heavy rains occur, and ample provision is made for carrying off the water by sinking parts of the roof so as to make channels 20ft. wide, into which water from a wide area of higher roofs converges, and is taken away by capacious down spouts lined with sheet iron. There is no attempt at decoration, the timber being left bare and unvarnished, but there is an ample display of flags.

In visiting the grounds of the Exhibition one is struck by the absolute level and by the appearance of the river, which is within 2ft. of the floor of the Exposition, the drainage, like that of the city, being towards the lake Pontchartraine, which is about five miles to the north-east and 18ft. lower than the river, this lake being the same level as the sea, while the river has to flow 120 miles to the sea. The soil is but loose mud, and presents great difficulties in making foundations. Numerous buildings in New Orleans show signs of settlement, the new Cotton Exchange, a handsome stone structure, having sunk 9in. within a year, and the Post-office and Custom-house, a building as large as the General Post-office in London, having sunk 20in. The maximum load that can be placed with safety on this soil, even on a driven pile, is 800 lb. per square foot. The vertical posts of the buildings rest upon sills of timber, which sufficiently distribute the weight brought upon them.

A very large motive force has been provided for the electric lighting and the machinery in motion, the latter, which, as compared with previous exhibitions, is not of great extent, being stopped at dusk when the lighting begins. The engines, shafting, and their numerous appurtenances and foundations have all been arranged by Mr. S. H. Gilman, the chief consulting engineer, who has overcome many difficulties with ingenuity and success. Owing to the soft and loose character of the soil, already alluded to, considerable care was necessary to ensure firm beds for the large and heavy engines employed. The principal engines are ranged upon a platform about 2ft. above the floor in the centre of the main building. There is not very much variety in these engines, although many different makers are doing their best in competition. With the exception of the Westinghouse automatic two-cylinder vertical engine, of the Willan type known in England, all are of the horizontal kind, mostly adaptations of the Corliss principle, although there is a tendency among some of the makers to ignore the name Corliss, and to claim for their modifications in details the invention of new types. At Philadelphia in 1876 the Corliss which attracted so much attention was a beam engine, which is now working at the car factory in the town of Pullman. It is curious to note how all the engine makers have followed suit in adopting the horizontal type, and it is also interesting to see that there is a change for the better in the style of finish, the greater sobriety to which we are accustomed in England having been substituted for the somewhat gaudy ornament which used to be the fashion in this country. It is also to be mentioned that there is not one compound engine in the Exhibition, probably the small amount of marine work done in the country having something to do with the backward condition of American engineers in this respect.

The largest engine is a Harris-Corliss, made by a company of that name at Providence, Rhode Island. This engine has a cylinder 30in. by 72in., with a nominal capacity, according to American rating, of 650-horse power. The principal novel feature in this engine is in the self-packing of the valve spindle in the steam inlets, by which it is claimed that much friction on the spindle is avoided. The fly-wheel is 24ft. diameter, 6ft. wide on the face, and is built up of ten segments, weighing 40 tons in all. The main shaft carrying the wheel is 15in. diameter. The power is transmitted by a Gandy cotton belt, 4ft. wide, woven in one length. The foundation for this and the other principal engines is on brickwork in English Portland cement, the beds being splayed out at the base so as to impose a load of only 600 lb. per square foot on the soil below. The effect of the tariff is shown in one of its many peculiar aspects in this matter of cement. No chalk has yet been found in this country; the cement made here from other material is of a very inferior kind, and those who desire good cement have to pay the penalty of a high import duty, so that cement which costs 7s. 6d. a barrel in London costs 15s. here. The lofty memorial tower which has lately been completed at Washington, and which probably concentrates a greater load on its foundations, in proportion to their area, than any other masonry structure in the world, showed signs of yielding at its earlier stages till English cement was used. The engine next in importance is a Reynolds-Corliss, with 32in. by 60in. cylinders. There is also a Corliss engine, made by Hewes and Phillips at Newark, New Jersey. It has a cylinder 18in. by 36in., and is rated at 100-horse power. We illustrate it above. In all there are about forty-five engines actually doing work, besides more than 100 running empty.

Steam at 80 lb. pressure is supplied to the engines from fifty-three boilers, ranged in line outside, and 50ft. distant from the main building, the boilers being in groups or batteries of four and five. Along the front of the boilers is one main trunk steam pipe, 400ft. long, 30in. diameter, of ⅜in. steel plates. This pipe was made at Pittsburgh, and brought to the site in 30ft. lengths. There are no expansion joints, the pipe being fixed in the centre of the line and resting on concave rollers placed at intervals along its length, the supply pipe from each group of boilers being connected to it by a vertical bend swivelling in a stuffing-box. A similar arrangement is adopted where the steam branch pipes are attached to the various engines, these branches being taken as T pieces from the main trunk pipe, and always from the top of the pipe. Several very long branch pipes are used to transmit the steam to the various engines in the building, one pipe being 2400ft. long, another 1900ft., and another 1100ft. All these are fixed on rollers as just described, without expansion joints. The pipes are well enveloped in a wrapper of paper and asbestos, which retains the heat very well,



and the pipes are never allowed to get cold even when the engines are not running. The exhaust steam from the large central engines converges to one main trunk pipe below the floor, and within it is a group of tubes, through which the feed-water is passed, and by which the water is raised to a temperature of about 200 deg.

None of the boilers are of a kind which would be used in England for such a purpose. All are fired externally, the heated vapours passing along outside the boiler, returning by two internal tubes, and thence up the chimney. There is one boiler known as the Babcock and Wilcox, composed entirely of tubes, but more successful, it is said, in operation than have been the Root and other tube boilers tried in England. A group of tubes is arranged sloping downwards from the front, and a furnace being built in brickwork below, the heated vapours pass first upwards between the tubes and along the top of them two-thirds of their length, and are then arrested by a wall and directed down and below the tubes, and thence up the chimney. Vertical tubes connect those just described to a horizontal cylindrical tube of large diameter above the brickwork, this large tube being half-full of water, and the upper half forming the steam space.

The use of boilers of this or somewhat similar types is so common in America, that the manufacture of large lap-welded tubes has became a trade of importance.

There are six lines of transmission shafting, 11,000ft. in all, much of it extending into the machinery annexe, the longest line being 1900ft. This shafting is not turned, but planished or cold-rolled, and has been made by Messrs. Jones and Laughlins, of Pittsburg, who make a speciality of this system, and who produce large quantities of small diameter shafts for cotton mill spindles. The shafting in the Exhibition has been accurately set out, but universal couplings are provided at intervals to allow for settlement, and the vertical bracket bearings on the timber supports are also adjustable. Great care was exercised in fixing the supporting frames, to ensure a firm bearing in the loose soil. Holes for the vertical posts having been excavated some inches larger than the posts, the latter were inserted 16ft. into the ground; the surrounding space soon filled with water, and into this heavy sharp sand of a peculiar kind found on the sea shore was inserted, and the sand as it sunk expelled the water and held the posts in a firm grip.

The electric lighting installations, as at present established in the city of New Orleans and at the Exhibition, together form a larger aggregate than exists at any other place in the world. In many of the American cities the electric light is used instead of gas to a much larger extent than in England, the simple reason being that gas is so much dearer here, while the cost of coal or other fuel is as cheap as with us. The present price of gas in New Orleans is 7s. per 1000. In the city the Brush Company have the sole concession for the electric lighting of the streets, and their lofty poles carrying the wires along the main thoroughfares, additional as these poles are to those of the telegraph and telephone companies, greatly disfigure the streets. An annual fee or rent of 5 dols. is paid to the municipality for each pole erected. The whole of the city electric lighting, including that of the private consumers, is at present worked from one central station, there being fourteen circuits, averaging five miles each. There are 250 public lamps, burning all night, for which the city is charged 200 dols. per lamp per annum. In addition to these there are 550 private lamps, all alike being of a nominal 2000-candle power. The motive power is provided by three Atlas-Corliss horizontal engines of from 250 to 275-horse power each, worked from five groups or batteries of boilers, each group being of 200-horse power. This electric lighting is confined to the principal streets or avenues, there being much gas lighting also in the less important streets. At the Exhibition the Government building has been allotted to the Brush Company, and here they have at present 300 lights, and 60 more are being added, the power being provided by the Harris-Corliss engine before described.

The main building is lit by the Louisiana Electric Company, which uses thirty Excelsior dynamos, each equal to thirty arc lights of 2000 candles. At present the number of these lights in operation is 825, the carbons being $\frac{7}{16}$in. diameter, and a current of 30 ampères, the lamps being known here as the invention of E. Pickering. Of these 825 lamps seventy-five burn all night, the remainder only for four hours. Power is supplied by one of the big Corliss engines and seven smaller engines.

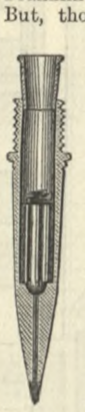
The Jenney Electric Company, of Fort Wayne, Indiana, which have a special dynamo and arc lamp of its own, light the cattle, carriage, and furniture sheds with 112 lamps of 2000 candles, and besides these it has ten similar lamps on each of the six towers in the grounds. There are at present being prepared five groups of lights, to give 36,000-candle power in each group, on similar towers. The towers are 125ft. high, framed of three wrought iron solid columns of a cross-shaped section, the three columns being arranged as a triangle in plan, with 21ft. sides at the base, strongly but lightly braced in eleven tiers, exclusive of the basket at the top holding the lamps.

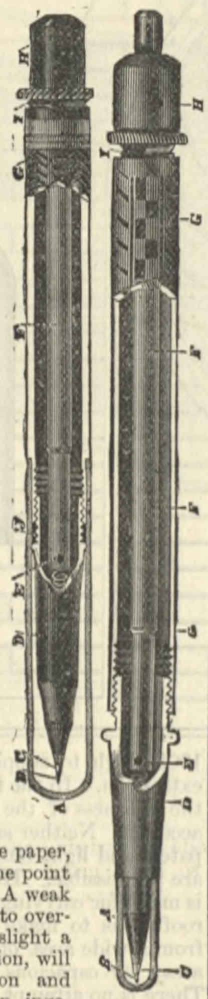
The Thomson-Houston Company, of Boston, lights the horticultural hall and the surrounding ground. This company, which is well thought of, and is not unknown in England, has its own lamp, and a dynamo with an automatic regulator, which, by a self-acting movement of the brushes on the commutator, allows a 25-light machine to serve instantaneously a single light. By means of six 30-light dynamos and one of twenty lights, 175 arc lamps are illuminated, and a few incandescent lamps. This company is arranging for a complete and extensive installation at the Inventions Exhibition at South Kensington this year. In regard to force of current and in other main respects, the system is very similar to that of the Brush Company.

All the foregoing installations are confined nearly exclusively to arc lamps, and the incandescent lamps are allotted to the Edison Company, which lights the art gallery, the music hall, and under the galleries of the main building, 5000 16-candle lamps in all, the full capacity of the machinery being 6000. There are six steam engines and twelve dynamos.

THE MACKINNON PEN.

Although the pen is as old as the sword or the plough, its original form is still retained; but the material of which it is made is now drawn chiefly from the mineral instead of from the vegetable kingdom. About the year 1875, Duncan Mackinnon, a druggist of Stratford, Canada, read a statement in the *Scientific American* to the effect that he who should devise an ink-writing instrument, as convenient as the lead pencil, would achieve both fame and fortune. This stimulated his inventive powers, and abandoning the usual form of split nib, he started from the *stylus* of the ancients. In a couple of years he had produced an instrument which, though far from perfect, was welcomed in the United States, and, after a year's constant use, was stated by the above-named journal to have "given good satisfaction," while the Science and Art Committee of the Franklin Institute also reported favourably on the invention. But, though the correct principle had been attained, the practical difficulties of manufacture were far from being surmounted. The metal cases were too heavy, besides being liable to corrosion by acid inks; and the platinum points wore away too quickly. Ultimately, vulcanised india-rubber was adopted for the case, being both light and proof against corrosion. Glass was tried for the points, but, though hard enough, was found too brittle. Iridium answered the purpose admirably; but it took six and a-half hours to drill the first point with a hole too large for the needle, besides wearing out a 10-dol. diamond drill. Later on, a Swiss succeeded in drilling two small holes of the required size, and hoped to accomplish six or eight holes a day. The process of drilling was secured by patents; and the successive improvements in the pen itself were patented in the United States, Great Britain, and other countries. The Mackinnon pen now became a fact, and its success induced pencil-case makers to imitate it as closely as possible; but the points were made with a platinum alloy of uncertain hardness, the durability of which could not be depended upon. The Mackinnon is chiefly distinguished from other forms of stylographic pen by the iridium point, which is practically unwearable.





The needle which regulates the flow of ink at the orifice is also controlled mainly by a weight, forming a clack valve, which is lifted by the pressure of the pen on the paper, the needle projecting slightly beyond the point when there is no contact with the paper. A weak spiral spring is, however, added, probably to overcome the friction and the inertia of so slight a weight. The annexed views, partly in section, will assist in understanding the construction and working of the pen, which is really an ingenious piece of mechanism. The tube or holder G is filled with ink, which should be of good quality, and especially of uniform composition, but not too thin, as might have been supposed the best. The orifice is closed by screwing in the needle chamber D, a slightly enlarged detail of which is shown in section. Inside the holder is the tubular air chamber F, with its outlet E, and inlet at I, the open end of the tube being closed by the cap H; but a flat side is formed on the screw, for admitting air on the cap being unscrewed. As the ink in the holder is used, the air, entering to supply its place, maintains an even feed and flow. C is the hollow iridium point, and E the needle, made of gold and tipped with iridium, that works therein, breaking up air bubbles and displacing minute extraneous particles that would otherwise collect at the point and intercept the flow of ink. A is the cover for protecting the point when the pen is not in use, and which, for convenience, is placed on the projection at the other end when the pen is being used. In the newest form of Mackinnon pen this cap is made longer and of the same diameter as the holder—as shown in the second view—so as to add to its length, a great convenience in writing, besides giving the pen a simpler and more business-like appearance. The inside of the cap is also provided with an india-rubber cushion, which completely closes the point when not in use.

