THE ELECTRICAL TRANSMISSION OF POWER.

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No. 1

THE subject of the transmission of power by electricity is one of surpassing interest at the present time, and will doubtless become of great commercial importance. I propose in a few articles to write out its theory as simply as possible, so that anyone acquainted with dynamo machines and elementary electrical laws will be able to follow the whole in detail, if they are willing to give careful attention to the matter, and if they can work ordinary algebra and differentiate.

And first consider the fundamental case of transmission by two dynamos alone, one driven by power at one end of the line and made to produce a current, which is transmitted by the line wire to the other dynamos, and drives it at the other end of the line. There is a certain inevitable loss of power in the first or sending dynamo; there is a certain inevitable loss in the line wire; and finally there is a certain loss at the receiving dynamo. All these losses must be considered, and the conditions determined which will keep them all at a minimum. With mere mechanical waste of power by common friction we will have nothing to do. It is obviously important to keep down the friction at the bearings, especially when very high speeds are employed, and I think scarcely enough attention is paid to this point in some instances, and that ultimately the mechanical loss will be much reduced by roller bearings, high-class workmanship, and by avoiding much churning of the air. There will be no useful purpose served, however, by mixing up this kind of waste with electrical waste; the latter shall be considered alone.

By the mechanical power applied to drive a dynamo I mean, then, always the net power, every kind of friction having been allowed for; and by the power obtained from a current-driven dynamo I mean its gross power, including all expended in friction as well as in really useful work. I shall, moreover, neglect any power expended in heating insufficiently-subdivided iron masses, or other conductors moving in the field, by local currents which contribute nothing to the main effect; for if a machine wastes much in this way it is obviously imperfect. The two ends of the line may be called respectively the sending station, where mechanical power is converted into electrical power; and the receiving station, where electrical power is reconverted into mechanical. And the two dynamos, one at either end, even though they may be identical in all respects, will be called the sending and the receiving dynamo respectively; and the theory of the two will be slightly different.

Now there are three methods of exciting the field magnets of a dynamo, each of which needs considering separately: direct or ordinary self-excitation, where the whole current is sent round the field magnets—such a dynamo we will call a series-dynamo; shunt or derived-current self-excitation, where only a fraction of the total current is sent round the field magnets, the machine being then called a shunt-dynamo; and lastly, separate excitation, where a battery or another machine is used to excite the magnets, either continuously when the magnets are of soft iron, or once for all when they are made of steel. Leaving permanent steel magnets out of account for the present, separate excitation is, in some respects, a simpler, in some respects a more cumbrous method than self-excitation, and its economy is not so easy definitely to calculate, because a great deal depends on the exciting machines as well as on the principal ones; there are, in fact, at least four machines to consider instead of two.

In order to decide on the best arrangement it will be necessary to examine the conditions, not only on the assumption that the same type of machine is used at the sending and receiving end, but also with the possibility in view that a shunt dynamo may do best at one end and a series at the other, and so on.

However, all these things are apt to look more troublesome than they really are, and they will probably boil down satisfactorily enough when we come to investigate them. But we must take them piecemeal; and first,

The theory of a sending series dynamo.—

Let a be the resistance of its armature, from brush to brush, in ohms;

b the resistance of the wire on its field magnet.

Let E be the total electro-motive force generated in its armature as it revolves in the magnetic field, in volts;

e the available electro-motive force, or the difference of potential between its terminals;

and let C be the current, in Ampères, which circulates in every part of the circuit.

The ratio $\frac{e}{C}$ is a very important quantity, whose value can always be determined, whatever the nature of the external circuit may be; and as it will be convenient to have a single symbol for it, we will style it the external resistance, and denote it by r.

Finally, let P be the net mechanical power applied to drive the dynamo machine, or, what is the same thing—see preceding—the total power obtained as electric current altogether;

and p be the portion of this power available for use in the external circuit, both these last being expressed in Watts. 1-H.P. = 746 Watts.

By the electrical *efficiency* of the sending dynamo we shall mean the ratio $\frac{p}{P}$, and may call it f. Then by Ohm's and Joule's laws we have the following simple relations among the above quantities, in addition to

$$e = rC, \quad \ldots \ldots \ldots \quad (1)$$

namely,

$$E = e + aC + bC$$
$$= (a + b + r)\,C \quad \ldots \quad (2)$$
$$p = eC = rC^2 \quad \ldots \ldots \quad (3)$$
$$P = EC = (a + b + r)\,C^2 \quad . \quad . \quad (4)$$

From the last two, therefore, the efficiency of the machine is simply

$$f = \frac{p}{P} = \frac{e}{E} = \frac{r}{a + b + r} \quad . \quad . \quad (5)^*$$

From this we only perceive that for high efficiency it is needful that r shall be very great compared with a and b. We do *not* perceive what is the best relation to exist between a and b. To determine this we shall have to express how the electro-motive force generated in the revolving armature depends on the current flowing round the field magnets, and this is not easy completely to do. We know that the electro-motive force in a revolving coil is proportional to the number of turns of wire on it (N), to its speed (n), and to the strength of the magnetic field in which it turns (H), say—

$$E = k\,N\,n\,H,$$

where k is a constant depending on the size and arrangement of the armature. And we also know that H, the magnetic field, is proportional to the number of coils of wire wound on the field magnet (N′), and that it depends on the current flowing therein in some undefined way; the dimensions and the quality of the iron of the magnet having to be taken into account. All we can say, then, is that—

$$H = N'\,\phi\,(C),$$

where ϕ is a function determined by the "carcass" of the dynamo machine, irrespective of the particular wire with which it is going to be wound, because the part depending on this has been separated and expressed explicitly.

Now, how is the number of turns of a wire connected with its resistance, when the said wire is wound into a given space? For we must assume something about the total size of the machine we are going to employ, and we may as well assume that the amount of space we can afford for the wire of the armature, and the space we can afford for the wire of the field magnet, are both limited and given. Let the spaces be V and V′, then if l is the mean length of a single turn, and s is the sectional area occupied by each wire and covering—

$$V = N\,l\,s$$

$$\text{moreover resistance} = a = \frac{N\,l}{s}$$

$$\text{Therefore,}\ \frac{N^2}{a} = \frac{V}{l^2} = \text{constant}$$

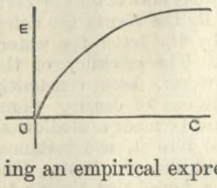
or N varies with the square root of the resistance a. Similarly N′ is proportional to $\sqrt{b}$.

Hence we may write $H = \sqrt{b}\,\phi\,(C)$

$$\text{and} \quad E = K n \sqrt{a\,b}\,\phi\,(C) \quad . \quad . \quad (6)$$

n being the speed, and ϕ a function determined by the size and shape and quality of iron of the dynamo before any wire is wound upon it.

The function here indicated by ϕ is the function plotted by Dr. Hopkinson and other experimenters on the behaviour of dynamo machines. It is like this: r being different for the different points of the curve, and n being constant.



We will not trouble about guessing an empirical expression for this function, though

$$y = \tan x$$

naturally suggests itself; but we will take it as unknown and see what happens.

Comparing (2) with (6) we get

$$r + a + b = K n \sqrt{a\,b}\,\frac{\phi\,(c)}{c}$$
$$= K\,n\,\sqrt{a\,b}\,\psi\,(c) \text{ say.}$$

The power applied to the machine is given by (4), and may be regarded as constant, while the fraction of it which is wasted is $\frac{a + b}{a + b + r}\,.\,P.$

So we want $\frac{a + b + r}{a + b}$ to be a maximum.

Call this quantity u, and write it—

$$u = K\,n\,\frac{\sqrt{a\,b}}{a + b}\,\psi\,(c).$$

Now, permitting a and b to vary independently, the maximum will be obtained when

$$\left.\begin{array}{l}\left(\frac{1}{2\,a} - \frac{1}{a + b}\right)\psi\,(c) + \frac{\delta\psi}{\delta a} = o \\ \text{and} \quad \left(\frac{1}{2\,b} - \frac{1}{a + b}\right)\psi\,(c) + \frac{\delta\psi}{\delta b} = o\end{array}\right\}$$

that is, subtracting, when

$$\frac{1}{2}\,\psi\,(c)\left(\frac{1}{a} - \frac{1}{b}\right) + \frac{d\,\psi}{d\,c}\left(\frac{\delta c}{\delta a} - \frac{\delta c}{\delta b}\right) = o.$$

But referring back to (4) we perceive that $\frac{\delta c}{\delta a}$ and $\frac{\delta c}{\delta b}$ are the same thing; hence, the second term of this equation vanishes *whatever the form of the function* ψ, and u is a maximum simply when

$$a = b.$$

We may take it, then, in all cases where the dimensions of the carcass of the machine are fixed beforehand, that it is best for the armature wire and the field magnet wire to have the same resistance. We shall, therefore, in future not separate a from b, but call their sum the *true resistance of the dynamo at rest*, say, ρ, so that

$$a + b = \rho \quad . \quad . \quad . \quad . \quad . \quad (7)$$

We will now pass to a very similar, but not identical theory.

Theory of a receiving series dynamo.—That is to say, of a dynamo machine driven by means of an electric current supplied to it. Use the symbols $a\,b\,E\,C\,\rho$ in precisely the same sense as before—though, of course they will not have the same numerical values.

e also shall still mean the difference of potential between the terminals, but it is now the applied electro-motive force, and it is greater than E instead of less.

r shall still be defined as the ratio of $\frac{e}{C}$, and it may be called—though somewhat incorrectly—the internal resistance of the machine. It is equal to ρ when the machine is stationary, and always greater than ρ when the machine is doing work.

P must now stand for the total electrical power applied to drive the machine.

And p for the useful portion of this power, or the gross power which appears as mechanical work.

Then the equations corresponding to those previously written are—

$$e = r\,C \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$
$$E = e - a\,C - b\,C$$
$$= (r - a - b)\,C \quad . \quad . \quad . \quad . \quad . \quad (9)$$
$$p = E\,C = (r - a - b)\,C^2 \quad . \quad . \quad (10)$$
$$P = e\,C = r\,C^2 \quad . \quad . \quad . \quad . \quad . \quad (11)$$
$$\text{and} \qquad f = \frac{E}{e} = \frac{r - (a + b)}{r} \quad . \quad . \quad . \quad (12)^*$$

It will again be found that, dimensions of machine being given, it is best for a to equal b; and the sum of a and b may still be called ρ.

I hope no difficulty will be felt from my having used the same symbols in different, though very analogous, significations for the two machines; in particular it must be remembered that the letter r has an especially different signification when applied to the receiving, instead of to the sending, dynamo machine. When applied to the sending dynamo, $\frac{e}{C}$ means the "resistance" of the external circuit; when applied to the receiving dynamo, $\frac{e}{C}$ means the internal "resistance" of the machine itself. As soon as we come to consider the two machines together, we must distinguish the letters belonging to each by suffixes; affixing the suffix 1 to everything connected with the sending machine, the suffix 2 to every letter belonging to the receiving end. The line wire, since it connects both, need have no suffix, and its resistance shall be called R. In order to compare the first five of the above written equations with the last five, it is necessary to suffix 1 to every symbol in the former set, and 2 to every symbol in the latter. We will henceforth suppose this mentally done.

Theory of the two series dynamos connected.—Now establish the connecting link, a line wire of resistance R; and first let the same current C circulate round both machines, in other words, let there be no leakage from the line wire. As soon as we wish to take leakage into account we must maintain the distinction between C_1 and C_2. The connecting equation is simply

$$r_1 = R + r_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

The power expended in heating the line wire is

$$p_1 - P_2 = R\,C^2 = (e_1 - e_2)\,C \quad . \quad . \quad (14)$$

and what may be called the efficiency of the wire is

$$f = \frac{P_2}{p_1} = \frac{e_2}{e_1} = \frac{r_2}{R + r_2} = \frac{r_2}{r_1} \quad . \quad . \quad (15)$$

The efficiency of the whole arrangement is, of course, the power obtained from the second machine, viz., p_2, divided by the power applied to the first, viz., P_1, and this we will call F.

$$F = \frac{p_2}{P_1} = f_1\,f\,f_2 = \frac{E_2}{E_1} = \frac{r_2 - \rho_2}{R + r_2 + \rho_1} \quad . \quad . \quad (16)$$

In these equations, where a number of expressions are given for the same thing, it is not intended that they are necessarily derived from each other in the order indicated, nor, indeed, that any one form of expression is much more obvious than any of the others; they are all written down as being either practically useful or else interesting and instructive forms.

To understand fully the important expression for the total efficiency of two connected dynamos given at the extreme right-hand side of (16), we must remember that —see equation (9)—

$$r_2 = \rho_2 + \frac{E_2}{C},$$

and therefore that

$$F = \frac{E_2}{E_2 + (R + \rho_1 + \rho_2)\,C} = \frac{E_2}{E_2 + E} \quad . \quad . \quad . \quad (16')$$

where E is a new symbol, meaning the electro-motive force necessary to drive the current C through the total true resistance of the circuit, both the machines being held still; and E_2, remember, is the electro-motive force generated in the revolving armature of the receiving machine.

Most economical arrangement of the machines.—To find out what are the best values of the resistances ρ_1 and ρ_2, we must write for E_2 an expression like that written for E_1 in equation (6), putting $\frac{1}{2}\rho$ instead of $\sqrt{(ab)}$ because we know that it is best for a and b to be equal. Thus,

$$E_2 = \tfrac{1}{2}\,K_2\,n_2\,\rho_2\,\phi_2\,(C) \quad . \quad . \quad . \quad . \quad . \quad (17)$$

and the expression for the ratio of the waste to the useful work becomes

$$\frac{\text{waste}}{\text{useful}} = \frac{1}{F} - 1 = \frac{2}{K_2 n_2 \psi_2 (C)} \cdot \left(\frac{R + \rho_1}{\rho_2} + 1\right) \quad . \quad (18)$$

And since this is to be kept as small as possible, we clearly see that the bigger ρ_2, the resistance of the wire on the receiving machine, is, and the smaller ρ_1, the resistance of the wire on the sending machine, is, the better. Moreover, we learn that every increase in K and ψ and n, the size, quality, and speed of the receiving machine, is an advantage. In fact (16) had told us that for high efficiency E_2 must nearly equal E_1, so that if the machines were alike in all respects, the receiving machine ought to run at nearly the same speed as the sending machine; but we now see that there is no advantage in making them alike, but that the bigger and more intense the receiving machine is, the better; and the more slowly it may be permitted to run without loss of efficiency.