This pen is really a very delicate instrument, so constructed as to withstand ordinary rough usage. Various hypotheses of a very ingenious character have been published as explanations of the working of the pen; but it is quite clear that the idea that capillary attraction would prevent the flow of the ink down the very small space between the needle and the very small hole in which it fits is erroneous. When in use, some of the ink is rubbed off the point to the paper; and the molecular cohesion of the fluid is sufficient to cause the flow of more ink to the point, this flow being permitted by the air supply from above, and capillarity really helping in the work of drawing the ink along the tiny channel allowed it.

TROSSIN'S SUPERHEATED STEAM ENGINE.

A curious motor is illustrated by the accompanying engravings. The invention consists mainly in the employment of a bucket wheel which works in a vessel containing molten lead with a small percentage of tin. In the engravings, Fig. 1 shows the cross section and Fig. 2 the longitudinal section of the motor. A cast iron bucket wheel A is placed in a cast iron case B, made in halves, which is fixed on a base plate C. The shaft c of the bucket wheel A is carried in bearings at a and b, and passes through a stuffing-box d. A large spur wheel D is fixed on shaft c, and gears into a spur wheel pinion E. The shaft of the latter is carried in bearings at f and g. The end of this shaft carries the fly-wheel F, which also serves as main driving pulley. h and i are two small pulleys used for driving the governor G. The latter actuates the rod n by means of rod k and angle lever l—see plan of these parts in Fig. 3. The movement of rod n is influenced by means of a cam disc m. The rod n has on its end two catches which run against the cams of disc m, and thus a movement of rod n to one side or the other is temporarily prevented. The disc m is moved in the direction of the arrows, shown in Fig. 3, by means of a cam on shaft e, and thus its movement is temporarily communicated to rod n. By means of rod o the small slide p in slide-box q is shifted, and thereby the steam ports r r r are more or less opened or shut. Rod o is passed through a stuffing-box at s.

Next to the machine is the superheater H, which is provided with the grate t, and fire-door u, and its ring-shaped space v is filled with a certain amount of the lead-tin alloy. The boiler is placed on the superheater, and, as shown, the entire machine with boiler and superheater is enclosed in brickwork except at K, in the middle of the machine, where the wheel case B is screwed together. This opening is closed by means of two plates w, and the hollow space is filled up with sand. The flame and heated gases pass partly through the lower opening Y of the boiler J into flue Z, which surrounds the superheater, and then rise round the steam wheel case B. The gases then return in a flue round the outer half of the boiler, and are thus sufficiently cooled to enter into the chimney. The remaining gases rise into the boiler and pass by a damper 1 into the chimney. As soon as sufficient pressure has been obtained in the boiler the stop valve 2 is opened, and the saturated steam passes through tube 3 into the superheater, where it presses on the metal, which has already been melted, and drives it through tube 4 and valve 5—the valve can be closed by the end of rod o—into the slide-box q and through steam ports r r r into the steam wheel case B, where it surrounds the steam wheel A and fills the buckets. As soon as all metal has entered the case B, the strongly superheated steam enters the buckets of the wheel, which, by its buoyancy, it causes to turn round. Every bucket, as it passes by the steam ports, is partially filled with steam, and as it moves upward the steam expands and transmits its energy to the steam wheel. Thus all the buckets on the left side of the wheel are filled with steam, whereas the buckets on the right side are filled with metal. The difference of weight contained in the buckets on each side is the driving force of the wheel; this force is transmitted to the fly-wheel shaft by means of spur wheels D and E. As soon as each bucket arrives at the top its mouth is directed upwards; the steam passes out and the liquid metal—which stands a few inches over the wheel—enters into the buckets. The steam escapes through the perforated plates 6 and 7—in order to prevent the metal from being carried over—through stop valve 8 into the spiral tube 9, situated in the boiler. The superheated steam is cooled nearly to the temperature of the saturated steam, and almost the whole amount of heat which had been expended in superheating the steam is recovered. From this spiral tube 9 the steam is conducted into the feed-water heater or in condensing engines into the condenser. The steam flows into the machine without interruption, and therefore there is, of course, no valve gear required. The small slide p is required only for the purpose of regulating the steam supply. An engine of about 1-horse power is shown at work by the inventor, Mr. Otto Trossin, 2, King-street, Finsbury-square, London.

THE METEOROLOGICAL SOCIETY.

This Society opened its sixth annual exhibition of instruments on Wednesday, the 18th inst., at the Institution of Civil Engineers, 25, Great George-street, S.W. This exhibition is devoted to sunshine recorders and solar and terrestrial radiation instruments.

At the meeting of the Society the president, Mr. R. H. Scott, F.R.S., read a paper giving a brief account of the various instruments and arrangements to be found in the exhibition, for the purposes of recording solar and terrestrial radiation and the duration of sunshine, both in regard to its light and its heat, the last-named being obtained by means of the sunshine recorders which are now pretty generally used. He exhibited twelve monthly maps, showing the percentage proportion of hours of recorded sunshine to the hours the sun was above the horizon in the various districts of the United Kingdom. He stated that the features which strike any one on examining the maps of sunshine, which are for the most part for the last five summers and the last four winters, excluding January to March, 1885, which has not yet expired, are:—First, the broad fact that the extreme south-western and southern stations are the sunniest, as has already frequently been pointed out. Jersey is undoubtedly the most favoured of our stations in this particular. Secondly, that in the late autumn and winter Ireland is much sunnier than Great Britain, Dublin having absolutely the highest percentage of possible duration of sunshine in November and December, and being only equalled by Jersey in January. The Dublin instrument is not situated in the city, but at the Mountjoy Barracks in the Phœnix Park, beyond the Viceregal Lodge. The north-east of Scotland is also exceptionally bright, as the station—Aberdeen—lies to leeward of the Grampians. In April the line of 40 per cent. of possible duration takes in Jersey, Cornwall, Pembrokeshire, the Isle of Man, and the whole of Ireland, except Armagh. The absolute maximum of the year occurs in May, and the amount rises to 50 per cent.—nearly 60 in Jersey—over the district just mentioned as enjoying 40 per cent. in April. In June there is a falling off, which is continued into July, and even into August in the Western Highlands. In the South of England, however, a second maximum occurs in August, the figure for Jersey rising to 50 per cent. This is mainly due to the exceptionally bright weather of August, 1884, in the southern counties of England. In September Ireland shows a falling off, and the greatest degree of cloudiness is in Lincolnshire. In October the midland counties of England are the worst off. In November the line of 40 per cent. encloses two districts, one Dublin, already mentioned; the other the eastern counties—Cambridge and Beccles. The absolutely highest monthly percentages in the period under consideration are in the month of May, 1882, in which St. Anne's Head, Milford Haven, had 62 per cent.; while Geldeston—Beccles—Douglas—Isle of Man—and Southbourne—Bournemouth—show 61 per cent.

Drinking Water for the Soudan.—Particular attention has been paid by the Transport Department to the important matter of water supply for those engaged in the present Soudan Expedition, nearly the whole of the vessels chartered having condensers for the production of drinking water. The following vessels, among others, are so fitted, and with the producing capacity mentioned:—

Name of ship.	No. of condensers.	Maker.	Daily production.
Amethyst	1	J. Kirkaldy	6,000 gals.
Bulimba	1	do.	6,000 ,,
Calabria	10	do.	60,000 ,,
Cyphrenes	8	A. B. Fraser & Co.	48,000 ,,
Geelong	1	J. Kirkaldy	6,000 ,,
International	8	do.	48,000 ,,
Kangaroo	10	do.	60,000 ,,
Laleham	1	do.	5,000 ,,
Mount's Bay	1	do.	2,000 ,,
Somerset	1	do.	1,250 ,,
Tiverton	1	do.	2,000 ,,
Zurich	4	do.	24,000 ,,
Total	47		268,250 ,,

All have been rigidly tested by the Department.

PRIVATE BILL LEGISLATION.

DURING the past week a fair amount of work has been accomplished in regard to Private Bills, although few Select Committees have sat. Judging from what has taken place this week, there is not, after all, very much vitality in the opposition to Bills this Session, and Standing Orders Committees, Examiners and *Locus Standi* Committees have already decided the fate of many of the Bills without difficulty, while such Select Committees as have met have easily disposed of the schemes submitted to them. The Ship Canal Bill is, of course, a conspicuous exception, but of that more later on.

The Thames Deep-water Dock Bill, which we have previously mentioned, was in the end thrown out by Earl Ducie's Committee, the object of the measure being to obtain an extension of time for three years, within which to purchase lands for the proposed deep-water dock at Dagenham, sanctioned in 1881. It was at first thought that this decision would necessarily destroy the whole scheme, but it seems that the powers for acquiring the land do not expire till next July, so that the promoters have still a chance of purchasing the land, or coming to some agreement with the owners. Then they can go on with their scheme in their own way. The Standing Orders Committee of the Lords has dispensed with certain orders to enable the Crystal Palace, South-Eastern, and Metropolitan Railway Bill, and the East and West India Dock Company's Bill to proceed, but refused to facilitate in the same way the Northfleet Docks Bill, which therefore fails. The corresponding Committee in the Commission has allowed several Bills to go on—despite certain non-compliances—including Southwark and Vauxhall Water Bill; but declined to dispense with the Standing Orders in favour of the Regents' Canal, City, and Docks Railway—lands—Bill, and the two Bexley Heath Railway Bills. In the Court of Referees' the Metropolitan District Railway, and the London, Chatham, and Dover Railway sought for a *locus standi* against the Metropolitan Railway Bill for the erection of buildings, at a cost of £25,000, on certain lands at New Cross, which they hold on lease from the East London Railway Company. The case of the two opposing companies was that these lands belong to the five metropolitan railway companies, having in partnership rights over the East London line, and they therefore objected to the Metropolitan Railway Company obtaining a separate title to the property. After a long argument the referees so far agreed with the opponents as to grant them the *locus standi* they asked for. In the same Court a lengthy discussion was also raised with regard to the petitioners claiming a *locus standi* against the South-Eastern—various powers—Bill. There were in all seventeen petitioners, but the principal were the Midland, the Great Western, and the Great Northern Railway Companies. Some of the cases were arranged privately, but nearly all the rest obtained a *locus* with respect to certain portions of the Bill, especially that relating to the making of agreements with the Metropolitan Railway. A group of Bills remitted to a Committee, presided over by Mr. W. H. Gladstone, was disposed of in a very summary manner, all petitions against the Caterham Spring Water Bill and the Colne Valley Water Bill being withdrawn; an agreement being arrived at respecting the Maidstone Water Bill, and the opposition to the Rickmansworth Water Bill being dropped. Similar results ensued as to some other measures of a minor character. A Bill for the abandonment of the Skipton and Kettlewell Railway Bill—through want of support and consequent insufficiency of capital—and the release of the parliamentary deposit; and another Bill to revive and extend the time for the compulsory purchase of lands for the completion of the Selby and Mid Yorkshire Union Railway, were passed as unopposed Bills by the Chairman of Ways and Means; as were also the Oswestry Water and Runcorn Gas Bills.

The Mersey Subway Bill likewise came before Sir A. Otway as an unopposed measure, but it raised some interesting points before being passed. The purpose of the Bill is to extend and enlarge the powers of the promoters of the Liverpool and Birkenhead Subway, the capital for which is fixed at £500,000. One of the gentlemen interested—Mr. Bushell—stated that on a moderate calculation a surplus of income over expenditure to the extent of £20,000 a year would be realised, and it was proposed to save that profit year by year till the capital could be returned to the subscribers, after which the tolls would be abolished. Sir A. Otway asked why, instead of the promoting Company, the wealthy Corporations of Liverpool and Birkenhead did not take up the scheme; and Mr. Bushell replied that although the Mersey Dock Board had about one-third of the docks at Birkenhead, there had always been jealousy between the two sides of the river, and the Dock Board had refused to help the scheme until they saw the result of the Mersey Railway scheme. They had not actually refused to subscribe to this subway, but the Birkenhead Corporation had subscribed a fourth of the capital, and the Great Western Railway Company had agreed to subscribe £75,000. Observing that, in his opinion, a scheme for uniting these two important places in this way ought to have been undertaken by the two Corporations, Sir A. Otway next assailed the proposed toll of 1d. each way, urging the promoters to reduce it to ½d. each way, as in the case of the Thames Subway, or else to make the toll 1d. for the double journey. He pressed this suggestion more than once, but it could not be, or, at any rate, was not adopted, and all he could then do was to declare the Bill proved except upon one technical point. That was whether under certain Standing Orders amended since the original Bill was passed, a fresh deposit of 5 per cent. on the original estimate should be required and impounded. This question he reported for settlement to the House, and by the House it was referred to the Select Committee on Standing Orders.