* All these equations apply to the sending dynamo. Every letter may be supposed to have the suffix 1.

* These equations apply to the receiving dynamo. Every letter to have the suffix 2.

INLAND NAVIGATION IN IRELAND.

THOSE who hope to find in Irish water some contrast to the interminable discord about Irish land, will get little consolation from the recently-published report of the Royal Commission on "The System of Navigation which connects Coleraine, Belfast, and Limerick." The inquiry is in itself a singular one. All the large Irish towns being on the coast, it follows that any fresh-water route connecting them will have to bear the competition of sea-carriage; and this rivalry will tell most upon canals which run north and south, since the length of Ireland is about two and a-half times its breadth. It is obvious, therefore, that waterways which form links between Coleraine and Limerick are those least likely to find employment, while those which run comparatively east and west afford most traffic and best prospects.

The commerce between our two main islands consists chiefly of an interchange of the minerals and manufactures of Britain and the agricultural produce of Ireland. There is also the American grain trade. Each Irish rural district therefore seeks cheap communication with the nearest port, especially if that port be on the East coast; and those lines of transport will naturally be most used which facilitate the exchange of unlike products. Thus, we find that the Laggan, Newry, and Grand Canals, and even the puny Boyne-Navigation are of value to the districts they traverse, while the Upper Shannon has comparatively little traffic. In considering the general suitableness of Ireland to inland navigation, various considerations present themselves. On the one hand, it is essentially a country of raw materials, bulky in proportion to their value; the rainfall is copious, the frosts comparatively slight, the rivers and loughs abundant. On the other hand, one of its most marked physical features—the high central plain, extending to within a few miles of the coast—is unfavourable to water carriage, for the ascent or descent of a staircase of locks causes delay and precludes steam towage, which is so economical on long flats. The flatness of the central plain also causes floods, which embarass navigation as well as drainage.

In order that the proceedings of any Commission may have the greatest practical value, free scope should be given to its inquiry. A preliminary limiting of the functions of those who are to investigate an important problem finds it parallel in the popular game of jumping in sacks. The means of progression are carefully impaired before the performers are allowed to move. This having been duly done in October, 1880, the Commissioners entered upon their labours, Viscount Monck presiding, and we now have the results; for, though the Report was issued last April, it is only recently that the evidence on which it is based has been published. Without the statements of the witnesses it was impossible to form any idea as to the points at issue between General Dickens and his colleagues. The experience of that officer in the canal works of India naturally gives great weight to his opinion; and the points on which he dissents from the majority are not the least important part of the investigation.

The consideration of rivers in their transporting capacity necessarily carries with it the collateral questions of drainage, water supply, sewage, fisheries, water power, harbours, &c. Each basin, from summit to sea, is a great natural unit, one and indivisible, and must be viewed comprehensively in all its bearings. The water which falls from the heavens is a gift to the community, and might well be received by trustees commissioned to watch over its career. It would rest with these "Stream-Wardens" to see that the water on its way to the sea caused the maximum of public benefit, the minimum of injury. The cost of the necessary works might in some degree be met by the proceeds of navigation, fisheries, water power, &c.

The Floods Prevention Bill for England and Wales contemplates the division of basin-lands into lowlands, subject to ordinary floods and damage therefrom; midlands occasionally subject to floods, or to the entire or partial obstruction by floods of drains or outfalls passing under or through them, and to damage therefrom; and uplands, the remaining lands of the drainage district. It is provided that the highest rate charged upon uplands should not exceed one-tenth of that levied upon lowlands. In Ireland vested interests have not assumed such proportions as in busier countries; and the State, by its contributions to public works, has purchased a right to arbitrate in case of conflict.

The Bann, which forms the northern part of the Irish water system, shows the result of attempting to deal with a basin upon piecemeal principles. Since 1859 sundry drainage, navigation, and harbour boards have had charge of a river remarkable for destructive floods, unused water power, and scanty traffic. For twenty-three years the canalised river has had no portal. For this it is now proposed to substitute an efficient estuary with no waterway leading to it. Below Coleraine harbour works are in progress, at a cost of about £66,000, which may make that port one of the busiest in the North of Ireland. The fact of such a sum having been raised under Sir John Coode's advice augurs well for the project, and pleads for a respite before any death-blow is given to the Lower Bann Navigation. The advocates for its retention would be satisfied with a minimum depth of 6ft. instead of 8ft., as at present; but this would entail a revision of the present hiatus between Castleroe and Coleraine Bridge, since it is only at the latter point that the authorised deepening of the estuary is to begin. The Commission of 1881 will not have been fruitless if it leads to a blending of the various conflicting authorities in this small basin; but, so far, the union of the Lower Bann Navigation and Drainage Boards is all that has been recommended.

For the sake of the navigations which converge on Lough Neagh, the maintenance of its "present summer level" is advocated by the Commissioners, but no notice is taken of the project for relieving floods, *viâ* Portadown and Newry. This proposal to form a second outlet for that lake will not bear overlooking, since it is the excessive discharge at Toome which occasions the present demand for the removal of the weirs on the Lower Bann. The cutting between Portadown and Newry, suggested by Mr. Nimmo in 1828, has hitherto been thought too expensive; but the increasing wealth of the Bann Basin is bringing this scheme within the range of practicability. The execution would so materially affect the hydrological and commercial conditions of the whole district that no inquiry which ignores it can be considered conclusive. Besides constituting Newry the trade portal of the Bann and Erne Basins, it would drain a considerable acreage; and such flow through the cutting as was permitted would tend to reduce Lough Neagh floods. That great lake would exercise a regulating influence upon the whole water system somewhat analogous to the action of a fly-wheel upon machinery. Its management would naturally be entrusted to a corporate body representing the large area and various interests concerned.

Improved water communication between Lough Neagh and Newry must benefit the Ulster Canal, which derives thence and from Belfast its present scanty traffic, yielding but £55 annual tollage on a length of 45 miles. The constant deficit (£1000 a year) on this canal has induced the Commission to recommend its sale; and it is against this proposal that General Dickens' protest is chiefly directed. His hopes for the future of this canal, if it were deepened and stanched, are supported by competent and impartial testimony. The engineer in charge recommends an expenditure of £10,000 to give 5ft. of water, and thus admit larger lighters. When asked (Q. 1668) whether after that outlay "we might not have the same state of things to face in five years more," his answer is, "I pledge my existence you would not." This opinion is supported by detailed estimates of cost and traffic, which seem to show that the present annual deficit would probably be more than met if the £10,000 were laid out. If this outlay caused no improvement in the traffic, the interest (£300 a year) would be met by the rental which the Government now receives for the Laggan Navigation. When, however, it is considered that the proposed works would increase the cargo of lighters from 44 to 66 tons (50 per cent.), and obviate trans-shipment, there seem grounds for hope, especially when the recent progress of the neighbouring navigations is remembered. Between 1875-6 and 1879-80 the receipts of the Laggan Navigation increased 26 per cent. The Newry Navigation pays 5 or 5½ per cent. Those parts of the route which are nearest to busy towns, and therefore most lucrative, have been handed over to private companies, which will reap much of the profit if their chief feeder be improved at the public cost.

To the north-west stretches the magnificent Erne Navigation, on which large sums are now being spent under the Act of 1880. Some witnesses have calculated that the traffic from that basin would add £1000 a year to the revenue of the Ulster Canal if the latter were made 5ft. deep. Mr. J. G. V. Porter gives enthusiastic evidence about the 52 "miles without a lock" above Belleek; but "eyes front" is the order of the day with the Commissioners, who press steadily onward to the poor mountain district through which the Ballinamore and Ballyconnell Canal runs. As nearly quarter of a million has been spent on that waterway, one is glad to find its value as an arterial drain so generally admitted; but its prospects of traffic seem almost limited to the clay goods of Lough Allen. The fact that these are carried to Limerick hardly proves that they would also be sent to Belfast. The distances from Leitrim to the two cities are about the same, but three watersheds must be surmounted to reach Belfast, entailing the passing of sixty-seven locks, as compared with fifteen between Leitrim and Limerick. Belfast can also obtain clay goods from other sources. The proposal of the Commission to leave the Ballinamore and Ballyconnell Canal in such a state that navigation could be re-established at some future time, appears to meet the practical exigencies of the case; for the utility of the navigation seems at best prospective.

The rest of the investigation is devoted to the Shannon, and follows its course for about 100 miles, traversing a basin which occupies about one-seventh of Ireland. On this river much has been written, many commissions and committees have sat, and a million has been spent, resulting in annual receipts which usually only balance the cost of maintenance. This state of things is explained by the fact that the whole character of the through navigation is determined by the small locks above Leitrim and below Killaloe. What "break of gauge" is to a railway, varying-sized locks are to a waterway; and it certainly seems unfortunate that the usefulness of the fine locks on the Middle Shannon should be limited by the inadequate ones at the northern and southern ends of the Navigation. By the former the rising industry of Lough Allen is checked; by the latter the water-borne trade of Limerick is cramped. The efficiency of the whole Shannon Navigation has, however, been constantly threatened, and even now does not seem out of danger. Some years ago a cry was raised that it should be made as shallow as the canals Grand and Royal that lead into it, and instances were given of rivers navigated by light draught boats. The Seine was often quoted, but it is to be hoped that those who then appealed to that river are now aware of its state and prospects. A large head reservoir at Settons tends to equalise the flow of the main affluent, the Yonne; above Paris, the *mouillage* is to exceed 6ft.; while from that city to the sea a standard depth of 9ft. or 10ft. is to satisfy the popular aspiration, "Paris, port de mer!" Certainly, if a precedent were wanted for impairing waterways, it is not in France that it should be sought. No country has better understood that the national importance of interior navigation is not indicated by the mere tollage that it yields.

The following passage is from the admirable report of M. Krantz's Commission of 1874:—"Jusqu'ici nous n'avons tenu compte, dans les revenus des voies navigables, que des produits du péage, les seuls, il est vrai, que puisse percevoir une concessionaire; mais, quand l'Etat entreprend lui-même l'etablissement de ces voies, sa situation n'est pas, à beaucoup près, la même que celle des particuliers. Si le canal suscite des ameliorations agricoles, provoqué l'etablissement d'usines, facilite l'exploitation de mines, de carriers, de forêts, augmente, en un mot, la richesse publique, l'Etat, notre inévitable associé, prend sa part de toutes les richesse créées, et cette part peut être assez large pour le rémunerer suffiisament, même en l'absence de tous peages; il peut donc trouver un très-sérieux profit à créer des voies navigables, qui ne pourraient offrir à l'industrie privée qu'une remuneration insuffisante." It is eight years since this was written, but the full consideration which the whole subject has since received has ended in a decision to expend £40,000,000 in covering France with a network of waterways, with two metres as the standard *mouillage*, and with locks about 120ft. by 16ft. Many of the works with this object are in course of execution. The cost is to be met by local as well as national contributions; for, in the words of the above-quoted report:—"L'est la, en effet, le criterion le plus sûr, la preuve la plus certaine, de la réalité des intérets a desservir. Quelle que soit l'insistance que l'on mette à patronner une entreprise, les ressources d'esprit que l'on deploie en sa faveur, l'autorité des faits ou des noms que l'on invoque et est permis de croire qu une entreprise est bien peu utile, quand aucun de ceux qui sont appelés à en recueillir les avantages ne veut consentir, en sa faveur, à aucun sacrifice."

The Shannon basin contributes nothing to the £52,000 now being spent on inserting sluices in the navigation weirs, by which the lands immediately above them are expected to benefit considerably. Between 1840 and 1850, when £557,000 was spent on Shannon works by the Government and the neighbouring counties, the riparian proprietors paid no special rate on the ground that such a tax would be "difficult to applot and to levy, and of an irritating character." Comparing this river, therefore, with others, it appears that the owners of lands bordering on it have been singularly fortunate, since all that they have paid towards flood-abatement is a small fraction of the contributions of their respective counties. The dissatisfaction which has been felt throughout the basin is perhaps largely due to there having been taxation without representation. There can never be certainty that the witnesses who present themselves before a commission represent the sense of the majority. No general deliberative body has afforded the people an opportunity of expressing their wants and opinions; and while the large tributaries have been allowed to form drainage boards and to discharge their waters upon the lower districts, the main river itself has suffered from the increased flooding thus occasioned without means of redress. In this, as in all cases of wide-spread evil, co-operation seems the obvious remedy. The small bodies representing the component parts of the great basin would effect more by united action than they are likely to accomplish severally. Considering the injury to navigation, which may be caused by shallowings in anticipations of rains, and by swift currents when floods are escaping, it would seem just that any conservancy-board should include representatives of the canal companies which use the river. On the body which manages the Severn, the navigation companies are represented as well as the riparian cities and counties. In the case of the corresponding Irish river, the reason for the participation of the State is to be found in the history of Ireland; and though Lord Monck's commission deprecates the further expenditure of Government money, it is not apparent why the national and local partnership, under which the present works have been created, should be dissolved.

There seems little ground for the cry of bribery, jobbery, &c., which some newspapers have raised in connection with this matter. The misdeeds of the old Royal Canal Company nearly a century ago may well be forgotten. Some of the branch canals were made as relief works when famine rendered hasty measures necessary; but the Irish Railway Commission of 1864 reported that "the canals of Ireland were, no doubt, in their day of great public benefit, and probably justified the large sums of public money which were spent on them."

The cost of 708 miles of Irish inland navigation has been met as under:—

Charged on counties	£385,364
Raised from private sources	2.296,349
Public money (before and since the union)	2,040,498
Total	£4,722,211

By far the greater part of this appears to have been Irish money. Out of the £2,040,498 as above, £857,382 was voted in College Green. The Grand and Royal Canals, which represent 262 miles out of 708, have not succeeded commercially; but it must be remembered that they were made before steam had revolutionised land and water transport. One of the reasons assigned for the extension of the Royal Canal from Coolnahay to Termonbarry was "the difficulty of navigating the Gulph of Lough Ree." The introduction of railways deprived the canals of passengers and light goods; the repeal of the corn laws affected the grain trade; and emigration reduced the traffic in building materials. It is now obvious that one large canal crossing the watershed between the east coast and the Shannon by the lowest summit-level would have been far better than the two defective lines which divide the traffic. As it is, however, Dublin receives large supplies of peat by its two canals, and the water which they convey eastwards is a source of power from which that city derives some benefit, and may yet derive considerably more. The Barrow Navigation, which dates from the days of the old Irish Parliament, has, on a whole, been a success.

The sum which Britain has contributed to Irish waterways since the union of the two islands cannot be looked upon as wasted. Much of it has been devoted to the Shannon, which in 1881 yielded a tollage of £2146, as compared with £1347 in 1872. Of the remainder, a large part has been spent on works having arterial drainage for their primary object, but affording navigation at slight additional cost. The cheapening of transport thus caused has stimulated the consumption of British coal and the reclamation of Irish land. Those who have seen the provinces of Drenthe and Gröningen will remember the Dedemsvaart and other canals by which the interchange of fuel and town manure is constantly carried on. In Germany a "Central Moor Commission," to deal specially with bog reclamation, was created in 1876; and the first step towards the reform of any peaty district seems to be its intersection by a network of canals, capable of carrying fuel, manure, and lime at the lowest rates. Without these canals it does not seem surprising that many Irish experiments should have failed. Of late years the improvements in steam navigation, the adoption of canal lifts in certain cases, and the success of wire-rope towage have done much to revive the usefulness of waterways. It is to be hoped then that the future of inland navigation in Ireland will follow the precedents set by other nations, and that the questions which successively arise will be considered in a comprehensive spirit, which shall gradually give to the present scattered fragments that unity of type and of administration in which they are so lamentably wanting.

This unity should be attained not by the crippling of the larger waterways, but by the enlargement of the smaller ones; for, as a lucid French writer puts it, it is a rule almost mathematically exact that the cost of freight is in inverse proportion to the tonnage of the boat. At a time when the purchase of the canals by the State is being mooted, the sale of one already under Government would seem singularly *mal apropos*. As General Dickens points out, "opinions have changed since Sir John McNeil wrote his report on the Ulster Canal twenty-one years ago." And here a few more words from the report of M. Krantz's Commission may not be inappropriate:—"Nous sommes, grâce à Dieu, déjà loin de l'epoque où, emportés par un enthousiasme *peu reflechi*, mais facile à comprendre, nous admettions assez volontiers en France que routes et canaux avaient fait leur temps et qu'il fallait declasser les unes, combler les autres et substituer la locomotive à tous les anciens engines de transport. Le temps a fait justice de ces exagérations, il a montré que si la circulation sur les routes s'est modifiée dans les details, elle s'est accrue pour l'ensemble; que les voies navigables soutiennent, malgré leur organisation defectueuse, la lutte contre les chemins de fer et assurent partout où elles existent, le bas prix de transport. Sous la pression des faits une réaction s'est produite."

In this country Mr. F. R. Conder, C.E., and others have done much to call public attention to the value of cheap transport. No agency can be more effectual in developing the material resources of a country; so that national money which has been spent on promoting industry cannot be considered misused. The expendiency of bribing people to beg, or of paying war indemnities to dishonest belligerents, may be doubtful; but the fostering of Irish public works by the Imperial treasury since 1800 seems no cause for regret. We may rather be glad of any benefit that Ireland has reaped from a union effected under circumstances upon which neither island can look back with particular satisfaction.

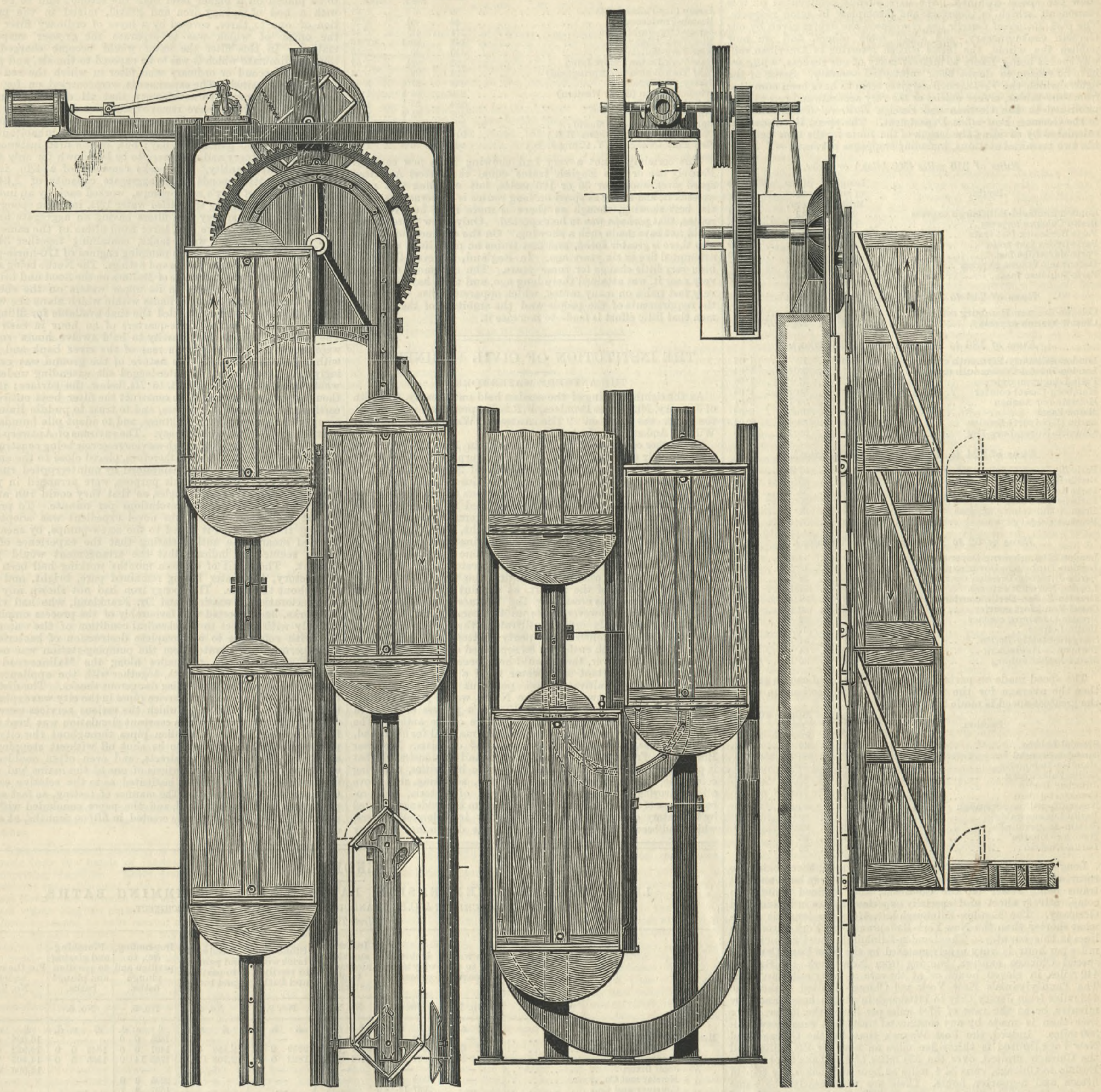
Since the above was written the committee on Railway Rates has reported in favour of the utilisation of Irish canals by Local Trusts. C.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Henry G. Burr, engineer, to the Lord Warden, additional, for service in the Elk; and Henry Onions, engineer, to the Asia, as supernumerary.

KING'S COLLEGE ENGINEERING SOCIETY.—At a general meeting held on Tuesday, the 23rd inst., Mr. N. D. Douglass, S.I.C.E. delivered his opening address. It was decided that the subject for discussion on February 26th should be "Motive Power for Tramways."

HART'S CYCLIC ELEVATOR, MANSION HOUSE CHAMBERS.

MESSRS. J. AND E. HALL, DARTFORD, ENGINEERS.



THE constantly increasing demand for offices at the different centres of business has resulted in the structures intended for this purpose being made so lofty that it has become quite a labour to toil up to the upper floors; while the enormous rentals demanded for lower floors put them beyond the reach of any except those doing large and lucrative businesses. It has long been a matter of anxious study to provide a means of overcoming this difficulty, and various forms of mechanical lifts have been devised and tried with this end in view; but none of them have been quite satisfactory as passenger lifts, because from the nature of their arrangement it has always been necessary to have an attendant who alone was permitted to work them, and frequently long delays would occur in consequence of the cage being at an upper floor at the time when a person or persons were waiting to be lifted.

These inconveniences proved so great that people frequently preferred the fatigue of mounting long flights of stairs to the loss of time involved in waiting, and mechanical lifts for passengers have hitherto been regarded as more or less unsatisfactory contrivances. It is claimed for the cyclic elevator, which we illustrate above, that it entirely removes all these difficulties. It consists of a number of moving cages, some of which are rising while others are descending. These cages move at a comparatively moderate speed, and each cage in its turn passes every floor both upwards and downwards, so that a person may get in or out at any floor he pleases, and whenever he requires, without delay. The moderate rate at which the cages move renders the getting on or off them a matter of no difficulty whatever, while one very special feature about the cyclic lift is that by an ingenious mechanical arrangement the cages pass to the extreme height of the lift and then descend without losing their vertical position, so that in case a passenger omits by inadvertence or otherwise to get out at the intended place, he is in no sort of danger.

On reference to our illustration it will be seen from the general arrangement that an endless steel chain of special design passes round two chain wheels, one at the top and one at the bottom of the elevator. To this chain the cages are attached at equal intervals, and in such a way that when passing over the top and bottom they preserve their vertical position. This end is attained by attaching each cage at a point considerably above its centre of gravity, so that so long as the cage is free to move about this attachment it tends to keep vertical. To make this motion perfectly certain, however, there is fixed at the back of each cage, and at a lower level than the chain attachment, a triangular casting. The apex of this triangle is made in the shape of a T, and runs in guides all up and down the lift. In the centre of the base of the triangle is a roller, which runs on a track up and down the lift, but on the opposite side of the cage to the T-head. Now when the cage nears the top or bottom of the lift, the T-head is guided to a centre, about which—by means to be described later on—the triangle turns, the roller in its base describing a semicircular path. Thus the triangle is reversed; the roller, which, when ascending, was on the left-hand side of the T-head, now, in its descent, changes to the right-hand side. The reversal of the triangle is brought about in this way. The link of the main chain, on which the cage is hung, has firmly attached to it a casting provided with four arms, which correspond to four projections cast on the triangle. Round these arms and projections pass the links of a light chain, so that any motion given to the top casting is communicated to the triangle below. Now each time the main chain passes over the chain wheel, each link performs half a revolution. This motion is communicated by the casting attached to the link to the triangle, which therefore also makes half a revolution. At the same time as this is taking place, the link of the main chain is passing from left to right, and each position of the link gives a corresponding position to the triangle, thus ensuring the perpendicularity of the cage.

A small horizontal engine drives these elevators by friction and spur gearing, a comparatively small amount of power being required, as the cages counterbalance each other, and all descending traffic of course assists the engine. There is also a special combination of governor and brake, which effectually prevents the possibility of the lift racing, which might otherwise occur if heavily laden on its descending side. The floors of all cages are provided with flaps, as also are the landings on the ascending side, thus preventing any possible accident from anything projecting from a cage.

Several of these elevators have been erected by Messrs. J. and E. Hall, and are at the present time working at the Kensington Palace Mansions, at the *Glasgow Herald* Office, Glasgow, and at Mansion House-chambers; in Size-lane, Bourse-buildings, Bucklersbury, and other places in the city of London. At the two latter addresses they are daily at work in the ordinary course of business.

The one in Size-lane undoubtedly carries more people daily than any other lift in London, the average number of passengers from the bottom to the top floors being about 2000 per diem, exclusive of those entering at the intermediate floors. The offices in the top floor here let, we are told, as readily as the bottom floors, and a restaurant on the fourth floor apparently does a good trade. Lavatory accommodation for the whole building is also on the fourth floor, thus effectually preventing any annoyance from objectionable odours arising therefrom, without any reduction of convenience. In watching the elevator at work we have seen ladies and elderly gentlemen avail themselves of it without hesitation.

THE new Canadian Government has started the manufacture of rifle cartridges at Quebec.

LIVERPOOL ENGINEERING SOCIETY.—The first meeting of the session was held on Wednesday, the 17th inst., at the Royal Institution, Colquitt-street, Mr. H. Bramall, M.I.C.E., president, in the chair, when a paper entitled "Engineering Notes from the United States and Canada," was read by Mr. John J. Potts, Assoc. M. Inst. C.E. The author having recently made a tour of between six and seven thousand miles on the American continent, during which he visited the principal cities lying between the eastern seaboard and the Missouri River, and between Manitoba on the north and Tennessee on the south, described the various sights and works of engineering interest on the route, which include railways, bridges and bridge-works, ironworks, waterworks, elevators or grain warehouses, steamboats, &c.; and concludes that a visit to the United States, where there is much to be learned, while tending to soften insular prejudices, strengthens the bond of friendship between the two countries, and a holiday cannot be better spent than in that country, where new health is to be gained from entire change of scenery and living.

THE SPEED OF FAST TRAINS IN EUROPE AND AMERICA.