The Water Companies—regulation of powers—Bill having been referred to a Select Committee of the House of Lords, was considered on Monday by that body. The principal matter for discussion arose out of Lord Camperdown's clauses requiring water companies to supply the particulars of their claims, and to take certain other steps before cutting off the supply of a consumer. A number of petitions were presented against the Bill on behalf of various provincial companies, and after some argument an adjournment till after Easter was ordered. Although there were these petitions, the companies generally show a desire to accept the Bill with certain amendments, and Mr. Hollams, representing the Metropolitan Water Company, said they wished to so alter the provisions with regard to giving particulars as to enact that the companies should not have power to cut off water or to enforce their powers until a period, say of twenty-one days had elapsed after they had delivered full particulars and given full opportunity to the consumer to object, and that if within that period the consumer appealed to a magistrate to fix the amount of the claim, then the company's powers of cutting off water should not be exercised until the magistrate had given his decision.

In the House of Lords, on Tuesday, Lord Lamington endeavoured to raise another discussion on the Bill for widening Parliament-street, although, as he himself admitted, the Bill was no longer in that House, but in the Commons. On the conclusion of his remarks, Lord Rosebery said he quite concurred with his noble friend in considering it highly objectionable that so important a site as Parliament-street, so close to the Government offices, should be dealt with by private enterprise; but although they would keep the subject before their attention, the Government could not do anything in the matter at present. The Select Committee on the restoration of Westminster Hall have suspended their inquiry for a week; but before their last adjournment they went in a body down to Westminster Hall to judge, by means of wood and canvas models, of the effect of the designs under their consideration. Into these designs we need not enter now; but although the Committee will take further evidence, it is believed that they incline to a design embracing a two-storey structure, which will contain rooms likely to be of use to members of Parliament.

Two matters connected with Private Bills, although not arising in the House, may be mentioned. The parochial authorities of Shoreditch and Bethnal Green have resolved, after a conference with the promoters of the Columbia Market Railway Bill, to withdraw their opposition to that measure, with a view to the development of the market as far as that is possible by means of the projected railway. Lord Henniker's Committee of Peers, Members of the House of Commons, and others interested in the Railway Rates Bills, held a meeting a few days ago to consider further their position with regard to these Bills. After a long discussion the Committee decided to take no further steps in the way of negotiation until it was seen whether these Bills were either rejected by the House or formally withdrawn.

The Manchester Ship Canal Bill continues to engage Earl Cowper's Select Committee of the Lords, eleven sittings having now been occupied. The promoters' case has been completed, and that of the opponents opened, so far as regards the engineering part of the scheme; and here it should be explained that since our last issue the Committee have announced that, contrary to expectation, although they are taking the engineering portion of the project first, they will not decide upon the Bill until they had also gone into the various other elements in the measure.

After the point at which we left the enquiry last week Mr. Leader Williams, the engineer, was cross-examined on some of the subsidiary issues, and this concluded his testimony. Mr. Michael, Q.C., then produced this new clause which the promoters had drawn up in place of clause 31 of the old Bills, and which should be read in order to understand the subsequent evidence:—"The company may from time to time dredge the bed, banks, shores, and channels of the river Mersey or the estuary thereof, and of the river Weaver or the estuary thereof, and of the river Irwell, within the following limits and for the purposes, in the manner, and to the extent following: That is to say, for the purpose of making and maintaining an access to the canal at Eastham, so much of the river Mersey or of the estuary thereof as lies below the commencement of work No. 1 and between Bromborough Pool and the commencement of work No. 1, and within those limits between the southern shore of the river Mersey and an imaginary line drawn from the entrance of the canal towards the Sloyne, distant about 300 yards from the shore at Eastham Ferry and 500 yards from the shore near the magazines at Bromborough. For the purpose of making and maintaining accesses to and from the low-water channels of the river Mersey or the estuary thereof, from and to the works No. 1 B B, 1 G (*a*), 1 G (*b*), 1 G (*c*), and 1 H (*a*), and for securing the passage and escape of land waters into the river Mersey or the estuary thereof; so much of the river Mersey or of the estuary thereof as lies to the north of work No. 1 and between the commencement thereof and Runcorn Bridge and an imaginary line drawn parallel with and at a distance of 500 yards to the north of the side of that work. In connection with and for the purposes of the works authorised by this Act, so much of the river Weaver and of the estuary thereof as lies between Frodsham Bridge and the estuary of the Mersey, also of so much of the river Mersey as lies between Runcorn Bridge and the junction of that river with the river Irwell, and so much of the last-mentioned river as lies between its junction with the river Mersey and Hunt's Bank in Manchester." Mr. Aspinall, Q.C., representing the Liverpool Corporation, said he was not satisfied with this clause, and promised to show that in effect there was no difference between the new and the original clause.

The promoters' evidence being resumed, Mr. James Abernethy, C.E., consulting engineer to the promoters, was examined. He expressed the conviction arrived at without any communication with Mr. Williams or anyone else, that the present plan took the most practicable route for a ship canal between Runcorn and Eastham; and that the works would not affect the estuary at all prejudicially, or tend to deflect the course of the present channel. He was also of opinion that the Weaver and Bridgwater Navigations, and the various systems connected with them, would be in no way injured, but, on the contrary, improved, and that those Navigations would gladly use the canal and pay tolls rather than wait for the tidal water of the estuary. He was satisfied further that this canal would not diminish the tidal scour of the Mersey. Mr. Hill, C.E., took a similar view on each of these points; and following him on the same side came Mr. Vernon Harcourt, C.E., a convert to the Bill. In 1883 and 1884 this gentleman gave evidence against the scheme, because, as he now explained, he believed that a fixed channel would injure the estuary. He believed, however, that a dredged channel, such as was now proposed, would not injure the estuary, hence his appearance on behalf of the Bill. As to the conflict between the promoters' scheme and that suggested last year by Mr. Lyster, he agreed that they differed in details, but not to the extent that the former would damage the estuary, while the latter would not. All things considered, he was satisfied this scheme would do no harm to the estuary on either side. Mr. John Fowler, C.E., enginer to the Tees Commissioners, and Mr. Messent, C.E., engineer to the Tyne Commissioners, both of whom were witnesses for the previous Bills, also spoke in favour of the present scheme, the latter observing that he still thought last year's plan a perfectly good one, though the present plan was, perhaps, more workable, as not being open to the objection of possible injury to the estuary.

Three or four more experts concluded the engineering case for the promoters, among these being Mr. Giles, C.E., M.P., engineer of the Southampton Docks. He stated that he still considered the previous schemes quite practicable, and that he was of opinion that the present scheme entirely got rid of the objections made against cutting a channel through the Mersey estuary. As the opponents had proposed practically the same scheme as this, he could not understand their opposition from an engineering point of view. The abstraction of water from the estuary would be so small in quantity as not to be worth consideration, and the ports on the river would not, in his judgment, suffer, while ships of the largest size would be able to navigate the channel.

The petitioners' case was opened, without any preliminary speech, by the examination of Captain Graham Hills, and his evidence had some surprising results imparting some very welcome animation to the proceedings. This gentleman is the marine surveyor to the Mersey Docks and Harbour Board, and may therefore be regarded as having the same interest in this matter, if not precisely the same views, as Mr. Lyster, the engineer to the Board; but it would appear that something has occurred since the last inquiry, when these two officials were quite at one. He of course combatted Mr. Leader Williams's contention, urging that a far greater amount would be extracted from the area of the river than Mr. Williams estimated, and that great damage would be done to the river generally, and to the bar by this scheme. He also severely criticised the evidence of Mr. Giles, and remarked that in some of his calculations that gentleman was really "going back to prehistoric times" for his basis. He, in fact, condemned the promoters' scheme and evidence all round; but when he came to be cross-examined by Mr. Pember, he boldly declared that Mr. Lyster's—his colleague's—alternative plan was not his plan, and he should recommend everybody interested in the Mersey to oppose that plan. This declaration took everyone by surprise, and created a commotion for a time; but its effect was somewhat marred by the subsequent explanation that he had not been asked for his advice upon Mr. Lyster's plan, and knew nothing of it beforehand. Later on he admitted that this plan was less open to objection than the promoters' plan, because it followed the sinuosities of the high-water line more closely, and did not cut off the indentations to the same extent, nor enter so far into the Weaver. The effect of Captain Hill's statements was very singular, and it is said that more surprises are in store for the Committee. Mr. Lyster was next examined in opposition to the Bill, and with reference to his own scheme he insisted that it was what he had suggested last year, that it differed radically from, and was much more practical and safe than that of the promoters, and that it would be impossible to work the canal with such a system of locks as Mr. Williams proposed.

During the week a number of petitioners, including the Weaver Navigation Justices and the Rochdale Canal Company, have come to an arrangement with the promoters, they being satisfied with the provisions proposed for safeguarding their interests.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, March 14th.

MAIL and telegraphic advices up to to-day, from eastern and western iron centres, all seem to indicate a gradual improvement in the volume of business in rails, old material, structural and plate iron, merchant bar, and pig iron. The activity grows out of the action of a large body of small consumers and railway buyers, who have been waiting for a long time for the disappearance of cold weather, and the resumption of operations at mills. The lowest prices known in the history of the iron trade now rule. The downward tendency in steel rails has been apparently checked by inquiries from many quarters throughout the West and South for large summer supplies, which, according to the best advices here, foot up in the neighbourhood of 5000 tons. More inquiries are likely to be presented. In financial circles it is known that the bonds of several new railroad companies are about being negotiated, and if these operations are successful, railroad building will be shortly inaugurated on a large scale. A great deal of capital is seeking employment, and there is no very good reason for not accepting the statement of railway projectors, that construction will begin during April. Railroad journals have announcements of the projected construction of between three and four thousand miles of road, running from fifty miles to two hundred. Good authority inclines to the belief that, in the event of an improvement in traffic and earnings, advantage will be taken by railway builders of the present low prices of material and labour, and that construction will be pushed quite actively during the summer months. Steel rails are selling this week at 27 dols. at Pennsylvania mills, and 28 dols. in some Western mills. The production of pig iron is not increasing, notwithstanding stocks are light, and consumption about equal to production. Prices range from 14 dols. to 16 dols. for forge in tide-water markets, and 16 dols. to 19 dols. for foundries, according to quality.

Car builders and car-wheel makers have recently received several good orders, and locomotive builders have within ten days secured orders for between thirty and forty engines. The larger machine shops have added to their labour-force, and there are rumours of large orders coming into the markets at an early day. All of these movements have had a favourable effect upon manufacturers and manufacturers' agents.

The coal trade is on the point of improvement. Contracts covering between two and three million tons of coal will be placed, possibly within three weeks. At least a great deal of business will be done in this market as soon as the spring prices have been definitely fixed. Anthracite coal has been reduced in price, as has also bituminous, and a sharp competition is now in progress for the securing of large manufacturing, railroad, and steamship requirements. New England buyers are very short of coal stocks, and the demand which must spring up from this source will be very large, and impart, temporarily, firmness to prices. The development of new coal-fields in Central Pennsylvania and West Virginia have threatened the permanency of coal prices this season; but producers believe their combination will prevent any hurtful competition from that source. The transporting interests will profit most out of the traffic, while producers will obtain barely remunerative prices.

Advices from interior manufacturing centres show that an improvement has taken place, and the breaking up of the winter, now at hand, will prepare the way for the placing of a large amount of business.

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

(*From our own Correspondent.*)

THE threatening aspect which the political horizon has again assumed was a matter of considerable debate on 'Change in Birmingham to-day—Thursday—no less than in Wolverhampton on the previous day. The effect upon the markets is to create such an amount of uncertainty as to prevent all chance of operating for forward. The demand is without improvement in any direction. Indeed, business is rather worse than a week ago, and the number of mills which are wholly idle is increasing.

All over the district works are to be found very partially employed. At some establishments only one-third of the plant is running. This state of things is seen alike in sheets, bars, and hoops, and the prospects of any early change for the better seem remote. In one part of the district the make was reduced last month by the stoppage of about fifty puddling furnaces.

Prices are easier than a week ago, and as to iron for constructive engineering purposes and for tank making, the competition of the North of England makers is unrelieved. Simultaneously, the Lancashire manufacturers are keenly competing with our makers of hoops, and strips, and galvanised sheets, and the Welsh steel and ironmasters are pushing their bars into this district. Marked bars remain nominally at £7 10s., at which they have stood for over two years. Current prices for common bars are the lowest that have been accepted for a number of years past. They are selling at £5 10s. down to £5 5s. and even £5 2s. 6d. Hoops and strips of common qualities may be had at the same prices, although other makers quote £5 10s. up to £6.

Colonial orders are about the best on export account, but South America and India are also moderate customers. Enquiries are on the market this week for baling strips for the United States, of 90ft. lengths, rolled into coils. Most of the business, however, doing with the United States and Canada is in thin sheets and tin-plates. Prices of merchant and galvanising sheets are open to much negotiation. Singles are quoted at £6 10s., but buyers declare that they can purchase for less money.

Sales of pig iron are small, and deliveries under former contracts from alike native and Midland makers are decreasing rapidly, in accordance with the expressed desire of consumers who have not the necessary orders on their books to work them up. One native maker in particular has stacked several thousand tons since Christmas, and some other makers are not much better off. Furnaces, therefore, are being blown out. It is estimated that the present weekly aggregate output has dropped to not much beyond 7000 tons.