A GERMAN journal, *Die Verkehrszeitung*, has recently made a comparison of the fast trains of leading countries in Europe, to show the speed attained. We have already commented on this statement, which is incorrect and incomplete in some respects. The *U.S. Railroad Gazette* has reproduced the figures given by our German contemporary, and added some others, and we now publish the whole, the latter portion referring to American railway speeds being likely to interest many of our readers, while we have no reason to doubt their substantial accuracy. Some of the figures which the *Verkehrszeitung* gives seem to have been compiled from time-tables, either official or the very accurate and recent ones published in the German and Foreign *Railroad Guide* compiled in the German Post-office Department. The speed in all cases is calculated by dividing the length of the route by the time between the two terminal stations, including stoppages between:—

Runs of 310 *miles* (500 *kilos.*) *or more.*

Route.	Length of run, miles.	Miles per hour.	Minutes per mile.
London-Sheffield-Edinburgh express	416	41	1·464
Berlin-Cologne express	354½	37	1·625
Paris-Bordeaux fast train	346¾	36⅓	1·650
Paris-Lyons fast train	326	36⅓	1·650
Paris-Marseilles fast	536	34⅔	1·730
Bodenbach-Vienna express	335½	31·4	1·910
Paris-Toulouse fast	466½	29·4	2·040

Runs of 248 *to* 310 *miles* (400 *to* 500 *kilos.*).

Route.	Length of run, miles.	Miles per hour.	Minutes per mile.
Cologne-Bremen-Hamburg courier	277½	33⅓	1·80
Cracow-Vienna express	257	27¼	2·20

Runs of 186 *to* 248 *miles* (300 *to* 400 *kilos.*).

Route.	Length of run, miles.	Miles per hour.	Minutes per mile.
London-Salisbury-Plymouth express	230	17	1·62
London-Bristol-Portsmouth express	247	36·6	1·64
Paris-Longuyon express	207½	31·6	1·90
Hamburg-Cassel courier	215¾	30·8	1·95
Holzminden-Aachen	203½	30·0	2·01
Mainz-Basel	218½	29·7	2·02
Berlin (Kohlport)-Breslau	123½	29·4	2·04
*Munich-Nuremburg-Hof	241	26·7	2·25

Runs of 124 *to* 186 *miles* (200 *to* 300 *kilos.*).

Route.	Length of run, miles.	Miles per hour.	Minutes per mile.
Paris-Boulogne-Calais express	184¼	37·0	1·62
Berlin-Hamburg	177½	35·3	1·70
Paris-Rouen-Havre fast	141½	33·1	1·81
Paris-LeMans fast	131	33·1	1·81
Bremen-Magdeburg express	163	31·7	1·89
Brussels-Cassel express	133½	30·6	1·96

Runs of 62 *to* 124 *miles* (100 *to* 200 *kilos.*).

Route.	Length of run, miles.	Miles per hour.	Minutes per mile.
London-Sittingbourne-Dover express	78	44·8	1·34
London-Tunbridge-Dover express	65¼	43·5	1·38
Berlin-Jüterbog-Dresden courier	116½	38·1	1·57
London-Norwich express	114	37·0	1·62
Dresden-Zoffen-Berlin courier	108	34·3	1·75
Cassel-Frankfort courier	123½	33·9	1·77
Breslau-Oderburg courier	132¼	32·4	1·85
Berlin-Leipsic	101¼	32·4	1·85
Stargard-Stettin-Berlin	115	31·7	1·89
Darmstadt-Heidelberg	37¾	34·9	1·72
Mainz-Aschaffenburg	40¼	30·3	1·98

The speed made on parts of the longer runs is of course greater than the average for the whole. Some of the sections on which the greatest speed is made are as follows:—

Section.	Length, miles.	Miles per hour.	Minutes per mile.
Stendal-Lehrte	83¼	45·1	1·33
Spandau-Stendal	57¼	43·5	1·38
Hanover-Debisfelte	54⅔	43·5	1·38
Berlin-Falkenberg	69½	41·1	1·46
Jüterbog-Berlin	39	41·1	1·46
Frankfort-Juben	30	41·1	1·46
Neustadt-on-Dosse-Spandau	—	40·3	1·49
Berlin-Luckenwalde	31	39·5	1·52
Stettin-Angermünde	42¾	37·5	1·60
Hanover-Cologne	203½	35·9	1·67
Berlin-Kustrin	51⅓	35·6	1·69

Long runs at fast speeds are few, it will be seen, there being no room in Great Britain for what we could call a long run here, and fast trains being fewer on the Continent, and confined chiefly to comparatively short and specially important routes in France and Germany. The London-Edinburgh line, 416 miles long, is somewhat shorter than the New York-Buffalo and New York-Pittsburgh lines in this country. The London-Edinburgh speed of forty-one miles per hour is very nearly matched by the New York Central's special Chicago express, running from New York to Buffalo, 440 miles, in eleven hours, or at the rate of forty miles an hour. The Pennsylvania's New York and Chicago limited makes the 443 miles from Jersey City to Pittsburgh in eleven hours and fifty minutes, or at the rate of 37·4 miles per hour—the latter faster time than is made by any continental train that runs more than 300 miles. Indeed, the Fort Wayne's time for the Chicago and New York limited is thirty-five miles an hour for 468 miles, and the Chicago limited, over the 525 miles of the Lake Shore from Buffalo to Chicago, runs 34·4 miles an hour and makes the trip in fifteen and a-quarter hours. These are very nearly the same speed as that of the fast train over the 536 miles between Paris and Marseilles. The fast train on the Michigan Central makes the 284 miles from Detroit to Chicago in eight hours and five minutes, which is 35·1 miles per hour, and the Great Western train connecting with it runs 229 miles, from Windsor to Clifton, in six hours and twenty-five minutes, which is 35·8 miles an hour.

On no European route of 200 miles or more named above is there a train making as much as thirty-seven miles an hour except between London and Edinburgh, Berlin and Cologne, and London and Plymouth. The list, however, strangely omits what is perhaps the most frequented of all—between London and Liverpool, on which there certainly are trains that make more than forty miles an hour, and which is from 225 to 250 miles long by different routes—about the same distance as from New York to Boston, New York to Washington, or Buffalo to Detroit. The best examples we have of trains to match these are on these very routes from New York to Washington and Boston. Trains now run from New York to Boston, by the Shore Line, 232 miles, in five hours and fifty-three minutes, or 39⅓ miles per hour, and this includes the ferry transfer at New London. On the Springfield line trains take six hours for the 234 miles—39 miles per hour. This is not equalled by any English speed given above for a line 200 miles long or more, except that between London and Edinburgh, but we are sure that it is surpassed by some of the trains between London and Liverpool.

During the session of Congress the Pennsylvania last season ran a limited express, which passed over the 244 miles between Jersey City and Washington in 5 hours and 50 minutes, which is at the rate of 41⅚ miles per hour—not matched by any European line of equal length in the above list. Of shorter routes, and parts of routes, there are many in Europe on which the speed is more than 40 miles an hour, and but few here. Our fastest train is one between Jersey City and Philadelphia, making the 89 miles by the Pennsylvania Railroad in 1 hour and 52 minutes, which is 47⅔ miles per hour, and by the Bound Brook route substantially the same time is made—faster than the speed of any European train reported by the *Verkehrszeitung*. On the Boston and Providence Railroad a train makes the 44 miles between Boston and Providence in 57 minutes—47⅓ miles per hour—also faster than any of the above European trains. The fastest train over the 142 miles of the New York Central between New York and Albany takes 3½ hours for the run, making a speed of 40·6 miles an hour. Below we tabulate these fast American trains which will render comparison easy with the European trains in the tables above:—

Route.	Length, miles.	Miles per hour.	Minutes per mile.
Jersey City-Philadelphia	89	47⅔	1·26
Boston-Providence	44	46⅓	1·29
Jersey City-Washington	244	41⅚	1·43
New York-Albany	142	40·6	1·47
New York-Buffalo	440	40	1·50
New York-Boston (Shore Line)	232	39⅓	1·52
New York-Boston (*viâ* Springfield)	234	39	1·54
Jersey City-Pittsburg	443	37·4	1·60
Windsor-Clifton (Great Western)	229	35·8	1·68
Detroit-Chicago	284	35·1	1·71
Chicago-Pittsburg	468	35·0	1·71
Buffalo-Chicago (Lake Shore)	525	34·4	1·74
Chicago-Jersey City (Penna. R.R.)	911	35·6	1·69
New York-Chicago (N. Y. C. and L. S.)	965	36·3	1·65

This certainly is not a very bad showing for a new country. Possibly one or two English trains equal the fastest American speed given above for 50 or 100 miles, but we think that none exceeds it, and so far as speed on long routes is concerned we make the best showing, though as there is more room here for long routes, that perhaps was to be expected. Only a few years ago we could not have made such a showing. On the continent of Europe also there is greater speed, and fast trains on more lines, than was attempted five or six years ago. In England, however, there has been very little change for some years. The maximum, or a rate very near it, was attained there long ago, and there have long been very fast trains on many routes, which apparently has so satisfied the requirements of the people and the ambition of the railroad men that little effort is made to increase it.

* Numerous stoppages and an unfavourable alignment make this train slow.

THE INSTITUTION OF CIVIL ENGINEERS.

THE ANTWERP WATERWORKS.

AT the eighth meeting of the session held on Tuesday, the 16th of January, Mr. James Brunlees, F.R.S.E., president, in the chair, the paper was read on "The Antwerp Waterworks," by Mr. William Anderson, M. Inst. C.E.

The author commenced by stating that in 1879 the concession for the supply of water to the city of Antwerp fell into the hands of his firm. Antwerp had a population of 200,000 inhabitants; it ranked as the third largest port in Europe, and was being rapidly extended and embellished. Previous to the construction of the works the water supply was derived from shallow wells and open canals. As the sewage arrangements were very imperfect, the well water, though clear, bright, and sparkling, was for the most part dangerously contaminated. The scheme adopted by the author's firm, the only one practicable from a financial point of view, was originally suggested by Mr. J. Quick, M. Inst. C.E., and consisted in taking the waters of the river Nethe, an affluent of the Escaut, at a point eleven miles from Antwerp, where it was crossed by the Malines-road. The waters of the Nethe were, however, quite unfit to compete with the existing supply, after only ordinary filtration through sand, because they were greatly coloured by peaty matter, and very finely-suspended mud, which could not be separated either by subsidence or filtration. Moreover, there would have been great risk in introducing into an important town water from a river which flowed through a highly cultivated and populous country; and the attempt to supply Antwerp from the Nethe would probably never have been made had not Professor Bischof's process of filtration through spongy iron come under the notice of the author. The properties of finely-divided metallic iron as a material for filters had, for some time, attracted the attention of chemists. Professor Bischof, Dr. Frankland, and Mr. Hatton had demonstrated that it possessed the power of destroying organic impurities, removing colour, separating finely-suspended matter, softening, and, above all, destroying the germs of putrefaction, of bacteria, and probably those of epidemic diseases. To confirm the evidence afforded by laboratory experiments, and by spongy iron domestic filters, which had been in use for some time, it was determined to carry out experiments on a large scale at Waelhem, the proposed site of the intake of the works, under the auspices of Mr. Ogston, Assoc. Inst. C.E. The arrangement recommended by Professor Bischof took the form of a pair of filters, having an aggregate area of 680 square feet. The first filter was to be placed on a higher level than the second, and to be filled with a bed of spongy iron and gravel, mixed in the proportion of one to three, covered by a layer of ordinary filter sand, the office of which was to separate the grosser suspended matter. In this filter the water would become charged with iron, to eliminate which it was to be exposed to the air, and passed through a second or ordinary sand filter in which the red oxide would be deposited. The experiments were carried on for three months, and proved so satisfactory that all doubts about the efficacy of the process were removed, and the designs were made for the permanent works. The terms of the concession required a daily supply of 33 gallons per head for 175,000 inhabitants, or nearly six million gallons per day; but, in the first instance, the pumping machinery and main were to be laid down for only 40 per cent. of that quantity. The works consisted of a 42in. intake-pipe, two settling-ponds of an aggregate capacity of 2,640,000 gallons, a pair of Airy's screw-pumps, worked each by an independent engine, for raising the settled water 19ft. into the spongy iron filter beds; three spongy iron filters having an aggregate area of more than 31,000 square feet, three sand filters of the same area, two cast iron filtered water tanks, containing together 340,000 gallons, and two pairs of beam pumping engines of 170-horse-power each, together with their boilers and fittings. The Nethe being a tidal river, carrying up the drainage of Malines on the flood and bringing down that of the villages on its upper waters on the ebb, the authorities prescribed certain limits within which alone the waters should be taken; these restricted the time available for filling the settling ponds to about three-quarters of an hour in each tide. The settling points, of a capacity to hold twelve hours' supply, were excavated immediately in rear of the river bank and lined with dry stone pitching. The nature of the ground was exceedingly treacherous, a bed of water-logged silt extending under the whole area, at a depth of 6ft. to 7ft. below the surface; it was thought prudent, therefore, to construct the filter beds entirely of earthwork resting on the surface, and to trust to puddle linings to secure the necessary water-tightness, and to adopt pile foundations for the engine-house and chimney. The environs of Antwerp being very flat did not permit of a high-service reservoir being constructed, the filtered water tanks were, therefore, placed close to the engine-house, and the service was maintained by uninterrupted running of the engines, which, for this purpose, were arranged in pairs, each pair coupled at right angles, so that they could run at any speed between 1½ and 22 revolutions per minute. To provide against the effect of frost, the novel expedient was adopted of heating the water, as it flowed to the screw-pumps, by means of injected steam, the author stating that the experience of last winter seemed to indicate that the arrangement would prove efficient. The result of eighteen months' working had been very satisfactory, the water having remained pure, bright, and clear throughout the time. The spongy iron had not shown any signs of deterioration or wasting; and Dr. Frankland, who had visited the works, had reported very favourably of the process employed, not only with respect to the chemical condition of the water, but also with reference to the complete destruction of bacteria and their germs. The water from the pumping-station was carried in a 20in. main for ten miles along the Malines-road; its course was described at length, together with the appliances for getting rid of air and of avoiding dangerous shocks. The distribution of subsidiary mains and service pipes in the city was explained, together with the manner in which the various services were laid on. By the system adopted a constant circulation was kept up as far as possible in the distribution pipes throughout the city. It permitted a range of pipes to be shut off without stopping the supply of the neighbouring streets, and even often enabled the service to be kept up when portions of one of the mains had to be shut off. A comparison was instituted as to the relative cost of German and English pipes. The manner of testing, as fast as the pipes were laid, was described, and the paper concluded with the statement that the works were erected in fifteen months, at a cost of £280,000.

TENDERS.

LLANDUDNO PIER EXTENSION, PAVILION, AND SWIMMING BATHS.

B. NELSON, ARCHITECT & C.E., LLANDUDNO.—QUANTITIES BY THE ARCHITECT.

First Tendering.

	Sea wall, &c., to pier extension. No. 1. £ s. d.	Ironwork only to pier extension. No. 2. £ s. d.	Ironwork and stone abutments to pier extension. No. 2A. £ s. d.	Stone and brickwork to pavilion and baths. No. 3. £ s. d.	Woodwork and painting to pavilion and baths. No. 4. £ s. d.	Iron roofing, &c., to pavilion and plunge baths. No. 5. £ s. d.	Plumbing and glazing to pavilion and plunge baths. No. 6. £ s. d.	For the whole, except No. 2A. £ s. d.
Messrs. Woodall*	—	1798 0 0	2316 0 0*	—	—	1305 0 0	—	16,098 0 0
" Braddock	5832 0 0	2036 7 6	2731 0 0	2859 2 6	2,500 0 0	1401 0 0	1843 0 0	15,952 0 0
" Gradwell	4257 5 0	2001 14 8	2478 0 0	1822 0 0	2,763 11 3	1755 14 9	1865 5 0	14,465 7 6
" John Dixon	—	—	—	—	—	—	—	14,000 0 0
" Horsley and Co.	—	2535 0 0	—	—	—	2295 0 0	—	—
" Courtney and Co.	—	2087 12 4	—	—	—	1597 8 7	—	—
" John Hughes	—	—	—	—	2,875 0 0	—	—	—
" Haigh and Sclater	—	—	—	—	—	—	2227 0 0	—
" J. B. Jones	—	—	—	—	2,300 0 0	—	1820 0 0	—
" Shelley	—	—	—	—	—	—	1755 15 0	—
" Head, Wrightson, and Co.	—	2780 0 0	—	—	—	—	—	—
" Jones and Co. (Nos. 1 and 3)	—	—	—	2860 0 0	—	—	—	—
" Williamson and Co. (Nos. 1, 3, and 4)	—	—	—	—	11,300 0 0	—	—	—
" Scott and Edwards	6126 0 0	—	—	—	—	—	—	—
" Owen and Co.	4500 0 0	—	—	1932 0 0	—	—	—	—
" Pritchard and Co.	3291 10 10	—	—	1424 5 3	—	—	—	—
" Pilling and Co. (Nos. 1 and 3)	—	—	—	4830 0 0	—	—	—	—
" Smith and Co.	3684 0 0	—	—	1826 0 0	—	—	—	—

Amended or Second Tendering.

	No. 1.	No. 2.	No. 2A.	No. 3.	No. 4.	No. 5.	No. 6.	For the whole, except No. 2A.
Woodall*	—	1847 8 9*	—	—	—	1836 0 0	—	—
Braddock	4005 0 8	2036 1 6	—	—	—	—	—	—
Gradwell*	3046 0 0	2016 0 0	—	—	2,655 0 0*	—	—	—
Horsley and Co.	—	2560 0 0	—	—	—	—	—	—
Courtney and Co.	—	2121 9 1	—	—	—	—	—	—
J. B. Jones	—	—	—	—	2,800 0 0	—	—	—
Shelley and Co.*	—	—	—	—	—	—	2100 0 0*	—
Head, Wrightson, and Co.	—	2820 0 0	—	—	—	—	—	—
Jones and Co.	4400 0 0	—	—	—	—	—	—	—
Owen and Co.	2633 0 0	—	—	2035 0 0	—	—	—	—
Smith and Co.*	2486 0 0*	—	—	—	—	—	—	—
Pilling and Co.	3487 0 0	—	—	—	—	—	—	—
Pritchard and Co.*	2481 0 0	—	—	1650 0 0*	—	—	—	—
Brettell and Co.	—	—	—	—	—	2970 0 0	—	—
Janson and Co.*	—	—	—	—	—	1580 0 0*	—	—
Roberts	—	—	—	—	2,600 0 0	—	—	—
Griffith	—	—	—	—	2,800 0 0	—	—	—
Midland Joinery Company	—	—	—	—	2,975 0 0	—	—	—
Roger Williams	—	—	—	—	2,410 0 0	—	—	—
Helliwell	—	—	—	—	—	—	2290 0 0	—
Rendle and Co. (for roof glazing only)	—	—	—	—	—	—	941 15 0	—
Gradwell (for roof glazing only)	—	—	—	—	—	—	952 14 0	—
Chas. Perry	—	—	—	—	—	—	2398 0 0	—

* Accepted tenders. * Pritchard and Co., for completion of contract No. 1, £2246 15s. in addition.

HOT-AIR ENGINES.—Messrs. Hayward Tyler and Co., Queen Victoria-street, have just issued in pamphlet shape a handy little catalogue of hot-air engines, which contains a good deal of information concerning these small motors. Messrs. Hayward Tyler and Co. state that a half-horse power Rider engine will easily deliver 600 gallons of water per hour at an elevation of 70ft. or 80ft. from the surface of the well or cistern, or a proportionately larger quantity at a less elevation, and will use, when running ten consecutive hours, about 30 lb. of coke. This represents a cost of nearly one penny for 1000 gallons of water raised 80ft. high, or about one-halfpenny per 1000 gallons raised 30ft. or 40ft. This is cheap pumping.

RAILWAY MATTERS.

SEVEN thousand men are now at work on the British Columbia section of the Canada-Pacific Railway.

A NEW suspension bridge for the Michigan Central and Canada Southern Railroad Companies is to be constructed below the Falls of Niagara.

THE *Colonies and India* says the tender of Messrs. Halliday, Owen, and Co. has been accepted for the railway from Nerandera, New South Wales, to Jerilderic. The amount of the tender is £284,330.

TELEGRAPHIC advices received on Tuesday report that heavy snow was obstructing nearly all the railways west of the Mississippi River. The extreme cold wave had reached the Atlantic, but accompanied by clear weather.

A NEW YORK telegram of Wednesday says:—A despatch from Cumberland, Maryland, announces that a lengthy coal train went off the rails near that place, and precipitated itself over an embankment 100ft. in height. All the men working the train, fifteen in number, are believed to have been killed.

FROM the 1st of May next, the date fixed for the opening of the Amsterdam Exhibition, the locomotives, tenders, carriages, and luggage vans of all trains on railways in Holland, the speed of which exceeds 60 kilometres—37 miles—an hour, must be provided with continuous and automatic brakes of a system approved by the Minister of Public Works.

THE Parramatta, New South Wales, tramway seems to be very unfortunate before it is made, for its completion has been delayed by the non-arrival of rails, the fish-plates were sunk in the Austral, and the motors in the Gulf of Finland, which was wrecked in the Red Sea.

AT the end of 1881 the total length of single line of way on the six principal French railway companies was 34,560 kilos., of which there were 17,090 kilos. laid with iron and 17,470 kilos. with steel rails. This difference of about 300 kilos., compared with that at the end of 1880, showed an increase of 2276 kilos. laid with steel rails and a decrease of 1315 kilos. laid with iron rails.

THE total quantity of coal brought into London by railway and canal in December was 614,087 tons, against 618,889 tons last year. Of these 614,087 tons the North-Western carried 140,123 tons; the Great Northern, 88,676; Great Western, 113,032; Midland, 194,926; Great Eastern, 69,928; South-Western, 5063; South-Eastern, 1767; and the Grand Junction Canal, 570 tons.

ACCORDING to Mr. Traill, the engineer of the Giant's Causeway and Portrush electric tramway, the total prime cost will be about £21,000 for six and a-half miles of tramway, the cost of buildings, rolling stock, electric plant, engines, law, parliamentary and engineering expenses. He says also that the electric car is able to ascend a long continuous hill of about 1½ miles in length, and with a gradient of 1 in 35, drawing a second car behind it, and work as readily and as well at a distance of two miles from the generator as adjacent to it.

THE small gauge railway between Calais and Anvin, 94 kilometres—58 miles—long, and of 1 metre—3ft. 3⅜in.—gauge, has lately been completed for the sum of 7,238,000f., or £289,520. The minimum radius of the curves is 130 metres, and the maximum gradient 1 in 66. The rolling stock comprises locomotives costing 32,000f., or £1280; carriages at 8000f., or £320; and luggage vans at 3650f., or £146. The line is not fenced, except at the stations; and the numerous level crossings are not provided with barriers except at villages.

THE Geneva correspondent of the *Times* says that all attempts to effect an amicable arrangement of the matters at issue between the St. Gothard Company and Favre and Co., the contractors for the great tunnel, having proved abortive, the contest will be fought out in the law courts. The proceedings there, in the cross actions, are likely to be long and costly, the amounts at stake being, for Switzerland, unprecedentedly heavy. The company claim from the contractors nearly nine million francs, and the contractors, on their part, are suing the company for 14,350,000f., the amount of the losses which they say they have sustained by the company's *laches*.

THE St. Gothard Railway is diverting the bulk of the Italian trade into the hands of Germany, Belgium, and Holland with surprising rapidity. Early fruit and vegetables are conveyed without transshipment from all parts of Italy to Ostend, Antwerp, and Rotterdam, whence they are taken by fast steamers to London and other English ports. The Great Eastern Railway Company alone is stated to have carried over 6000 tons of these goods, *viâ* Antwerp and Harwich, in a few months. Malta is now brought nearer, and Algerian produce, such as green peas and early potatoes, is made more available. On the other hand, Italy is receiving an unprecedented, not to say overwhelming, amount of attention from Germany. In two months after the opening of the St. Gothard route the Germans despatched 40,000 tons of coal, 107 tons of unmanufactured iron and hardware, 14,000 tons of machinery, 693 tons of copper, 17,409 tuns of spirits, 1446 tons of paper, and 76 railway wagons—the export, the *Times* says, of all these articles having previously been either *nil* or quite nominal.

COLONEL YOLLAND, in reporting on a collision that occurred on the 20th November between a passenger train belonging to the South-Eastern Railway Company and a goods train belonging to the Great Northern Railway Company, at the Borough Market Junction on the South-Eastern Companies line, between London Bridge and Charing-cross Stations, and referring to the electric system of intercommunication between the carriages, says:—"Before this electrical system was sanctioned by the Board of Trade, in July, 1869, I was present at some experiments in which a vehicle was detached while running, and the detaching of the vehicle equivalent to a separation of the train into two parts was then made known by the electric signal. I was under the impression that this had been adopted and carried out by the South-Eastern Railway Company as one main object of the communication along trains was to tell the engine driver that his train had separated into two parts. In its present state—the arrangement being to make instead of to break contact—I cannot say that this electrical communication is an efficient one, as it does not tell the engine driver that he has lost part of his train. If the train had been fitted throughout with automatic continuous brakes the separation of the train into two parts would at once have been made known to the engine driver of the passenger train."

RAILWAY extension has been attended with remarkable town growth in America, but few towns have been founded in a night. A curious history, however, involving such rapidity, attaches to the town of McGregor, in Texas, which is situate 150 miles west of Tyler, and twenty miles west of Waco. The site was selected as the crossing of the Gulf, Colorado, and Santa Fe and the Texas and St. Louis Railroads one day in September, 1881. The report spread, and by the next morning the place was staked out in town lots, with all the details of streets, squares, &c., which are generally the work of time on the part of surveyors. At the opening sale the lots were disposed of at the rate of one and a-half per minute. In the aggregate 442 lots, covering 300 acres, were sold, and the next two towns were started, one within two miles and the other three miles distant. Shanties appeared on the prairies moving with all speed on rollers towards McGregor, and by the second day twelve houses were under construction, while the owners camped round in tents. At the close of two months the town numbered 170 houses, with a population of 500 souls. A weekly paper called the *Plaindealer* appeared in the course of another month, and thirteen more new houses were built. The prospects of McGregor are said to be most encouraging. Last summer the railways carried away 15,000 bales from this thriving young town, and the railway authorities have begun to build a local freight and passenger depôt, with transfer facilities.

NOTES AND MEMORANDA.

THE deepest coal mine in America is at Pottsville, Penn. The shaft is 1576ft. in depth. The coal-boxes, holding 4 tons each, are run upon a platform, and the whole weight of 6 tons is lifted in a little more than a minute. The output is said to be 200 car-loads a day.

MR. E. KÖRTING, of Vienna, has recently taken out a patent for decarburising cast iron by means of carbonic acid, which, at the high temperature employed, parts with oxygen sufficient, it is said, to combine with the carbon in the iron. The inventor claims that the difficulties involved in the employment of a metallic oxide are hereby overcome.

IT is stated that in the North Atlantic, says the *Scientific American*, waves have been observed of 24ft. and 30ft. high, highest being 43ft., mean 18ft., in westerly gales. In the Pacific 32ft. is recorded; South Atlantic, 22ft.; Cape Horn, 32ft.; Mediterranean, 14½ft.; German Ocean, 13½ft.; and French sailors mention 36ft. in the Bay of Biscay.

THIS from the *Chemist and Druggist* may be useful in the shops and elsewhere:—"It is said that tar may be instantaneously removed from the hands by rubbing them with the outside of fresh orange or lemon peel, and wiping dry immediately. It is astonishing what a small piece will clean. The volatile oils in the skins dissolve the tar, so that it can be wiped off."

THE annual rate of mortality in London from all causes, which had been equal to 20·5 and 20·7 per 1000 in the two preceding weeks, rose last week to 21·9. At the Royal Observatory, Greenwich, the mean reading of the barometer last week was 29·78in. The mean temperature was 42·9 deg., and 4·3 deg. above the average in the corresponding week of the twenty years ending 1868. The lowest night temperature was 32·8 deg. on Wednesday.