Prices are down nearly at the lowest point touched for some years. All-mine sorts are quoted 60s. down to 57s. 6d., but with hematites quoted 55s., and selling at, it is reported in some instances, even 52s. 6d., it is impossible to get the rates demanded by the all-mine makers. Part-mines are 42s. down to 40s., and cinder pigs 37s. 6d. down to 35s. per ton. Derbyshire and Northampton pigs are without strength, at 40s., delivered to stations, for the former, and 39s. for the latter.

The coal trade is without life. The pits are only doing about half time, and in some localities only two days a week. Prices are very depressed, on the basis of 5s. 6d. to 6s. 6d. for forge sorts, and 8s. to 10s. for furnace sorts. Masters are beginning seriously to debate the prospects of a reduction in wages. Of course the men would threaten resistance, but combined action by the employers might render this resistance useless.

So dissatisfied are certain of our constructive engineers becoming at the condition of affairs that they are beginning to regard as almost useless the trouble of going through specifications. It is not therefore surprising that there should be serious debate at the present time, even by concerns of the largest magnitude, of the necessity for a reduction of engineers' wages. Only those firms can see a profit upon current business who are exceptionally placed in the matter of economical working and the like, and even with these concerns the profits are very small.

Steam pump makers have welcomed the inquiry by the War-office for four steam pumps for the Suakim-Berber pipe line, to supplement those purchased from Messrs. Worthington, of New York. I am able to state that the pumps are to be similar to the Worthington; *i.e.*, constructed on the duplex principle, and having 18in. cylinders.

Since last week additional contracts have been received by certain of the wrought iron tube makers previously engaged upon portions of the Suakim pipe line.

Engines, dynamos, and other machinery for electric lighting are in good demand. The electric machinery firms mostly keep quite busy. Parker and Elwell, Wolverhampton, are very favourably situated for orders, alike for engines and dynamos. Although they are constantly increasing their working staff, and are running overtime, they are unable to keep pace with contracts. Among the latest contracts accepted for motors is one for the machines for driving the new electric trams at Blackpool.

Local engineers should stand a good chance for the direct-acting, non-condensing steam engines, and well pumps, and the Cornish boilers just now needed by the local authorities at Hatherstone, but the contracts for the capital lot of engines and pumps and steel boilers for erection at the Hastings Waterworks will most probably go to London.

Machinists who supply the wants of the galvanised corrugated sheet makers have not much new work in hand, since the galvanised sheet business would seem to be rather overdone. Yet the Wolverhampton Corrugated Iron Company has just erected at its extensive new works two close-annealing furnaces, which together will close-anneal 120 tons of sheets at once.

The demand for engineering and ironfoundry work of a not heavy description for ironworks and colliery purposes is quiet.

Mr. Wiley, a nut and bolt manufacturer of Darlaston, together with his twenty-five men, still withstands the strong agitation which is in progress to induce him to join the Masters' Association. The Operatives' Society is doing its utmost to get him to give in his adhesion to the movement, since the general body of masters has only consented to forego the 10 per cent. reduction on the condition of the operatives compelling every master to join the Association. The agitation is not now confined to South Staffordshire, for the Operatives' Society has called men out at Workington, and they boast that they intend to extend it throughout Lancashire, Yorkshire, and Scotland.

An exhibition of gas stoves and other gas apparatus, promoted by the Bilston Gas Light and Coke Company, is being held in the Town Hall this week.

Cultivating and edge tool makers are active, but prices are still a matter of loud complaint. India is the best market—railway, plantation, and road-making tools going to Bombay, Calcutta, and Madras in large lots. Australia and America are buying moderately.

Makers have this week tendered to the War-office for shovels, pickaxes, army picks, hooks, large and one-hand axes, and other tools, to be used in the construction of the Suakim railway and for other purposes in the East. Some thousands of each description of tool is inquired for.

A ship tackle firm in Wolverhampton is negotiating with the Admiralty for a large order for work for the protection of ships from destruction by torpedo boats.

Muntz's Metal Company are manufacturing tubular coils upon an important new patent process. They dispense altogether with the mandril, and draw tubes 70ft. or 80ft. long, or longer, with a movable plug. No joint or brazing is required. Very large coils can now be manufactured with remarkable rapidity, and almost a revolution in this branch of tube making is threatened. An order for the Nile expedition was executed almost as soon as received.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Except that there are, perhaps, rather more enquiries stirring for finished iron, with here and there a slightly increased weight of business doing, there is no very material change to report in the condition of the iron trade of this district. A depressed tone still characterises business generally, with a disinclination on the part of both buyers and sellers, in the present uncertain state of the market, to commit themselves at all heavily to any long forward engagements. So far as pig iron is concerned, consumers who bought at all largely some time back, when contracts for a moderate weight of iron were placed, have in most cases either iron in stock or still to come in more than sufficient to cover any requirements they have in prospect, and low prices offer little or no inducement for giving out further orders. Practically, the only buyers in the market are those who have all along been purchasing simply from hand to mouth, and as the continued downward tendency of prices has fully justified them in this line of action, they are still only disposed to give out small orders to cover actual requirements. In the manufactured iron trade the slight improvement which has been manifested during the past week is not as yet sufficiently established, or so general in its character, as to make itself appreciably felt, and in most cases the forges are still only kept very irregularly employed, whilst prices are not more than maintained on the low basis that has been ruling of late.

The Manchester iron market on Tuesday was moderately well attended, but there was an absence of any animation in business, and to secure orders very low prices had to be taken. For local and district brands of pig iron, 40s. to 40s. 6d., less 2½ per cent., delivered equal to Manchester, remained the minimum figures quoted by the leading makers, but on the basis of these prices only a few small orders from regular customers are being got, and there are one or two sellers of district brands who are open to take 1s. to 1s. 6d. per ton under the figures quoted above. Middlesbrough iron meets with little or no demand, and the best foundry qualities are to be got at about 43s. net cash delivered equal to Manchester, with ordinary g.m.b.s offering at about 6d. per ton less.

For hematites no inquiry whatever is reported in some cases, and generally there is a continued absence of business of any weight coming forward. For delivery into the Manchester district 53s. to 53s. 6d., less 2½ per cent., are about the nominal quotations for good foundry qualities.

In the manufactured iron trade the opening of the shipping season is bringing out some inquiry which has resulted in a little accession of actual business, and in the home trade a few of the makers report orders coming forward rather more freely, but generally business continues very dull, and for delivery into the Manchester district prices remain on the basis of about £5 7s. 6d. per ton good Lancashire and North Staffordshire bars, £5 17s. 6d. for hoops, and £6 17s. 6d. to £7 per ton for sheets.

In the coal trade a moderate demand is still kept up for house fire classes of fuel, but all other descriptions of fuel for iron-making, steam, and general trade purposes meet with a very slow sale, and common round coal is quite a drug in the market. Prices are without material change, and except that some slight giving way in the delivered rates for engine fuel is probable in the Manchester district, there is no indication of any actually announced reduction in list rates with the close of the month. There is, however, generally so much underselling where business of any weight is to be done that list rates to a very large extent are little more than nominal, and although colliery proprietors, in the face of the threatened strike in the Yorkshire coalfield, are naturally chary about making concessions just at present, there is no actual firmness in prices. At the pit mouth best coal averages 8s. 6d. to 9s.; seconds, 7s. to 7s. 6d.; common coal, 5s. 3d. to 5s. 9d.; burgy, 4s. 6d. to 5s.; and slack, from 2s. 9d. to 3s. for common to 4s. for the better sorts.

Shipping has been only quiet, with good steam coal, delivered at the high level, Liverpool, or the Garston Docks, not averaging more than 7s. to 7s. 3d. per ton, and some descriptions to be bought at 6s. 9d. per ton.

Barrow.—There is no change to note in the state of the hematite pig iron trade. The bulk of the deliveries taking place are on home account, and very little is being done in the continental and colonial markets. There is a considerable amount of work in hand, but I hear general complaints of the dilatoriness of consumers to place fresh orders. This is the more remarkable, seeing that makers for a good while past have steadily resisted all attempts to lower current quotations, and that if any alteration should take place it is almost certain to be in an upward direction. I am aware that several makers with a reputation for accurately testing the trade barometer anticipate with some amount of sanguineness an accession of orders with the full advent of spring, and I should be sorry in any way to darken this roseate prospect. But "l'homme propose," &c. Any way, there is nothing to rejoice over in existing facts. Stocks are increasing every day, and I hear one important firm has decided to put out two furnaces in order to attain some proportion between output and demand. There is an improvement in the steel trade both for railway and merchant qualities, but fresh orders are immediately needed to prevent the present activity being merely spasmodic. Iron ore is in moderate demand at late quotations. The coal and coke trade has slightly improved in tone, but prices have shown no tendency to vary either way.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

IT is a good sign that the miners have abandoned the uncompromising attitude they adopted at their first conference at Rotherham, when they distinctly declined to seek any interview with the employers. They have now solicited a meeting, and the Coalowners' Committee have granted their request. No fewer than 36,000 miners and other colliery workmen are now under notice in South and West Yorkshire, with a probability of the number being greatly increased by the addition of Derbyshire and probably South Staffordshire. The serious part of the difficulty is that the coalowners themselves will be rather glad than otherwise to have an opportunity of clearing off their accumulated stocks, which are a great factor in the affair, particularly as summer is approaching. The singular feature of the present wages difficulty is, that although we are within four days of the threatened stoppage of nearly all the leading Yorkshire pits, coal keeps its normal value, instead of rising by leaps and bounds as in previous conflicts between capital and labour in the Yorkshire coalfield.

Messrs. Wm. Cooke and Co., of the Tinsley Steel, Iron, and Wire Works, have had a very pleasing incident to brighten their prolonged period of depression. It is the only case of the kind which has ever occurred in this or any other district. The puddlers and millmen, appreciating the great difficulties their employers have laboured under during the prolonged depression of trade, held a meeting at which they unanimously decided to make the company the offer of a week's work for nothing, to show their desire to assist them in the time of adversity. The offer was formally made to the manager on Monday, and accepted. It should be added that the men's wages are ruled by the South Staffordshire Board, and they have therefore no power to consent to a reduction; under these circumstances they did what they could, and did it handsomely. The offer has made a most agreeable impression in business circles.

The annual meeting of Messrs. William Jessop and Sons, Brightside Steel Works, was held on Wednesday. The chairman, Mr. T. Jessop, J.P., presided. The reduced dividend of 5 per cent. —2½ less than last year—was passed. In accounting for the operations of the year, Mr. Jessop stated that the American trade had been exceedingly dull, and the company was now turning its attention to other branches of work, which would prevent its being so dependent on one market. One great speciality, which it has to itself, was the production of stern frames in solid crucible steel for ships. A huge specimen of this work has just been delivered to a Belfast firm, for a London and North-Western steamer plying between Holyhead and Dublin. It was a stern frame for a twin-screw steamer. The size of the frame is 25ft. by 17ft., and it is 10ft. across, and weighs 13 tons. Messrs. William Jessop and Sons have several orders for frames for the English Admiralty, as well as for continental navies.

An unusual event has come to my knowledge within this week. About a fortnight ago several Arabs, accompanied by an interpreter, visited Sheffield. They had been at Birmingham, and their object in coming to Sheffield was to secure machinery, for which they were prepared to pay cash down, for the manufacture of gun-locks. They failed in their mission, and it is believed they were also unsuccessful in Birmingham, where, it is understood, they tried to negotiate the purchase of small fire-arm appliances.

Iron quotations are now as follows:—Common foundry iron, No. 1, 43s. per ton; No. 2, 42s.; No. 3, 41s.; common forge iron, 39s. to 40s. per ton; hematite pig iron, Nos. 1, 2, and 3, 52s. 6d. per ton delivered at Sheffield. The latter is used for Bessemer and Siemens purposes.

The conning towers for the Forth, Thames, Mersey, and Severn, to which I have already referred in THE ENGINEER, have been given out to Messrs. John Brown and Co., Atlas Steel and Iron Works. The Admiralty have now issued invitations for the two large armour-clads to be built by contract. Each ship will require about 2000 tons of compound armour and 700 tons of steel deck-plates.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

DULNESS still prevails in the Cleveland pig iron trade. It can scarcely be said, however, that things are worse than they have been of late, for it seems to be generally believed that the worst has passed. Makers generally have sufficient orders for the present, and are not pressing their iron on the market. On the other hand, buyers are extremely cautious, and but few sales have been made either by merchants or makers during last week. Prices are maintained at about the same as a week since. Merchants sell small lots of No. 3 g.m.b. for prompt delivery and for next month at 34s. per ton. Occasionally makers also accept that figure, but as a rule they do not take less than 34s. 3d., and certain of them continue to quote 34s. 6d. The best brands of forge iron realise 33s. 3d. per ton, the supply being still very limited. It may, however, pay to produce more of this grade, now that the difference in price between it and No. 3 is again normal.

There is but little demand for warrants, and holders do not seem to be disposed to take less than 33s. 6d. per ton for them. Messrs. Connal and Co.'s stock of pig iron at Middlesbrough is 50,832 tons, being the same as last week.

Inquiries for ship-plates, angles, and bars are rather more numerous than they have been for some time; but makers have not yet experienced much benefit, and prices remain the same as last quoted. Bar makers are fairly busy, and talk of stiffening their prices. Ship-plates can still be had at £4 15s. per ton, ship angles at £4 12s. 6d., and common bars at £4 17s. 6d. to £5; all on trucks at makers' works; terms cash 10th, less 2½ per cent. discount. Puddled bars are quoted at about £3 per ton net.

Steel-plate manufacturers are fairly busy, but the demand for rails is quiet. Plates are £6 17s. 6d. to £7 per ton, and rails £4 15s. per ton at makers' works.

The directors of Sir W. J. Armstrong, Mitchell, and Co. have declared an interim dividend of 5 per cent. on the past half-years' working.

The blast furnacemen of the Cleveland district have decided to terminate the sliding scale arrangements by which their wages are regulated, and have given three months' notice to that effect.

There is now nearly 45s. per ton difference between the price of iron and that of steel plates for shipbuilding. Not only so, but it is difficult to obtain steel as fast as is required; whilst, on the other hand, iron manufacturers execute with the utmost promptness any specifications which may be entrusted to them. The difficulty of obtaining steel is not due altogether to deficiency in power of supply, but partly to the delays and troubles arising from the severity of the tests deemed essential. It is rumoured that Lloyd's committee regrets the largeness of the reduction of scantlings, whish at first it permitted in favour of steel, and that its present policy is in the direction of diminishing this difference. Eventually it hopes to see all steel ships made to the same scantlings as have hitherto been insisted on for iron. All this is evidently in favour of a better demand for iron, for it increases the cost of steel ships, and diminishes their carrying capacity. Certainly the safety and durability of steel ships will be augmented; but this is a matter in which underwriters, sailors, and the nation generally are interested, rather than shipowners, who look for profit only or mainly.

There are still a large number of steamships laid up idle in the Tyne. At a meeting of the Commissioners, held on the 6th inst., it was reported that there were 95, with a gross tonnage of 71,254. In March, 1883, the number idle was 63, with a gross tonnage of 71,651. From this it would appear that the depression in the carrying trade had neither increased nor diminished. Inasmuch as the tonnage is about equal, whereas the number varies as 63 to 95, it would seem that the steamers at present idle are in size only two-thirds of those which were idle a year since; but there are once and a-half as many. This is difficult to account for. It may perhaps be concluded that long-voyage freights are the best now, and short-voyage freights were then.

The Wear shipbuilding trade is still detrimentally affected by strikes. This time it is the joiners, shipwrights, and smiths. They refuse to work at current wages. Some of them have left the town, and the remainder are appealing to the public for support. Sunderland workmen have certainly obtained a most unenviable notoriety for quarrelling with their bread and butter. Such men do not deserve to have any.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE was a slight upward movement in the warrant market early this week, in consequence of a report that efforts were being made which might possibly result in a slight curtailment of the output of pig iron. It is certain that, although there are only ninety-two furnaces in operation, they are producing several thousand tons a week more iron than can be disposed of, and this is a serious matter at a time like the present, when the demand is so poor and prices so low. At the same time, it may be doubted whether the damping of furnaces would yield much relief, particularly in view of the fact that the consumption of Cleveland pig iron in Scotland has been rapidly increasing since the beginning of the year. The shipments of Scotch pig iron continue very unsatisfactory in amount. In the past week 7299 tons were despatched, against 8879 tons in the preceding week, and 11,577 tons in the corresponding week of 1885. The inquiry from abroad does not exhibit any improvement. From Germany, particularly, only the most meagre orders are available, the Germans having largely increased their own production of pig iron. The stocks in the Glasgow warrant stores this week show an increase of 1500 tons.

Business was done in the warrant market on Friday at 41s. 4½d. to 41s. 3d. cash. On Monday forenoon business was done at 41s. 2½d. to 41s. 3d. cash, the latter being the quotation in the afternoon. Transactions occurred on Tuesday from 41s. 3d. up to 41s. 6½d. cash. Business took place on Wednesday at 41s. 6d. to 41s. 7½d. cash. To-day—Thursday—warrants declined from 41s. 7d. to 41s. 5d. cash, closing with buyers at the latter price; sellers ½d. more.

For makers' iron the demand is slow, and the prices current are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s. 3d.; No. 3, 46s. 6d.; 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. 6d.; 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.

Messrs. Andrew and Jas. Stewart, of the Clyde Tube Works, have now completed about one-half their contract of fifty miles of pipes for the water pipe line between Berber and Suakim. The pipes are strong, malleable, and tested to 1800 lb. to the square inch.

Several additional vessels have been placed with Clyde shipbuilders, the material for which will add to the activity of the makers of steel.

The past week's exports of manufactures from the Clyde included seven locomotives, valued at £18,592, machinery worth £21,200, sewing machines £1916, steel goods £8900, and general iron manufactures £28,080.

The coal trade is still exceptionally quiet in nearly every district. Shipments are lower than usual, and the home inquiry is likewise unsatisfactory. At Glasgow the week's exports of coals have been 10,135 tons; Greenock, 91 tons; Irvine, 1867; Ayr, 6737; Troon, 7094; and Grangemouth, 2029 tons. The inquiries are poor at most of the ports, but orders are in hand at a few that will keep them going actively until the shipping trade improves. The season in which steam coal ought to be in demand is approaching. In the meantime, however, business is very sluggish. The prices of all sorts of coals are reduced at Lanarkshire ports. Free on board, main coal is quoted at 5s. 9d. to 6s. 3d. a ton; ell, 5s. 3d. to 7s. 3d.; splint, 6s. 3d. to 7s.; and steam, 7s. to 8s.

A reduction of 6d. a day on colliers' wages is now to be made general in the West of Scotland, and it appears that at some of the ironworks the ironstone miners and ironworkers are likewise to have their pay curtailed. In some places the miners have held meetings to consider whether they should offer resistance to the reduction, but as they have neither a union nor funds, it is not believed that they can take any effective action. To the credit of the masters it should be stated that both the amount of business and the prices had been declining for several weeks before they resolved on curtailing the wages of the men. Notices were posted up on Saturday at all the pits in Fife and Clackmannan, intimating that in fifteen days the wages of miners would be reduced by 10 and those of workers above ground by 5 per cent. Stocks are rapidly accumulating, and trade has not been so dull as it is at present for seven or eight years.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

CARDIFF has suffered of late from the depression in the steamship trade, and has had to pay the penalty for too much speculation. At one time everybody wanted to have shares in a steamer, now few will look upon one, unless floated by one of the best of the coal firms.

The annual meeting of the Iolo Morganney Steamship Company was held this week, and the report, showing income and expenditure, is of general interest. For instance, I find that on one voyage the vessel took coal to Ancona at 10s. 6d. per ton; at another voyage she took coal from Leith to Odessa at 5s. 3d. per ton; at another, with coal from Cardiff to Gibraltar, 6s. 10d. per ton. The return voyages were: Rye, 2s. 6d. per quarter; iron ore, 7s. 9d. per ton; wheat, 4s. per quarter. The total receipts for the year were £5014 17s. 6d.; expenses, £5073 15s. 5d. In this latter item was included insurance, £1180 0s. 8d. As the working of the year showed a loss, it was decided to reduce the insurance from £22,000, the cost of the vessel, to £18,000.

The steam coal trade is decidedly looking up again at Cardiff and at Swansea. Both ports keep up a good average, and as for Cardiff it is rapidly totalling up to 160,000 tons weekly. Newport does not share this prosperity thus far, having a greater field of house coal, which remains in a stagnant state.

Generally speaking, the steam coal trade is dull, taking the whole of the coal-field into consideration, and prices are quiet. The leading collieries enjoy the best trade. Small steam continues in good demand, and prices are stiff. I find that one of the causes of this lies in the economical administration of several French and Italian companies—steam and rail—who are using small steam coal for their locomotives and boilers. The Italians claim to have found a method for using small in marine boilers, and the Societe Navigatione Generale Italiana, whose use of coal has been close upon 200,000 tons per annum, will adopt it.

No settlement has been arrived at between the owners and colliers at Middle Duffryn. The strike promises to be a severe one. The claim of the workmen at Tyla Coch for £700 wages will be heard this week, and the result is anxiously looked forward to.

In the course of a week or ten days the battle royal of the railways and docks will take place. The Bute and Taff Amalgamation scheme is securing good support. I should like to see the Taff and Rhymney railways amalgamated. This would strengthen the scheme, and certainly be regarded with favour by the committee. A good deal of agitation is current amongst Rhymney shareholders anent the matter, and all are anxious to amalgamate if fair terms are offered.

The Cardiff and Monmouthshire Railway scheme has been shorn of No. 8 railway, and will be the gainer in consequence, getting rid of opposition and an objectionable gradient. Cardiff Corporation will support the Bill.

I referred some time ago to the project of the London and North-Western Company for replacing their wooden with steel sleepers. Some little difficulty has been met with in making these, and steel makers in general cases have refused the order, as it has caused damaging breakages to the machinery. Dowlais, I hear, has at length succeeded in turning them out, and a new trade is likely. A good deal of hopeful anticipation exists at Dowlais on the subject. In addition, an immense outlay for new machinery and other improvements is being incurred at Dowlais, and this is assumed to mean business.

Early preparations are expected in the Taff Valley in the formation of the Cardiff waterworks.

Mr. Walker is getting on with his customary vigour at Barry, but of late several accidents have occurred from incautious operations by the men.

Mr. Riches, the able locomotive superintendent of the Taff Vale Railway, has brought out a new locomotive with special action. This I shall note again.

Some prospects are now certain of the Garth Works, near Cardiff, being utilised. A firm—Castell Patent Fuel and Purified Coal Company—are about to start them.

Most of the tin-plate works are tolerably full of orders, though, in the face of the forthcoming Birmingham meeting, there is a visible holding back of business by buyers. On Monday next the workers will hold a meeting at Swansea, and the proceedings are looked forward to with interest. Prices are quiet, and will remain so until both meetings have been held. Good cargoes have been sent away of late, and Swansea is rapidly becoming the headquarters of the trade. Special sizes and roofing plates continue in demand, and are regarded with favour by makers.

A project is on foot, principally by Llanelly men, to start a steamship company for trading between Liverpool and ports on the Bristol Channel.

A fine seam of coal has been struck in the Garw Valley by the Transatlantic Company. Mr. W. Thomas, Brynawell, is the engineer.

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.

17th March, 1885.

3414. PETROLEUM and GAS ENGINES, J. Spiel, Manchester.
3415. AUTOMATIC AIR PRESSURE TRAIN BRAKES, W. Webb, Leeds.
3416. GRIDIRONS, J. W. Sankey, Birmingham.
3417. RAILWAY SWITCH BOX, E. and J. H. Walker, Rotherham.
3418. INSURING SAFETY from COLLAPSE in STILLS, &c., R. M. McDougall, Glasgow.
3419. METALLIC ETCHING, A. Piper, Wolverhampton.
3420. AIR-WARMING GRATE BACKS, G. L. Shorland, Manchester.
3421. SEWING MACHINES, J. W. Urquhart, Northampton.
3422. VENTILATING, D. Thomson, Glasgow.
3423. FILTERING COMPOUNDS, &c., C. E. Chamberland, Paris.
3424. BRAKE IRONWORK for VEHICLES, J. G. Harrison, Birmingham.
3425. SLIDING RING HOOKS for SUSPENDING PICTURES, P. E. Ayton, Birmingham.
3426. SNARING of MOLES, J. Haden, Wolverhampton.
3427. SLIDING COVERS for BUTTER COOLERS, &c., T. Marsh, Birmingham.
3428. LOCK-STITCH SEWING MACHINES, D. Jones, London.
3429. ROCKETS, J. Whitley, Leeds.
3430. SADDLES for BICYCLES, &c., T. J. Kirkpatrick, London.
3431. TRAVELLING SWING, M. E. Studman, Glasgow.
3432. SHIPS' ANCHOR or RIDING LIGHTS, W. Harvie, Glasgow.
3433. ROLLER for WINDOW BLINDS, &c., T. R. Shillito.—(*O. Kluge, Germany.*)
3434. GUIDING, STRAIGHTENING, and EVENING FABRICS, H. J. Allison.—(*A. M. Arnold, United States.*)
3435. CLIMBING CHIMNEYS, &c., J. Brown and T. A. Porter, London.
3436. BASKET SKIPS, &c., T. Harden, London.
3437. PICKER STICKS for LOOMS for WEAVING, E. Pettersson, London.
3438. PUMPING ENGINES, G. Parfitt, London.
3439. FIRE-FEEDER, J. Goodman, London.
3440. ROUGHING HORSESHOES, E. J. Hayball, London.
3441. AMMONIATED SOAPS, FREE from OLEATES, &c., C. R. Huxley, London.
3442. STEERING GEAR, A. J. Boult.—(*C. H. Washburn, United States.*)
3443. PLANES, J. W. Lowe, London.
3444. PUMPS, J. A. Wade and J. Cherry, London.
3445. DECORATING GLASS, PORCELAIN, &c., G. J. Atkins, London.
3446. ELECTRICAL GENERATORS and MOTORS, T. J. Handford.—(*F. J. Sprague, United States.*)
3447. INVALID COUCHES, T., L., M., J., and T. Robinson, London.
3448. VALVES and VALVE STOPPERS, J. J. Varley, London.
3449. PREPARING FAT for the REFINING OPERATION, F. O. Kloninger, London.
3450. PRESSING and TENTERING WOOLLEN, &c., FABRICS, G. H. Nussey and W. Leachman, London.
3451. SPINDLE-BEARINGS of SPINNING, &c., MACHINES, L. H. Kraft, London.
3452. APPARATUS for CHECKING the RECOIL of GUNS, A. Sauvée.—(*J. B. G. A. Canet, France.*)—*20th December*, 1884.
3453. AIRING, &c., BEDS, L. A. Groth.—(*K. Weinberger, Germany.*)
3454. ARTIFICIAL GROTTOS, L. A. Groth.—(*A. Dirgl, Germany.*)
3455. CURBS or CHECKS, L. A. Groth.—(*P. and C. G. Rolla, Italy.*)
3456. GAME called HEXAGRAM, L. A. Groth.—(*J. Lüdemann, Germany.*)
3457. CHLORIDE or DOUBLE CHLORIDE with SODIUM or POTASSIUM of ALUMINIUM, L. A. Groth.—(*R. Grätzel, Germany.*)—*5th January*, 1885.
3458. VALVE COCK, R. B. Evered, London.
3459. CRUSHING or GRINDING MILLS, W. R. Lake.—(*H. Gruson, Germany.*)
3460. PRINTING MACHINE or PRESSES, W. R. Lake.—(*J. T. Hawkins, United States.*)
3461. MILK-CANS, W. R. Lake.—(*F. Fleischmann, Austria.*)
3462. PRODUCING ARTIFICIAL RESPIRATION, W. R. Lake.—(*J. Ketchum, United States.*)
3463. BOTTLE-STOPPERS, W. R. Lake.—(*F. J. Deverall and T. Coit, United States.*)
3464. FLUSHING CISTERNS, R. B. Evered, London.
3465. BUTTON-HOLE ATTACHMENTS for SEWING MACHINES, E. B. Moore and G. Rehfuss, London.
3466. SELF-LIGHTING APPARATUS, A. M. Clark.—(*J. Dufourg, France.*)
3467. DYNAMO-ELECTRIC MACHINES, A. M. Clark.—(*L. Vissière, France.*)
3468. TOOLS, J. Deeks, London.
3469. FIXING for REELS of FISHING-RODS, J. H. Hannay, London.
3470. REPEATING RIFLES, C F. Wood, London.
3471. GAS ENGINES, W. W. Pope, London.
3472. AIR-TIGHT BOTTLES, &c., L. Hamel, London.