AT the request of Mr. C. Greaves, M.I.C.E., several series of observations were taken at frequent intervals during last summer of the temperature of the surface of the pond a quarter of a mile distant from the Kew Observatory. More recently a float has been moored in the centre carrying maximum and minimum thermometers immersed just below the water-line. This is hauled to the shore every morning at 9 a.m., and the temperatures recorded.

MESSIEURS STOCKLIN ET VETILLARD, having experienced great difficulty in driving piles into the fine wet sand of the sea-shore, have succeeded by the adoption of the system of leading a jet of water along the sides of the pile to be driven, to from 7in. to 12in. below the point, by means of an india-rubber tube terminating in a metallic nozzle. Two such tubes are employed one on each side of the pile, care being taken to keep them as vertical as possible, and to move them continually for preventing their being closed in by the sand, which again becomes compact directly the flow of water stops.

SOME time ago, the *Engineering Review* says, "a Philadelphia machinist devised a substitute for the resin or lead with which it is customary to fill copper pipes in order to bend them without buckling. This consisted of a close-wound square steel coil forming a mandril. To remove the mandril after the pipe was bent, it was only necessary to pull on one end, at the same time giving it a slight twist to lessen its diameter. At the time it was brought out it was said to do well, but nothing has recently been heard of it." Lead or resin meet the requirements for any size of pipe, while a large number of mandrils would be necessary. Perhaps this explains it.

FROM a Parliamentary return just published it appears that the authorised gas undertakings in England and Wales, belonging to local authorities, received for gas during 1881 £3,189,940; while the total expenditure (exclusive of interest on loans) was £2,109,658, and the net profit was £438,303. There were 1,865,255 tons of coal estimated to have been carbonised during the year, producing the estimated result of 18,308,620,076 cubic feet of gas. In the return relating to gas undertakings other than those of local authorities no figures relating to receipts, expenditure, or net profit are given. The coal carbonised amounted to 4,500,081 tons; the cubic feet of gas made is estimated at 45,036,680,421. By the two returns it is shown that there are 1,581,654 consumers of gas, and 296,376 public lamps lighted in England and Wales.

IN chloride of sodium and chloride of potassium solutions, with access of air and carbonic acid, copper, brass, German silver, and zinc, are violently attacked, while in the absence of carbonic acid, they undergo comparatively little change. The contrary is the case with lead, tin, and Britannia ware, these being attacked more violently when exposed to air free from carbonic acid than in air and carbonic acid. In the latter case, lead is only half as much affected as in former, tin not at all, and Britannia metal very little. In the course of experiments by Professor Wagner, with access of air free from carbonic acid, not a trace of any of the metals was dissolved; with access of air and carbonic acid, considerable quantities of copper, brass, German silver, zinc, and lead were converted into soluble compounds, only a trace of Britannia metal went into solution, and no tin was dissolved.

AS an explanation of the effect produced by a thin stratum of oil spread over the surface of the sea in quieting the waves, M. Van der Mensbrugghe, in a paper read before the Academie des Sciénces, premises, first, that to increase the surface of a mass of water a certain amount of force is required, and this force is stored up, as potential energy, in the superficial layer of the water; secondly, when the free surface of a mass of water is decreased, a proportionate amount of this potential energy is changed into kinetic or actual energy. Thus, when one stratum of water is brought—say by the wind—over another, the potential energy of this latter is changed into kinetic energy, and a certain velocity is generated. When, however, one stratum of water is brought upon another covered with a thin layer of oil—and, consequently, having less potential energy than the first—the amount of force transformed into kinetic is considerably less than that remaining as potential energy. In other words, there would be a continual disappearance of actual force, and this would explain the tendency of the waves to subside much more quickly than when no oil is present.

IT is known that the vapour-tension of liquid carbonic acid is enormous; thus while it is about 50 atmospheres at 15 deg. C., it exceeds 100 atmospheres at 50 deg. and it reaches 800 atmospheres at 200 deg. Hence, a vessel of the liquid represents a certain quantity of energy ready for use—if the cooling due to vaporisation do not lower the temperature of the liquid too much. This fact has been lately turned to account by Major Witte, head of the Berlin Fire Brigade. The steam pumps are supplied with reservoirs of liquid carbonic acid. When a fire is announced the boiler fire is at once lit, but it takes some minutes to get up the requisite steam pressure, and the engine may have reached the scene before this is done. In that case, communication is opened between the reservoir of liquid carbonic acid and the motor-cylinder of the pump, and the vapour then drives the pistons like steam. As the temperature rises water is vaporised, and for a time the pump is driven by a mixture of steam and carbonic acid; then steam is used alone. The important point is that by this arrangement, the pump is always ready to act when the fire is reached. A gain of five or six minutes, thus sometimes realised, may be of considerable importance at the outbreak of a fire. Major Witte's experiments prove that the consumption of carbonic acid, before working with steam alone, does not exceed eight kilogrammes—say 20 lb.—but two receivers should be used, because the cooling effect of vaporisation of part of the acid causes the rest of the liquid to freeze. At the Krupp works it has been recently stated, according to the *Times*, liquid carbonic acid is utilised not only in the manufacture of compressed steel, but for production of ice and of seltzer water, also to give the pressure necessary for delivery of beer.

MISCELLANEA.

THE Kimberley, South Africa, Waterworks are reported to be a complete success, and water is now flowing into the town from the Vaal river.

A GOOD engineering paper cannot be obtained for less than a penny; but this is the price of the *Engineering Review*, which is now published at 16, Charing-cross, and contains a collection of information which will interest many.

THE directors of the Metropolitan Brush Electric Light and Power Company, Limited, have appointed Mr. Radcliffe Ward, formerly chief electrical engineer to the British Electric Light Company, the chief electrical engineer to the Metropolitan Company.

THE new ship canal between the Baltic and the North Sea will save nearly 600 miles of the water journey now made around the Danish peninsula. The cut, as proposed, will be from Gluckstadt to Kiel, and the length will be about half that of the Suez Canal, or some fifty miles.

ACCORDING to a telegram from Bombay, January 24th, the steamship Inflexible had sunk after a collision with the Clan Line steamer Clan Ogilvie in the Prince's Dock. The Inflexible had arrived from Liverpool and was fully laden at the time of the collision. The Clan Ogilvie is not much damaged, and was to sail yesterday.

MESSRS. G. BAILEY TOMS AND CO., of 7A, Laurence Pountney-hill, have just published a revised edition of their office sheet of sections of angle, channel, bulb, and Z, T, V, Y, and other sections, many of which are unusual sections, of which Messrs. Toms and Co. make a speciality. They have over 1500 sections, many of which may be rolled in steel.

MESSRS. R. MELHUISH AND SONS, of Fetter-lane, have just published a new edition of their catalogue of tools of all kinds, including American productions of almost innumerable varieties. Tools for amateurs form a well illustrated speciality; but the Sheffield goods and tools used by artisans of all classes receive the most attention. Machine tools, such as small lathes, and their parts, are also illustrated in the catalogue.

THE Corporation of Wolverhampton have long been dissatified with the system of deep drainage as at present existing in the borough, and it would now seem that they are likely before long to enter upon a new scheme. The Sewerage Committee of the Corporation have this week been empowered to engage a competent engineer, to be selected by them, to advise upon the whole question of the disposal of the sewage of the town.

THE Eastern Telegraph Company has just published a new edition of its tariff book, with rules, regulations, and other information relating to sending cable messages by its direct duplicate cable routes to Egypt, Aden, Penang, Singapore, China, Manilla, Japan, Australia, South Africa, Madeira, St. Vincent, and South America. The tariff book is accompanied by a series of very clear and well executed maps showing the cable routes and connections.

ACCORDING to the *Ship Canal Gazette* of the 17th inst., the ward subscriptions towards the Manchester Ship Canal Bill expenses amount to £15,856, and the total subscriptions to £57,000. As the examiners objected to the Bill as not complying with the Standing Orders, the *Gazette* has its pages occupied during the appeal before Standing Orders Committee when Parliament meets, and may possibly represent a project only during the greater part of the next twelve months; but its mission will no doubt find it plenty to say.

ALL the people who drink the Chelsea and the Lambeth Companies water may expect very soon to be ill or dead if they have faith in Dr. Frankland's opinions on the water supply, for he says these companies' waters of last month were imperfectly filtered and contained moving organisms. Fortunately last month is gone, and only a very few thousands of the drinkers of these waters have died, but no one knows how bad Dr. Frankland's report next month may show the water to have been during January, judging from the report of last November.

WE have received from Mr. E. W. Marfleet, of 63, Queen Victoria-street, a copy of the well-executed catalogue of sections of joist, angle, tee, bulb, channel, joist rail, tram, and plate irons made by Messrs. De Leeuw and Phillippsen, of Antwerp, for whom Mr. Marfleet is agent in this country. Every section is accompanied by its weight in French and English measures, the catalogue consisting of 54 lithographic plates, with an average of about fifteen sections on each, or over 800 sections in all. A table accompanies the book, giving the safe distributed loads for the iron joists.

THE Chester correspondent of the *Leeds Mercury* says:—"An important discovery has been made at Elm Colliery, Buckley, Flintshire. As some men were engaged at one of the levels worked by Messrs. Watkinson they struck upon spring mineral oil. They endeavoured to utilise the liquid, and they discovered that it gave a brilliant light, and at the same time produced less smoke than average oils. Another spring was discovered on the same level on a subsequent day. The supply from the wells is not, so far, copious, but it is sufficient to inspire the hope that a new industry will spring up in North Wales."

THE *American Miller* says:—"With some kinds of fuel large doors are needed, and these, when opened, will allow too much cold air to enter above the fire and so cool the bottom of the boiler, creating an unequal expansion; and yet, more than this, it will, when plates are over-heated, create a sudden evaporation of water so as to drive it sometimes from the plates. This fact is easily tested. Take a tea-kettle and place it upon the stove with water in it; bring it to the boiling point, and then take it off and place it upon a piece of ice, or upon a cold piece of iron, and it will at once boil faster than when upon the stove."

MESSRS. TOOPE AND CO. have made a new form of their now well-known compound asbestos and silicate cotton boiler and steam pipe covering materials, the new form being such that an asbestos woven cloth forms the inner and outer skin, and also an intervening supporting membrane by which the whole is formed into a firmly united structure, either in the form of sheets for covering boiler surfaces, or as split tubes for covering steam pipes. The favour in which this material is now held, as a non-conductor for either low or very high temperatures, is shown by its selection for the boilers of H.M.S. Collingwood, for which Messrs. Humphrys, Tennant, and Co. are about to use 900 sheets 2ft. 9in. by 1ft. 8in., and 2in. in thickness.

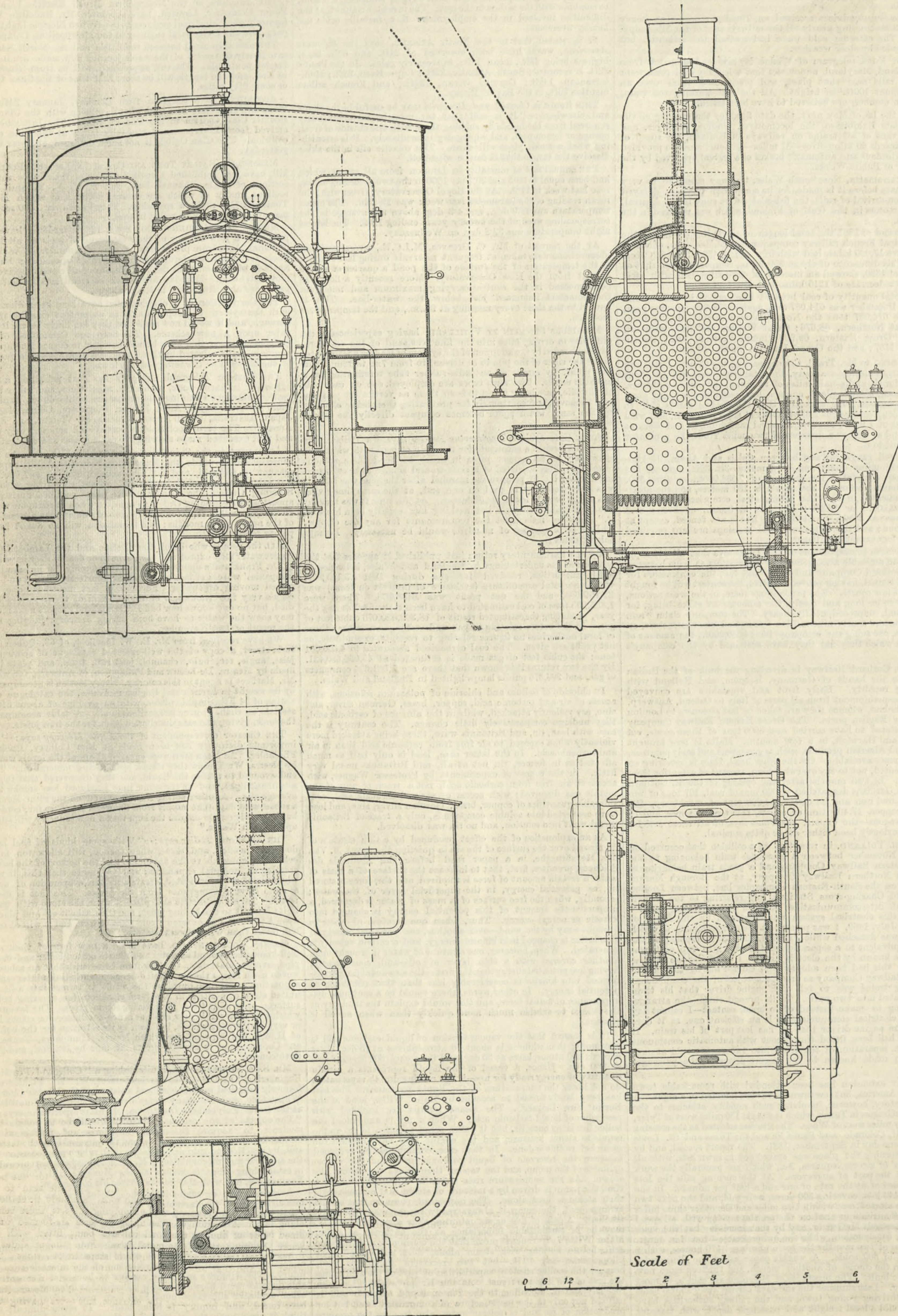
MR. S. F. PICHLER, C.E., is establishing a "College of Practical Engineering" at 162, Great Portland-street, W. Mr. Pichler was formerly practical mechanician and assistant of the late Sir Charles Wheatstone, and for many years deviser of mechanical novelties at the Royal Polytechnic Institution. In his prospectus he says:—"The objects of the course of instruction will be to enable the students to acquire theoretical knowledge of mathematics, mechanics, structure of materials, and the physical laws of matter, and, by practice, to gain manipulative skill, which are necessary to the engineer and mechanician." Mr. Pichler has been instrumental in establishing what is known as the Muswell Hill College of Engineering, but with this he has severed his connection.

A GASOMETER, or some, it is thought, of the gas from one, measuring 160ft. in diameter by 60ft. in depth at the Tradeston Gasworks of the Glasgow Corporation, exploded on Saturday night last. Attention was first attracted by a large volume of flame towering high in the air, which was followed immediately by an explosion, the effects of which were felt for miles round. A number of single story houses which immediately adjoin were almost totally wrecked, and scarcely one of the inmates escaped injury. The windows in a large number of houses at a considerable distance were blown in. It is believed that dynamite or some other explosive substance must have been used, as a fuse has been found, and inquiry is being made. It seems difficult to think it arose with the gasometer, as the gas in the holder was not burnt out until six o'clock on Sunday morning.

PASSENGER LOCOMOTIVE, DANISH STATE RAILWAYS.

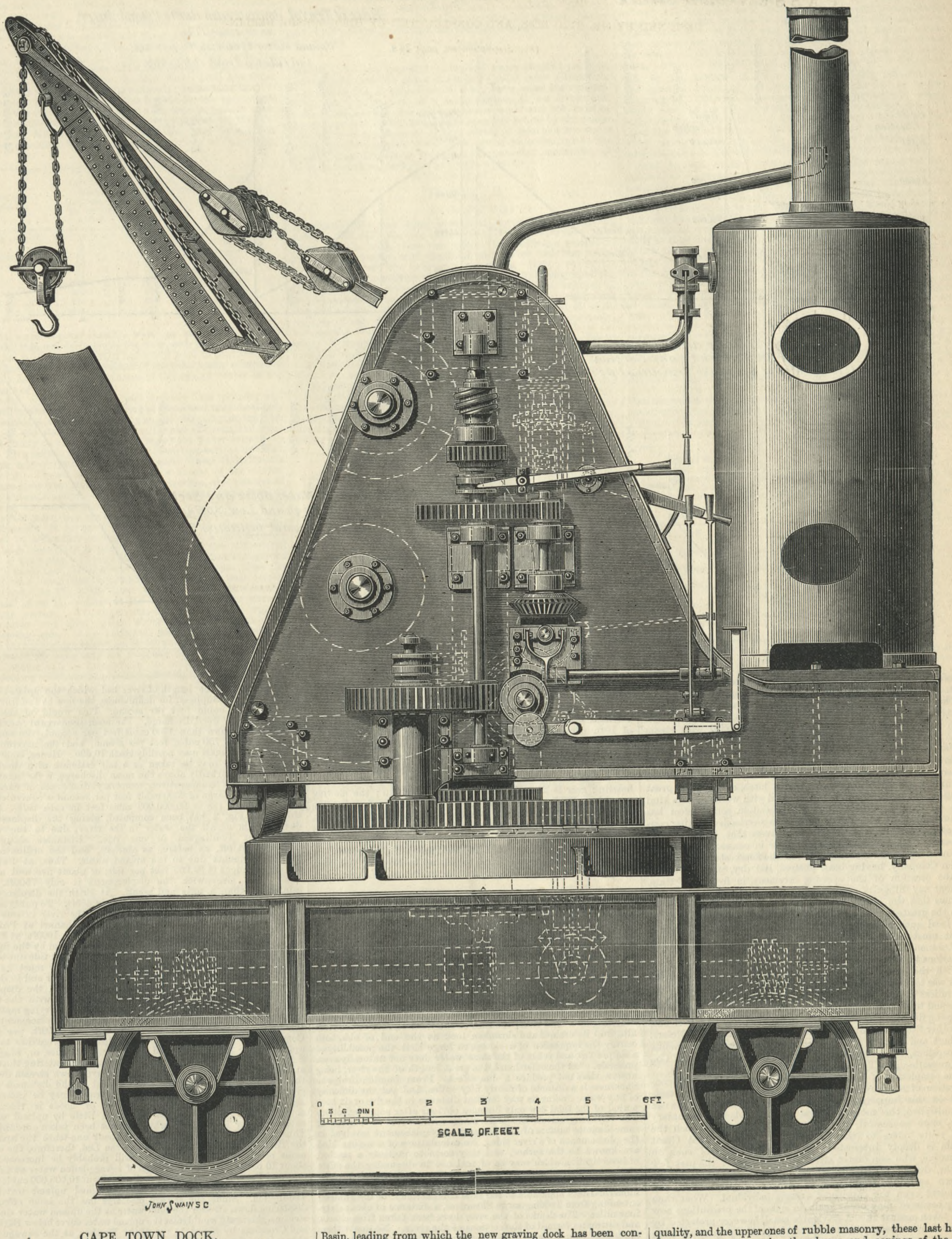
DESIGNED BY MR. OTTO BUSS, AND CONSTRUCTED BY HERR BORSIG, BERLIN.

(*For description see page 74.*)



TEN-TON TRAVELLING CRANE—CAPE TOWN HARBOUR WORKS

MESSRS. ALEX. CHAPLIN, AND CO., GLASGOW AND LONDON, ENGINEERS.



CAPE TOWN DOCK.

A NEW graving dock has just been opened at Cape Town which has received the name of the Robinson Dock, in honour of the Governor of the Colony, Sir Hercules Robinson. Built from the designs of Sir John Coode, this new dock will greatly facilitate the growth of our eastern carrying trade *viâ* the Cape, and anything which lends aid to the successful development of the alternative route to India and China cannot but be welcomed. The increase in the size of the ships employed in this trade of late years—and it is only by such increase that the ventures on the Cape line can be made profitable—has far outgrown the capacity of the patent slip which has in past years sufficed for the repair of vessels calling at the Cape *en route*, and the authorities found it absolutely necessary to supplement the means available for such repairs. The vessels of the Union Line, Castle Company, and other trading corporations and private owners, always proceed direct from sea into the Alfred Basin, leading from which the new graving dock has been constructed, there being ample water for the largest class of ships at all states of the tide. The excavation for this work has been made entirely in the solid rock, prison labour having been largely and profitably made use of. The new dock is 500ft. long on the floor, and 530ft. long over all from the inside of the entrance. The width between the copings in the waist of the dock is 90ft., while at the entrance it is 68ft. An inner or second caisson groove and invert are provided to subdivide the dock, so that its length may be reduced to 290ft. if required for the docking of one small ship. The large amount of rough rock obtained from the excavation will be available for any future breakwater extension, or for other work in connection with the harbour. Its value will therefore constitute a considerable set-off against the first cost of the work just completed. The sides of the excavation have been lined entirely with masonry, the lower altars being of granite from the Paarl, which furnishes stone of excellent quality, and the upper ones of rubble masonry, these last having granite courses to receive the shores and copings of the same material. The outer and inner entrances, with their inverts, caisson grooves, and stops, are entirely of Paarl granite. The dock having been, as we have before stated, excavated entirely in solid rock, no dressed masonry work was required for the bottom, all that was necessary having been a concrete skin to level the irregularities of the rough-cut rock. Similarly, no skilled mason's work was necessary to the emptying culverts, these being simply unlined headings. The filling culverts are formed one on each side of the entrance, all culverts being fitted with penstocks having scraped gun-metal faces. Four timber slides are provided, as also adjacent flights of steps at the sides. There are, in addition, an end flight and double slides, while altar steps lead directly from the inside of the inner and outer entrances. A ship-shaped caisson has been constructed by Messrs. Easton and Anderson for closing the entrance, this work having been most

MOVEMENT OF WATER IN TIDAL RIVERS.—THE THAMES.

Fig. 1.

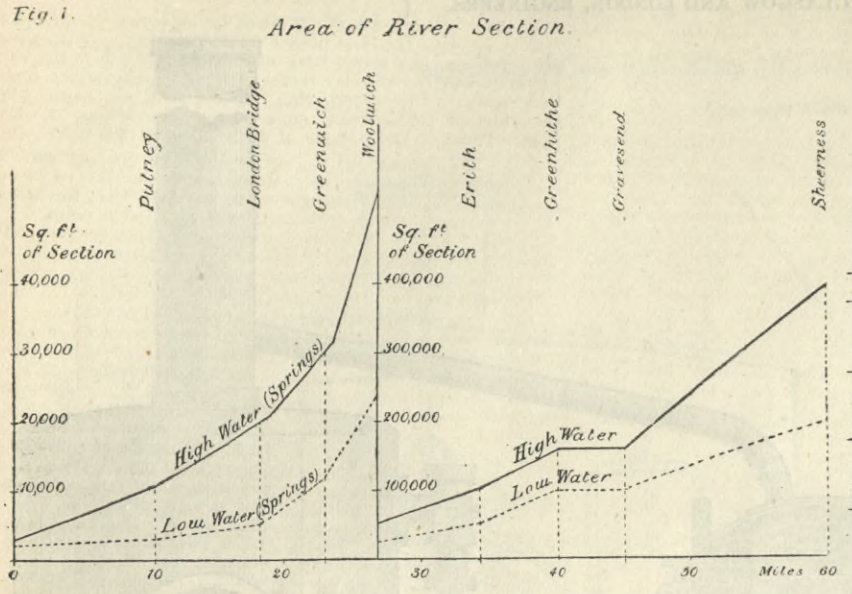


Fig. 2.

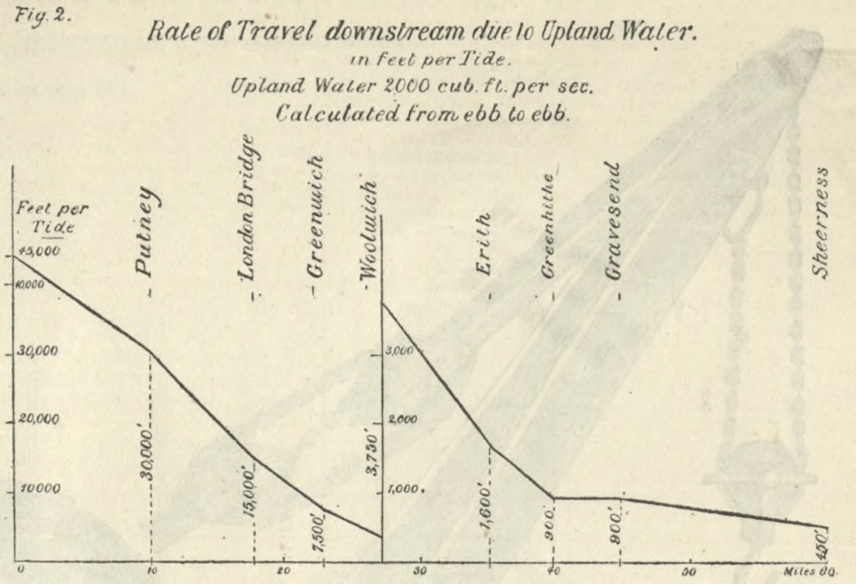


Fig. 3.

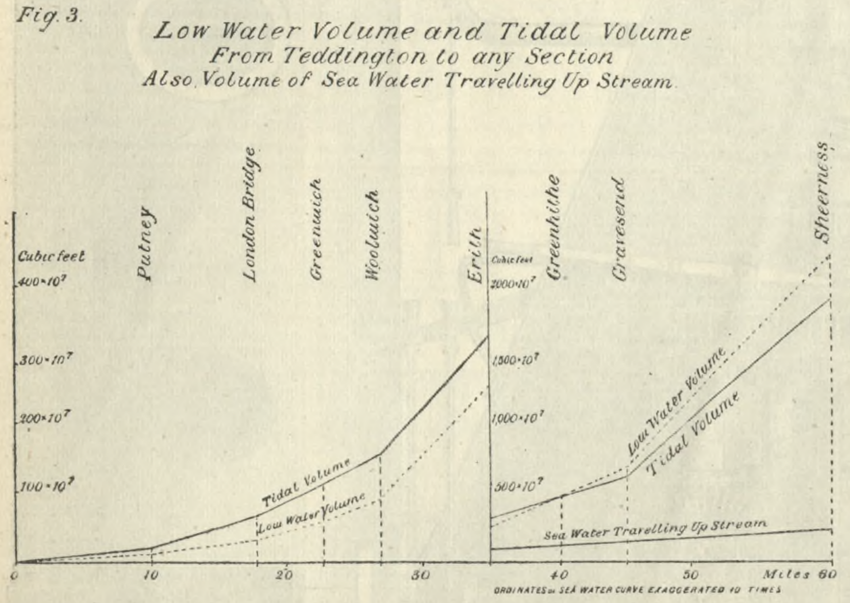
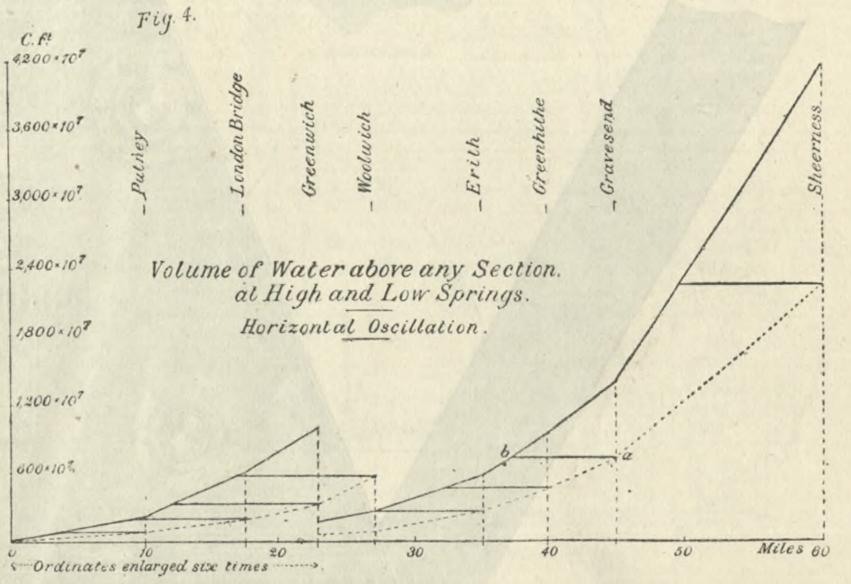


Fig. 4.



satisfactorily carried out. The depth of water over the cill is 26ft. at high water, and 21ft. at low water of spring tides.