18th March, 1885.

3473. SUGAR SIFTERS, A. J. Bailey, Birmingham.
3474. WASHING MACHINE, J. Kidd, Dublin.
3475. TELEPHONE RECEIVERS, G. H. Bassano, A. E. Slater, and F. T. Hollins, Derby.
3476. ANCHORS, W. W. Smith, Newcastle-on-Tyne.
3477. CHIMNEY COWLS, T. S. Wilson and H. T. Johnson, Manchester.
3478. REGULATING the PRESSURE on the ROLLERS of CLOTHES WRINGING MACHINES and MANGLES, P. Burt, Glasgow.
3479. ROLLERS for WASHING, W. J. Knowles, Halifax.
3480. TAPS or STOP-COCKS, J. Dunbar, Glasgow.
3481. ALARM BELLS, T. E. Ware, London.
3482. PERFECTION SASH, T. J. Hawkins, Uxbridge.
3483. SEED PROTECTOR, T. J. Hawkins, Uxbridge.
3484. COVERS for BOTTLES, &c., W. P. Thompson.—(*L. H. Warin, France.*)
3485. CATTLE FOOD, G. Lewis, Liverpool.
3486. SPINDLES and FLYERS, J. S. D. Shanks and J. Shanks, Belfast.
3487. FUSTIAN CUTTING FRAME, H. Beresford, Bollington.
3488. COLOURED ORNAMENTAL GLASS, G. Stephens, London.
3489. LUXOLEUM PAINTING in COLOURS, L. H. Goggs, London.
3490. BICYCLES and TRICYCLES, J. Monteith, Glasgow.
3491. FLANGES for LOOMS, T. Reeder, Preston.
3492. HOLDING WINDOW BLINDS, F. Howcroft, London.
3493. AUTOMATIC SAW-SETTING MACHINES, J. Anderson, Newcastle-on-Tyne.
3494. CUTTING STEEL RAILS, J. Cooke and J. Rushton, London.
3495. TRICYCLES, J. Bullock, Halifax.
3496. JEWELLERY FASTENER, J. E. Walsh.—(*E. König, Belgium.*)
3497. CONVEYANCE for CATTLE, &c., E. D. McCarthy, London.
3498. BEARINGS for LOCOMOTIVE ENGINES, J. Willis, Attercliffe.
3499. OHMMETER for MEASURING ELECTRICAL RESISTANCES, M. A. Andreoli.—(*L. Maiche, France.*)
3500. CHECKING the RECEIPTS of CONDUCTORS of OMNIBUSES, &c., D. Meehan, London.
3501. PRESS for HAY, &c., H. C. Capel, London.
3502. GAS-BURNERS, W. Goebel, London.
3503. HYDRAULIC TESTING PUMPS, T. I. Cammell, London.
3504. WEIGHING MACHINES, J. C. Mewburn.—(*D. Girres, France.*)
3505. ELECTRIC CARTRIDGES, S. Russell, London.—*22nd October*, 1884.
3506. WASHING, &c., WOOL, T. Speight and H. W. Whitehead, London.
3507. SUSPENDED LEVER WEIGHING MACHINES, W. Simpson, London.
3508. REFLECTOR SUSPENDER for GAS LAMPS, J. Bate and T. D. Green, Birmingham.
3509. HORSE-SHOEING, J. Atkinson, London.
3510. TOOLS for MOULDING the HEADS of BOTTLES, J. Deeks, London.
3511. SECURING FLANGES to COPPER and BRASS TUBES, J. W. Woore, London.
3512. FIXING DOOR KNOBS to their SPINDLES, &c., E. Summerfield, London.
3513. STOP TAPS, &c., T. Carpenter and W. H. Ford, London.
3514 FASTENER for GLOVES, E. Fisher, London.
3515. CORSETS, S. and A. Uhlman, London.
3516. SCREW FORGING or ROLLING APPARATUS, C. Fairbairn, London.
3517. APPLIANCE to SUGAR BASINS for HOLDING the SUGAR TONGS, M. F. E. Huard, London.
3518. INCANDESCENT ELECTRIC LAMP, A. Khotinsky, London.
3519. NUTCRACKERS, C. C. Hull, London.
3520. WATCHES, &c., J. Kendal and M. Laval, London.
3521. PUFFING COLLARS and RUFFLES, H. Schmidt, London.
3522. LUBRICATORS, R. Lauder, London.
3523. CIRCULAR or ENDLESS RAILWAYS, H. H. Lake.—(*A. Wood, U.S.*)
3524. ELECTRIC DYNAMIC MOTORS, T. J. Handford.—(*F. J. Sprague, U.S.*)
3525. DISTRIBUTING and UTILISING ELECTRICITY, R. P. and J. S. Sellon, London.
3526. METAL TOE CAPS for BOOTS and SHOES, C. Hamilton, Acton.
3527. PNEUMATIC TRANSMISSION of LETTERS, &c., A. M. Clark.—(*J. B. Berlier, France.*)

19th March, 1885.

3528. RAILWAY SLEEPERS and CHAIRS, J. Howard and E. T. Bousfield, London.
3529. STOPPERING BOTTLES, &c., R. G. V. van Avezathe, Wolverhampton.
3530. TUBULAR RIVETS, &c., B. L. D'Aubigne and G. G. Lusher, Birmingham.
3531. ROUNDING and IRONING the CURVES of HATS, F. Cree, Manchester.
3532. DISTINGUISHING and RECKONING POSTAGE STAMPS, &c., W. Balck, London.
3533. ROLLERS for WRINGING MACHINES, &c., T. E. Town, Bradford.
3534. VICES, O. Flagstad, Norway.
3535. STRIKING PLATES or STAPLES for LOCKS, W. Wilkes, Walsall.
3536. MEASURING ANGLES, P. Nevill, Isle of Man.
3537. ELECTRICAL LAMP HOLDERS, A. Swan, Gateshead-on-Tyne.
3538. SEWING MACHINES, W. E. Heys.—(*B. Rudolph, Germany.*)
3539. STOPPING LEAKS in VESSELS, &c., T. Hodgson, Newcastle-on-Tyne.
3540. EMBOSSING of EARTHENWARE, J. Holdcroft, Longton.
3541. CONNECTING LINKS for CHAINS for VELOCIPEDES, H. J. Brookes and W. R. Kettle, Smethwick.
3542. SECURING STRAPS and BANDS used in HARNESS, A. S. Findlater, Dublin.
3543. DOBBIES or JACQUARDS of LOOMS, J. Hollingworth, Halifax.
3544. VALVES for STEAM and other LIQUIDS, J. Dawson and G. A. Senior, Halifax.
3545. DUPE HEALDS, S. Butterfield, Halifax.
3546. UNTAPPED NUTS, J. P. Binns, Halifax.
3547. INVENTION for PERSONS not having the USE of their HANDS, M. E. de S. la Terriere, Cheltenham.
3548. HAULING or WORKING the NETS of FISHING BOATS, W. and J. B. Morrison, Glasgow.
3549. ADJUSTABLE BRACKETS, W. Lea and J. Beech, Wolverhampton.
3550. SHARPENING LEAD PENCILS, &c., H. Spackman, London.
3551. SELF-ACTING FILTERING APPARATUS, J. Walsh, London.
3552. STOVES, J. Barnett, London.
3553. ELECTRICAL CONNECTIONS, J. Enright, London.
3554. PRESERVING FISH, C. Jeffs, Great Grimsby.
3555. CIRCULAR FABRIC, G. Blunt and W. M. Richards, London.
3556. APPARATUS for EXERCISING the FINGERS, HAND, and WRIST, J. Brotherhood, London.
3557. METALLIC TUBES for STEAM BOILERS, &c., S. Fox, London.
3558. CONTROLLING the SPEED of VELOCIPEDES, R. M. Smith, London.
3559. WATER GAUGES, L. J. Crossley, R. Hanson, and J. J. Hicks, London.
3560. METAL or ALLOY for EMBROIDERY, &c., J. H. Hollinghurst, London.
3561. RING SPINNING FRAMES and SPINDLES, H. J. Allison.—(*C. H. Chapman, U.S.*)
3562. SEPARATING CINDERS from ASHES, H. J. C. Fenn, London.
3563. EMPLOYING HYDRAULIC PRESSURE as a MOTIVE POWER, F. W. Richardson, London.
3564. TELEPHONIC APPARATUS, &c., S. P. Thompson, London.
3565. VESSEL for CONTAINING LIQUIDS and DISPLAYING ADVERTISEMENTS, J. D. Mitchell, Glasgow.
3566. HYDRAULIC MACHINE TOOLS, J. L. Anderson and W. H. Payne-Gallwey, London.
3567. MELODEONS, &c., W. L. Wise.—(*L. Löwenthal, Germany.*)
3568. LIQUOR FLASKS, J. MacNaughton, Glasgow.
3569. SINGLE-ACTING STEAM ENGINES, P. Jensen.—(*J. Richards, U.S.*)
3570. JUSTIFYING PRINTING SLIPS, &c., S. Pitt.—(*M. H. Dement, U.S.*)
3571. JOINTS for IRON PIPES, A. Sauvée.—(*H. Jandin, France.*)
3572. SECURING CART and WAGON DOORS, J. Kaye, London.
3573. PICKING MOTIONS of WEAVING LOOMS, R. Ecroyd and J. Bentley, London.
3574. FILTERING APPARATUS, W. R. Lake.—(*A. Helaers, Belgium.*)
3575. STEERING MECHANISM of VELOCIPEDES, F. J. J. Gibbons, London.
3576. PRODUCING PICTURES on GLASS, T. J. Gullick, London.
3577. PRESSED YEAST, J. Imray.—(*M. Hatschek, Switzerland.*)
3578. COOLING LIQUIDS, H. A. Dufrené, London.
3579. DECORATING SURFACES, J. H. Johnson.—(*G. Cleis, France.*)

20th March, 1885.

3580. HOLLOW FIRE-BARS, E. Swindells, Manchester.
3581. PHOTOGRAPHIC DARK SLIDE, A. P Sharp, Dublin.
3582. COMPRESSION of PEAT, C. J. Doyle, Dublin.
3583. PORTABLE ANTI-FOULING ANCHOR, L. G. Moore, Northampton.
3584. EXPOSING ADVERTISEMENTS, H. Hitchen and R. Whiteley, Halifax.
3585. WOOD STAIN, G. G. Wolff, London.
3586. ATTACHMENTS to SADDLES, N. R. Roskell, London
3587. PISTONS and PUMP BUCKETS, W. J. Murgatroyd, Bradford.
3588. STEAM ENGINE GOVERNOR, W. E. Heys, Manchester.—(*M. Berry, Germany.*)
3589. CORK THREAD, R. Marsden, Manchester.
3590. BILLIARD RESTS, F. W. Garrard, Ipswich.
3591. RAILWAY CARRIAGE LAMPS, W. Fryer, Birmingham.
3592. ELECTRIC BELLS, P. Jolin, Bristol.
3593. COMPOUND STEAM ENGINES, H. C. Löbnitz, Glasgow.
3594. POLISHING METALS, J. Smith, Stoke-upon-Trent.
3595. RAILWAY BRAKES, W. B. Thomson, Wick, N.B.
3596. VELOCIPEDES, J. W. Smallman, Nuneaton.
3597. HEATING LIQUIDS, L. H. Pearce, London.
3598. MAGIC LANTERN SLIDES, M. Whiting, London.
3599. ELECTRO-MOTORS, A. Reckenzaun, London.
3600. SUPPORTING CANNON, J. P. Pieri, London.
3601. CARRIAGES for BOBBIN MACHINES, G. H. Bates, London.
3602. SAFETY BLASTING CARTRIDGES, R. Punshon, London.
3603. LAMPS, C. Asbury, London.
3604. SELF-REGULATING WATER-WASTE PREVENTER, J. Anderson, London.
3605. DRIVING SPINDLES, W. Blackburn and S. Blackburn, Halifax.
3606. DRIVING SPINDLES, W. Blackburn and S. Blackburn, Halifax.
3607. VENTILATORS, G. Sowerby, London.
3608. METALLIC PISTONS, &c., J. Watts, London.
3609. ANIMAL POWER ENGINE, A. Tietz, London.
3610. VELOCIPEDES, W. Scantlebury, London.
3611. REGULATING the ADMISSION of AIR through VENTILATING SHAFTS, A. L. Ward, St. Leonard's-on-Sea.
3612. HOLDING VIOLINS, R. Steadman, London.
3613. ELECTRO-OPTICAL NIGHT SIGNAL APPARATUS, O. Imray.—(*N. Lauer, Austria.*)
3614. RINGS and BRACKETS, T. Jeffery and H. Layton, London.
3615. WORKING the ACTION of BREECH-LOADING CANNON, J. P. Pieri, London.
3616. ELECTRIC LIGHT to GYMNASTIC APPURTENANCES, J. Harrison, London.
3617. CONNECTING SHAFTING, V. Holliday and E. W. Halliday, London.
3618. CARRIAGE WHEELS, P. Jensen.—(*J. O. Forsslund, Sweden.*)
3619. PROTECTION for SUSPENDED WIRES, E. Tomlinson, London.
3620. SEA-WATER DISTILLING APPARATUS, J. Leitch, London.
3621. DOUBLE AXLE TRICYCLE, G. H. Thynne and H. E. Aspinall, London.
3622. AUTOMATIC COUPLING for RAILWAY WAGONS, H. J. Haddan.—(*H. Frank, Prussia.*)
3623. ORDNANCE, P. M. Parsons, London.
3624. SHAFTS, AXLES, SPINDLES, &c., P. M. Parsons, London.
3625. SUPPORTS for the SHADES and BULBS of LAMPS, A. Swan, London.
3626. HANGING CARRIAGES, P. Ness, London.
3627. CUTTING FUSTIAN, VELVET, &c., J. P. Jones, Liverpool.
3628. KEYLESS CENTRAL WINDING MECHANISM for CLOCKWORK, A. M. Clarke.—(*V. E. Versepuy, France.*)
3629. BREECH-LOADING CANNON, J. P. Pieri, London.
3630. VELOCIPEDES, A. J. Eli, London.

21st March, 1885.

3631. WATCHES, &c., C. Ankers, Nantwich.
3632. FINISH in COLOURS on WATERPROOF FABRICS, P. Frankenstein, Manchester.
3633. REVOLVING or INTERMITTING LAMPS, J. Roots, London.
3634. VALVE MOTIONS of STEAM ENGINES, W. Sisson, London.
3635. FASTENER for GLOVES, &c., F. R. Baker, Birmingham.
3636. CARDING ENGINES, T. Smart, Newmarket Court, near Stroud.
3637. FUSIBLE PLUGS, W. H. Bailey, Manchester.
3638. PILE FABRICS, J. Sillavan, Manchester.
3639. RAILWAY PASSENGERS' SELF-ACTING STATION INDICATOR, D. McKellar, London.
3640. GLAZING and FINISHING PAPER, &c., W. Hartley, Higher Broughton.
3641. ROLLER MANGLES, E. G. Camp, Bristol.
3642. DETECTING the EXACT WHEREABOUTS of LEAKAGE in UNDERGROUND WATER MAINS, D. Bentley, Bradford.
3643. PERAMBULATORS, S. Hall, Derby.
3644. PHOTOGRAPHIC CAMERAS, J. Billcliff and J. T. Chapman, Chorlton-on-Medlock.
3645. STEERING and BRAKE MECHANISM of TRICYCLES, &c., S. Martin, Birmingham.
3646. FASTENING BAGS, &c., G. W. Legg, Birmingham.
3647. BRACELETS, B. E. Halford, Birmingham.
3648. FLY CAST PROTECTING BOOK, H. Smith, Birmingham.
3649. EMBOSSING and PRINTING MACHINES, S. Stansfield, Manchester.
3650. WASTE PREVENTING CISTERNS, B. C. and D. Cross, Stonehouse.
3651. NOISELESS REVOLVING CHIMNEY COWL, W. Green, Northampton.
3652. LASTS for BOOTS, H. W. Mobbs and A. Lewis, London.
3653. CIRCULAR FLUE STOVES, &c., B. J. Saunders, J. Woolven, and W. Eade, Brighton.
3654. HYDRO-CARBON OIL LAMPS, J. B. Fenby, Sutton Coldfield.
3655. MACHINES for TURFING FABRICS, M. F. Connett, jun., and H. B. Buck, London.
3656. VANE and INDICATOR, F. M. Rogers, London.
3657. SUBMARINE VESSELS, R. Morhard, London.
3658. METALLIC BUNG HOLES for CASKS, A. Attwood, London.
3659. WASHING MACHINES, A. Whowell, London.
3660. FIRE-GRATES and STOVES, J. W. Lewis and C. W. Rawlings, Halifax.
3661. SUPPLYING WATER to WATER-CLOSETS, &c., A. Stephens, London.
3662. PHOTOGRAPHIC CAMERAS, J. Rigby, London.
3663. ADJUSTING and SUPPORTING TOILET GLASSES, &c., J. Cooke, London.
3664. MINERS' SAFETY LAMPS, W. Morgan, Pontypridd.
3665. REFLECTING LAMPS, E. S. Toomer, London.
3666. BOOK-MARKERS, T. M. Potter, London.
3667. LAWN TENNIS BATS, C. Strange, London.
3668. METALLIC PACKING, R. White and N. S. Hawks, London.
3669. SHOULDER REST for VIOLINS, &c., F. Upton, London.
3670. PASSENGER CARRIAGES for RAILWAYS, &c., J. R. Banks, London.
3671. ELECTRIC CARTRIDGES and PRIMERS, S. Russell, London.
3672. INGOT MOULDS, L. G. Laureau and E. Ford, London.
3673. RAILWAY SIGNAL LAMPS, S. T. Dutton, London.
3674. PORTABLE LANTERNS or LAMPS, J. Everard, London.
3675. DISTANCE RECORDING INSTRUMENTS, T. Dunn, London.
3676. LETTER-PRESS PRINTING MACHINE, J. Paterson, Glasgow.
3677. KEYLESS LOCK, J. Martin and J. C. Mineard, London.
3678. VOLTAIC ELEMENTS, C. P. Orne, Cambridge, U.S.
3679. ELECTRO-MOTORS and DYNAMO MACHINES, M. Immisch, London.
3680. COILING and SOLDERING METAL RIBBON or WIRE, H. S. Maxim, London.—*8th January*, 1885.
3681. RAISING, &c, TOP MASTS, J. T. James, London.
3682. PURIFYING SEWAGE, &c., J. R. Shopland, London.
3683. NIGHT LIGHTS, S. Clarke, London.
3684. INFANTS' FOOD WARMER or NIGHT LIGHT, S. Clarke, London.
3685. CIRCULAR KNITTING MACHINES, L. Woodward and F. Chadwick, London.
3686. TRICYCLES, &c., A. Paget, London.

3687. Clockwork for Rotating the Optical Apparatus in Lighthouses, &c., J. Hopkinson and J. Kenward, London.

23rd March, 1885.

3688. Accommodable and Expansive Valves, D. P. G. Matthews, Newport.
3689. Spring Back for Closing Hood Perambulator, J. Aylward, London.
3690. Belt Protector for Driving Belts of Machinery, I. Jackson, Glossop.
3691. Axles, &c., for Wheels, J. Lapsley, Glasgow.
3692. Smoke Consuming Apparatus, T. Lowe, Old Ratford.
3693. Oiling Bearings of Revolving Shafts, W. Butterworth and H. Shawcross, Rochdale.
3694. Making, &c., Iron Hurdles, J. J. Corbett, West Mustow, near Kidderminster.
3695. Comb, G. A. Binns, Halifax.
3696. Paper Capsules, &c., Machine, W. Lawson, Dublin.
3697. Lever Presses, W. P. Abell, near Hinckley.
3698. Fireproof &c., Textile Fabrics, C. Moon, London.
3699. Preparing Cotton, &c., for Spinning, J. Macqueen, London.
3700. Covering Seats of Tram-cars, &c., F. W. C. Suggate, Ladywood.
3701. Spectacles, &c., R. G. Mason, Manchester.
3702. Combined Cigar Piercer or Cutter, and Seal, &c., T. Wilcox, Birmingham.
3703. Treating Oils for the Manufacture of Floorcloth, &c., T. Rowley, H. Grimshaw, and J. H. Kidd, Manchester.
3704. Transmitting Power by Ropes or Bands, J. H. Ratcliffe, Manchester.
3705. Costume and Mantle Stands, J. Goodwin, London.
3706. Alcoholic Beverages, J. H. Loder, Netherlands.
3707. Opaque Stained Glass, G. H. Stevens, North Brixton.
3708. Twenty-four Clock and Watch, J. Vaglica, London.
3709. Cutting Machine, J. Hunt, London.
3710. Stove Grate Ornaments or Screens, J. H. Stone, London.
3711. Water-closet Valves, J. Kretschmann, London.
3712. Box, T. Bradford, London.
3713. Carriages, B. T. Newnham and C. W. Kingdom, London.
3714. Fences, Dividing Walls, &c., C. Portway, London.
3715. Miners' Safety Lamps, E. Thomas, London.
3716. Tool, E. Thomas London.
3717. Regenerative Lamps and Burners, &c., W. Hemingway, Fulham.
3718. Condensing Steam Engines, R. Wyllie, London.
3719. Lamps, H. Wakefield, London.
3720. Tricycle Horses, J. Bate, London.
3721. Noiseless Water-waste Preventer Cistern, A. Emanuel, London.
3722. Furnaces, D. Purves, North Dulwich.
3723. Opening and Closing Doors, J. Barrett, London.
3724. Furnaces, W. H. Tooth and J. E. Rooker, London.
3725. Oleaginous Compounds, M. G. Coltart and J. Menzies, Glasgow.
3726. Dress Improvers, A. T. Story.—(*J. Clémencet, France.*)
3727. Saddles, J. Wheeler, London.
3728. Manufacture of Parts of Heels for Boots, &c., J. W. Jones, London.
3729. Transport Apparatus for Military, &c., Purposes, M. Knowles, London.
3730. Electric Incandescence or Glow Lamps, R. W. Wilson, London.
3731. Composition for the Protection of Straps, &c., E. B. Petrie and A. S. Fox, Manchester.
3732. Travelling Case, C. H. Royce, London.
3733. Roller Grinding Mills, R. B. Smith, Glasgow.
3734. Healds, &c., for Looms, B. J. B. Mills.—(*Messieurs Coint-Bavarot and Co., France.*)
3735. Sewing Machines, J. Charmbury.—(*H. Charmbury, United States.*)
3736. Steam Boiler, &c., Furnaces, W. R. Lake.—(*Louis Broussas, France.*)
3737. Manufacture of Iron, &c., into Sheets, &c., E. Morewood, London.
3738. Coating with Tin, &c., Metal, &c., E. Morewood, London.
3739. Paraffine Lamps, H. E. Smith, London.
3740. Heating, &c., Liquids, J. Price, jun., London.
3741. Chimneys, &c., for Lamps, C. W. Iliffe and C. Barton, London.
3742. Key for Securing Cranks, &c., P. L. C. F. Renouf, London.
3743. Safety Stirrups, F. V. Nicholls and A. Vickery, London.
3744. Regulators for Dynamo-electric Machines, J. H. Johnson.—(*A. de Méritens, France.*)
3745. Centrifugal Machines, E. Edwards.—(*E. Rothe, Germany.*)
3746. Lamps, E. Edwards.—(*W. Bertram, Silesia.*)
3747. Regulating the Supply of Gas to Motor Engines, H. P. Holt, London.
3748. Bleaching Cotton Yarns, &c., W. Mather, London.
3749. Protective Safety Door Fastener, R. W. Pyne, London.

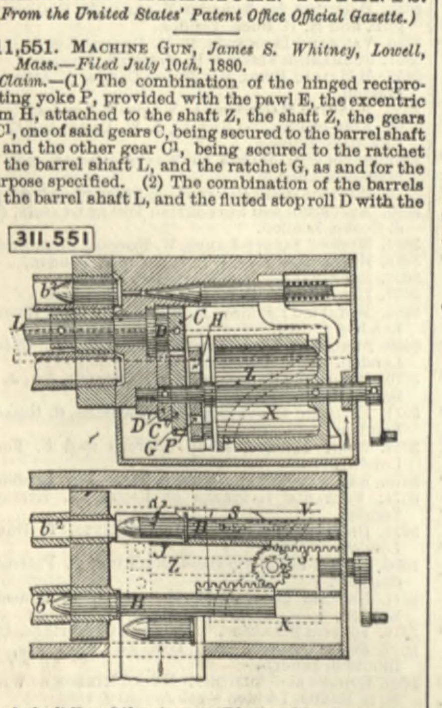
SELECTED AMERICAN PATENTS.

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

311,551. Machine Gun, *James S. Whitney, Lowell, Mass.—Filed July 10th*, 1880.

Claim.—(1) The combination of the hinged reciprocating yoke P, provided with the pawl E, the excentric cam H, attached to the shaft Z, the shaft Z, the gears C C^1, one of said gears C, being secured to the barrel shaft L, and the other gear C^1, being secured to the ratchet G, the barrel shaft L, and the ratchet G, as and for the purpose specified. (2) The combination of the barrels b^2, the barrel shaft L, and the fluted stop roll D with the

311,551

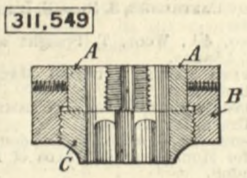


crank shaft Z and the stop cam D^1, as and for the purpose specified. (3) The combination of the hinged reciprocating yoke P, provided with the pawl E, the excentric cam H, attached to the shaft Z, the shaft Z, the gears C C^1, one of said gears C being secured to the barrel shaft L, and the other gear C^1, being secured to the ratchet G, the barrel shaft L, the ratchet G, the cylinder X, provided with the cam groove V, the plungers B B^1, each of said plungers being provided with a rack, 1 and 3, and one of said plungers, B, being provided with the pin Q, and the pinion 2, as and for the purpose specified. (4) The combination of the extracting plunger B^1, the lever S, pivotted thereto, and provided with a notch at the front end and a bevel at the rear end, and the casing provided with the shoulder J, and opening 8, as and for the purpose specified.

311,549. Die Stock, *Frederic E. Wells, Greenfield, Mass.—Filed March 5th*, 1884.

Claim.—The die stock comprehending the dies A A, the die holder B, and the guide C, all constructed,

311,549

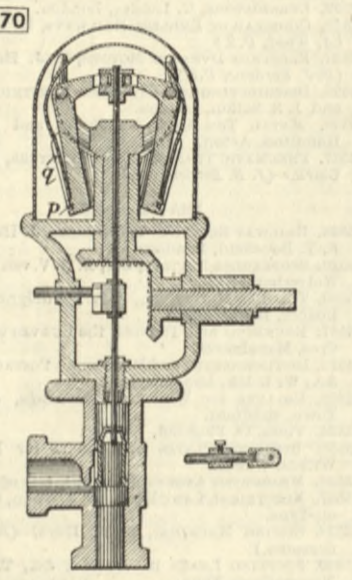


arranged, and secured together, substantially as shown and described.

311,770. Steam Engine Governor, *John M. Mason, Chelsea, Mass.—Filed March 27th*, 1884.

Claim.—(1) In a governor, the combination of the valve rod made in sections, as described, the turn buckle connecting said sections and provided with longitudinal ribs or flanges 7 7, and the pin 8, passing through a socket in the supporting frame and projecting between said flanges to prevent the turn buckle from rotating, said pin being secured by a set screw 9, whereby it may be loosened and withdrawn to permit the rotation of the turn buckle, as set forth. (2) The pivotted governor arms having recesses q q and studs p p, combined with the single spring adapted to bear at its edges against the sides of said recesses, and

311,770

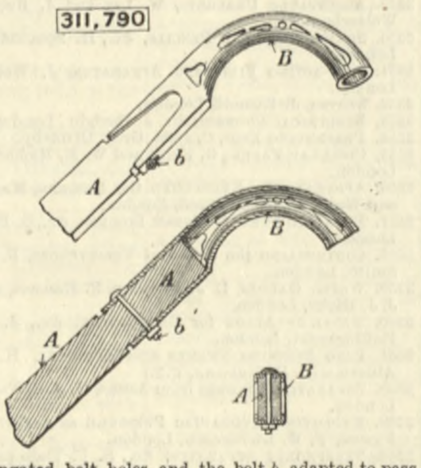


having orifices in its ends adapted to engage said studs, as set forth. (3) In a governor, the combination of the revolving governor arms, the fixed supporting frame having the flanged base or plate under said arms, and the elastic sheet metal dome or cover fitted to said flanged base and bearing against the same with a yielding pressure, whereby the dome is held in place on the base and its ready removal is permitted, as set forth.

311,790. Plough Handle, *Harrison D. Spangler, Rushville, Ind.—Filed May 26th*, 1884.

Claim.—The combination of a plough handle A, having a tapering tenon upon its upper end, and a metallic hand piece B having a tapering socket upon its lower end, adapted to fit over said tapering tenon and

311,790

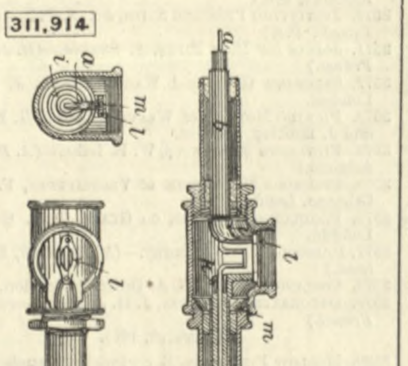


elongated bolt holes, and the bolt b, adapted to pass through said tenon and said bolt holes and secure said handle and hand piece together, substantially as shown and described.

311,914. Joint for Electric Arc Light Cables, *W. R. Patterson, Chicago, Ill.—Filed July 18th*, 1884.

Claim.—(1) The combination, with the concentric conductors a and b of an electric arc light cable, of the

311,914

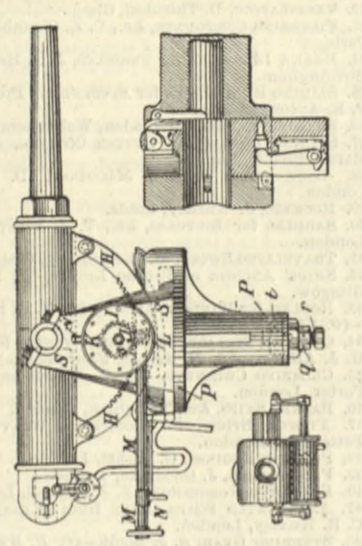


pieces i and k screwed to the opposing ends of the tube of the outer conductor, and the ends of the central conductor projecting through openings in said pieces, respectively, and the removable cross pieces l and m, substantially as and for the purpose specified. (2) The combination, with the conductor a, of the outer conductor b, and the pieces i k, provided with openings for the ends of conductor a, substantially as and for the purpose specified.

311,973. Breech-loading Ordnance, *Richard J. Gatling, Hartford, Conn.—Filed June 20th*, 1883.

Claim.—(1) In combination, the gun barrel, the adjustable nut accessibly and exteriorly attached to the barrel, the casing having the annular diaphragm, and the contained elastic spring packing held longitudinally between the diaphragm and nut, all substantially as described. (2) In combination, the gun barrel, the adjustable nut attached to the barrel, the casing formed with the intermediate annular diaphragm, and the contained elastic spring packing held longitudinally between the diaphragm and nut, all substantially as described. (3) In a breech-loading gun, a breech block bearing the hammer and main spring, and arranged to reciprocate laterally of the axis of the gun in firing the charge, all substantially as described. (4) In a breech-loading gun, a breech block bearing the hammer, main spring, and firing pin, in combination with the pawl attached to the breech, whereby the hammer is operated by the motion of the breech block, all substantially as described. (5) In a breech-loading gun, in combination, the reciprocating breech block bearing the pivotted ejector pawl, and the breech piece bearing the pivotted ejector, all substantially as described. (6) In combination, the breech-piece, the pivotted

311,973

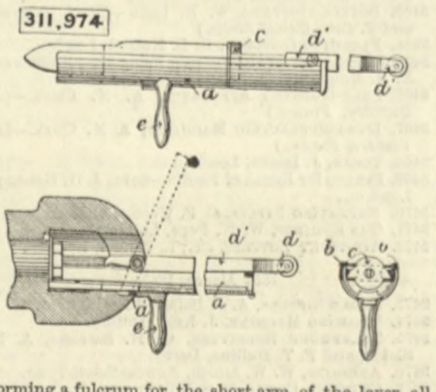


ejector, and the sliding breech block with pivotted ejector pawl, by the transverse motion of which the ejector is operated, all substantially as described. (7) In a device for mounting a gun, the bed-plate P, having a pivot socket closed by the cap q, in combination with the hardened step t, the screw bolt r, and the check nut, all substantially as described. (8) In a gun mount, the combination, the swivel S, the shaft s^1, bearing the spur gear I, and the worm gear J, the rotary sighting lever M, bearing the worm L, and the segmental gear H, fast to the gun or its case, all substantially as described. (9) In a gun mount, in combination, the bed-plate P, the swivel S, mechanism for adjusting the gun, the rotary sighting lever M, bearing the firing handle N, and the connected steam, compressed air, or like mechanism for firing the gun, all substantially as described. (10) In a gun mount, the combination, with a swivel bearing the gun, of mechanism for adjusting the gun through the medium of a sighting lever carrying a firing handle, substantially as described. (11) In a gun mount, the combination, with the swivel S and shaft s^1, and gear wheels, of the rotary case K, for inclosing the said gear wheels, and formed with peripheral sockets and a locking device v^1, substantially as described.

311,974. Loading Device for Breech-loading Guns, *Richard J. Gatling, Hartford, Conn.—Filed June 16th*, 1884.

Claim.—(1) As a feed device for breech-loading guns, the open trough-shaped body having an opening through the bottom and a handle fast to the lower side of the body, a follower sliding in guides on the body, and a lever pivotted to the follower, all substantially as described. (2) In a loading device for breech-loading guns, a feed case having a handle fixed to its lower side, an opening through the bottom of the case, a sliding follower bearing a lever, and a breech opening in a gun having a shoulder or lug

311,974



forming a fulcrum for the short arm of the lever, all substantially as described, and for the purpose set forth. (3) In a feed device for breech-loading guns, the case a, having the flanges or guides b, fixed handle e, and opening a^1, the sliding follower c, borne on the guides, and having pivotted thereto the lever d, with handle d^3, and short arm d^1, all substantially as described. (4) In a feed device for breech-loading guns, a case bearing a sliding follower and pivotted lever, in combination with a gun the chamber of which bears a fulcrum socket for the lever, all substantially as described.

311,996. Pitman for Mowing Machines, *Dewitt C. Markham, Towanda, Pa.—Filed July 15th*, 1884.

Claim.—(1) A box forming a bearing, and a strap inclosing said box, in combination with a plug externally and internally screw threaded, which

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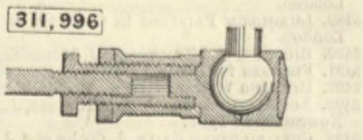
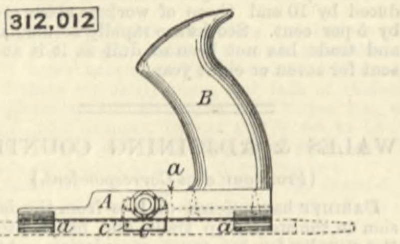


screws through said strap against said box, and a pitman rod which screws into said plug. (2) Two bearing boxes and two straps inclosing the same, in combination with a plug externally and internally screw-threaded, which screws into one of said straps and against its inclosed bearing box, and a pitman rod which screws into said plug at one end and at the other end into the other strap and against the inclosed bearing box, substantially as and for the purpose set forth.

312,012. File Holder, *W. H. Phelps, Stamford, Conn.—Filed June 11th*, 1884.

Claim.—(1) A file holder consisting of a stock A, having at one edge thereof and at a distance apart two downward projecting shoulders a, a handle B, projecting upward from the said stock, a clamp C, arranged intermediate to the said shoulders to slide transversely to the said stock and provided with a toe c^1, projecting downward at the side edge of the stock opposite that having the shoulders a, and means for tightening the grip of the said clamp C, substantially as and for the purposes set forth. (2) A file holder, consisting of a stock A, having at one edge

312,012

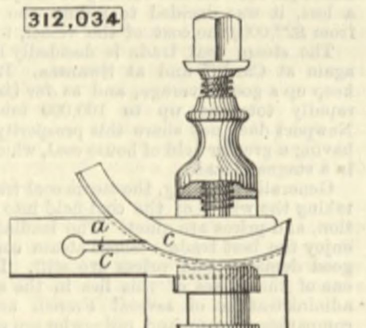


thereof and at a distance apart two downward projecting shoulders a, a handle B, projecting upward from the said stock, a clamp C, arranged intermediate to the said shoulders to slide transversely to the said stock, and provided with a toe c^1, projecting downward at the side edge of the stock, opposite that having the said shoulders a, the said clamp having also a threaded shank c^2, and a nut D, upon the said shank for tightening the grip of the said clamp C, substantially as and for the purposes set forth.

312,034. Lathe and Planer Tool, *Herbert B. Steele, Somerville, Mass.—Filed August 12th*, 1884.

Claim.—(1) The combination, in a lathe or planer tool, of a cutting bar curved in its length bow-like, as an arc of a circle, and a stock formed with a coincidently-curved side groove to receive and support

312,034



said cutting bar, substantially as specified. (2) The combination of curved cutting bar c, and body or stock C, grooved to receive and support said bar, and having slot a, and steadying pin d, substantially as specified.

CONTENTS.

South Kensington Museum.—Visitors during the week ending March 21st, 1885:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 11 241; mercantile marine, Indian section, and other collections, 2928. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m to 5 p.m., Museum, 1455; mercantile marine, Indian section, and other collections, 123. Total, 15,747. Average of corresponding week in former years, 15,330. Total from the opening of the Museum, 23,824,092.