The pumping machinery consists of two horizontal disc centrifugal pumps, having 21in. delivery pipes, which are driven by a pair of surface condensing engines, supplied with steam from two Cornish boilers, each 25ft. in length and 5ft. 9in. in diameter, and having a flue of 3ft. 2in. diameter fitted with Galloway tubes. The construction of these was entrusted to Messrs. Hick, Hargreaves, and Co., of Bolton. The whole of the machinery has been worked without a hitch, and reflects great credit on the makers. It is not unusual with works of this kind that on their first being put into operation some defect has become manifest which may have been overlooked during construction; but it is satisfactory to learn that there was no *contretemps* whatever of this character in connection with the Robinson dock, the Athenian, one of the finest steamers of the Union Company, having been entered, laid dry, and shored up on the occasion of the opening ceremony, in five hours' time, without any difficulty occurring. Indeed, our information goes to show that the entire work has throughout been carried on with the greatest care, and it has elicited warm approval both by the local authorities and by the colonists generally. Such a result must be highly satisfactory to the resident engineer, Mr. A. C. Jenour, M. Inst. C.E., under whose superintendence the operations have been from their commencement.

With the exception of machinery items, &c., no part of the work was let out on contract, convict labour being employed to the fullest practicable extent. Local factories were, of course, not equal to the manufacture of the items referred to during the foregoing description, nor to such fittings as penstocks, fairleads, and other fittings around the dock, which were made by Messrs. Stothert and Pitt, of Bath. Those very necessary equipments, the capstans, were supplied by Sir William Armstrong and Co., of Newcastle-upon-Tyne.

The completion of these works necessarily leads to some consideration of similar accommodation to be found further eastward on this important route, for the more such appliances can be multiplied, the more safe and certain, and, in a pecuniary sense, more successful, will become the alternative which the Cape route offers to that *viâ* the Suez Canal. That Great Britain is deeply interested in the maintenance of such an alternative, who can doubt after the experience of the past few months, during which the whole, or nearly the whole, of our Eastern carrying trade was in danger of paralisation, and dependent upon the caprice of a single individual. What then nearly occurred may occur again, in spite of the precautions now to be taken against it. A navigable canal, however protected by international agreement, can never be entirely guarded from malevolent or piratical attack. Hence no effort should be spared for the establishment of facilities along the whole line of the ocean route. From the Cape towards India, it is only at Mauritius that there exist any such facilities, and towards China it is only at the Straits that any docking accommodation is to be found. At both of these places, we believe, but comparatively small vessels can be docked, and it is to be hoped their authorities will soon follow the example of Cape Town.

Our illustration shows a locomotive steam crane for loads of ten tons, just constructed by Messrs. Alex. Chaplin and Co., of Glasgow and London, from the specifications of Sir John Coode, C.E., for these harbour works, which presents several points of general interest, forming a good specimen of a serviceable machine for heavy works of this kind. The crane has a massive wrought iron jib—the top of which is shown to a smaller scale than the rest of the crane—giving a radius in ordinary working of 30ft., at which it was tested with a load of twelve tons; the radius can be reduced to 18ft., when desired, by gearing worked from the engines. The side framing is also built of wrought iron plates and angles, as likewise is the under-carriage, which has steel-tired railway wheels to travel on rails of 10ft. gauge. All the motions of hoisting or lowering loads, turning entirely round in either direction, adjusting radius of jib, and propelling the crane along the rails, are worked by the engines—which have a pair of 7in. cylinders, 14in. stroke—and are arranged so as to be easily controlled by the driver. The hoisting gear is 24 to 1, with two falls of chain; the slewing gear 160; jibbing gear 24 to 1, with seven falls of chain; the travelling wheels being 3ft. 6in. diameter, and traveliing 40ft. per minute. The crane altogether is of ample strength for its work, steel being freely used for the parts most exposed to wear, and the whole carefully fitted and well finished throughout. A similar locomotive steam crane, to lift up to 15 tons, has been since made by Messrs. Chaplin for the Portuguese Government.

ON THE MOVEMENT OF THE WATER IN A TIDAL RIVER.*

By Professor W. C. Unwin.

The following is the paper to which we referred at length in our last impression:—

"It is probably the common opinion that with every flow and ebb of the tide in a tidal stream the river fills from the sea and empties again, at least to so great an extent that there is a real and considerable change of the material water filling the river bed. Standing by a tidal river, the rush of the tidal stream as the river fills, and its drained and shrunken look at the end of ebb, both convey the impression of a change so large that the possibility of a simple flux and reflux of the same water does not naturally seem probable. On the other hand, the great length of the river, being unseen, does not produce a due effect. From London Bridge to Sheerness is a distance of nearly fifty miles, and yet the difficulty of any water finding its way for that distance in the five or six hour period of the tidal flow only becomes obvious after some reflection. The following calculations were made with a view of arriving at some definite notions of the amount of displacement involved in the phenomenon of a river tide. No calculations of a similar kind are known to the author, and they seem to indicate a method of investigation which may be of real use in discussing the effect of the position of a sewer outfall on the condition of a river. To have a definite case for discussion, the author has taken numerical data applicable to the tidal compartment of the Thames, extending from Teddington to Sheerness, a distance of about sixty-four miles. The depths of the river have been taken from charts, and estimates formed of the sections of the river. No doubt these numerical values are only rough approximations. The object of the present paper is rather to indicate a method than to give exact results. Data for a much more accurate calculation no doubt exist, or, at all events, could be obtained at no great cost or trouble. But meanwhile, even an extremely rough but definite calculation seems to the author to be very instructive, and a very considerable error in his numerical assumptions would not greatly affect the general bearing of the results arrived at.

Sections of river.—Fig. 1 gives in the form of a diagram the areas of the sections of the river assumed in the following calculations. The distances along the river from Teddington are laid off as abscissæ, and the sections of the river as ordinates.* The estimates of the sections have been made for high and low water of a spring tide. The rapid growth of the river section in proceeding down stream is very striking.

Action of the upland water.—The direct effect of the upland water pouring into the river at Teddington must be to displace down stream all the water below it, by a distance which at each point is equal to the length of river bed which the upland water would occupy. Suppose, for definiteness, the flow at Teddington is taken at 2000 cubic feet per second. This would be about an ordinary winter flood discharge. The mean discharge of the river is probably not more than 1500 cubic feet per second, the summer discharge about 750 cubic feet per second, and the maximum in extraordinary floods may possibly reach 16,000. Hence, 2000 cubic feet per second may be taken as a fair estimate of a discharge which, while markedly above the mean discharge, is far below the exceptional and comparatively temporary discharges of excessive floods. A discharge of 2000 cubic feet per second is equivalent to $2000 \times 3600 \times 12\frac{1}{2} = 90,000,000$ cubic feet in each tide. From this value Fig. 2 has been computed, giving the displacement down stream of all the water in the river, due to the water entering at Teddington in one tide. Distances along the river are set off, as before, as abscissæ, and the ordinates are the displacements due to the upland water. Thus, at Putney, the displacement is 30,000 feet per tide, or about five and a-half miles. At Greenwich the displacement is only 7500ft. per tide, or less than a mile and a-half. At Erith the displacement is about 1600ft., and at Sheerness it is only 450ft. To put it otherwise, the volume of upland water entering the river in one tide would occupy 30,000ft. of the low water river channel at Putney, 15,000ft. at London Bridge, 7500ft. at Greenwich, 1600ft. at Erith, and 450ft. at Sheerness. The broad result indicated by the figures is this:—Above London Bridge the displacement per tide due to the upland water is considerable, and the upland water must have a large influence in maintaining the *régime* of the river and in determining the quality of the water. Below Woolwich the displacement due to the upland water is small compared with the tidal oscillation, and the effect of the upland water in carrying material seawards must be extremely slow. The mean displacement per tide between Woolwich and Sheerness is about 1200ft. per tide. Consequently if the travel from Woolwich to sea were due to the upland water alone, it would take about 130 tides, or, roughly, sixty-five days, to discharge at Sheerness material entering the river at Woolwich. In summer, the rate of travel down stream due to the upland water, may fall to one-third of the distances just given; and, during excessive floods, the travel may be increased eight times. The important influence of floods is therefore obvious. The results will be modified a little by upland water entering below Teddington, which has not been taken account of. Thus the Lea has a drainage area of about one-tenth the area of the Thames. Below the junction of the Lea, therefore, the ordinates of the upland water curve will probably be increased by about 10 per cent. The discharge of sewage-laden water at Crossness and Barking is, the author believes, about 10,000,000 cubic feet per tide, or about one-ninth of the assumed upland water at Teddington. Since the sewage discharge has the same effect in displacing down stream the tidal water as the upland water due to streams, this again would raise the upland water curve below Barking and Crossness by about 11 per cent. Further, as the sewage discharge is nearly constant while the upland water is variable, the proportionate effect of the sewage will be three times as great in dry summer weather.

Volume of water in the river at low water, and of tidal water above any section.—By multiplying the mean of the two sections at the ends of any compartment by the distance between them, the volume of water in that compartment is obtained. Proceeding thus for a series of consecutive compartments, and adding the results from Teddington downwards, the volume of water in the river above any section at high or low water is obtained.

The results of the calculation are given in the following table, (see Table A on next page) volumes corresponding to a spring tide. The numbers given above are plotted in the two curves shown in Fig. 3. The first portions of the curves are to a scale five times as great as the subsequent portions, for the sake of clearness. The ordinates of the dotted curve are the volumes in the river above any section, at low water, spring tide. The ordinates of the full curve are the volumes of tidal water above any section at high water spring tide. To obtain these volumes quite accurately the tidal lines of the river for each half-hour of the tide should be

* Below Woolwich the scale of the ordinates is diminished ten times.

ascertained. So far as the author knows such lines have not yet been observed for the Thames. Failing these, the assumption has been made that high water extends over the length of the river simultaneously. The error thus introduced makes the volumes and lengths of tidal oscillation somewhat too great. The volumes of water shown in the diagram are striking from their magnitude. Thus the whole volume of water above Sheerness at low-water is 22,380,000,000 cubic feet, and the volume of tidal water entering at each tide, at Sheerness, is 19,370,000,000 cubic feet. The curves have been plotted to the same axis of abscissæ to bring out one fact. At a point, which according to these calculations is at Greenhithe, the curves cross. Below that point the tidal volume is less than the low-water volume. Above that point the tidal volume is greater than the low-water volume. The importance of this is, that for the upper parts of the river the volume in the river at high tide is greater than, and for a considerable distance three times as great as, the low-water volume. Hence the water driven up the river by the tide must have a considerable influence on the condition of the water.

TABLE A.

Section considered.	Low water volume upstream of the section. c. feet.	Tidal volume which flows past the section. c. feet.	Total volume in river at high water. c. feet.
Teddington..	0	0	0
Putney..	13×10^7	22×10^7	35×10^7
London Bridge	32 ,,	69 ,,	101 ,,
Greenwich	56 ,,	115 ,,	171 ,,
Woolwich	94 ,,	168 ,,	262 ,,
Erith	263 ,,	332 ,,	595 ,,
Greenhithe	469 ,,	475 ,,	944 ,,
Gravesend	733 ,,	633 ,,	1366 ,,
Sheerness	2238 ,,	1937 ,,	4175 ,,

If the tidal water is purer than the water up stream, the general effect of the tide will be to purify the river, but if, as is probable, the converse is the case, the tidal water will tend to foul the river. Thus the large proportionate volume of the tidal water neutralises to a certain extent the large influence of the upland water in the higher parts of the river.

Horizontal oscillation due to tidal action.—The primary and main effect of the tidal water entering at Sheerness must be simply to drive back the water, which at the end of ebb occupies the river channel. At any station in the river, as the ebb slackens, the water comes gradually to rest. As the flow begins the water returns up stream. To a certain extent there may be mixing actions by which water from a lower point gains on and passes water initially at a higher point. The set of the currents, the excess of the central and surface over the lateral and bottom velocities, the rotation of the river at bends, and the eddying motions which are superposed on the general stream-line motion, cause such a mixing. But the general effect must be simply a driving back of the water already in the channel. It is quite in accordance with the ordinary procedure in hydraulics to neglect, at least for a first approximation, such secondary actions as those due to the differential motions of the water. If the tidal action taken alone is regarded as such a back flow, then a very simple construction gives the range of the oscillation produced by the tide at each section of the river. In Fig. 4 the lower dotted curve is the same in Fig. 3, and gives the volume at low-water in the river channel above any section. The upper curve gives the total volume of low-water and tidal water above any section, at high-water, spring tide. Any horizontal line, such as *a b*, is the distance through which the water, which at the end of ebb is at *a*, will be driven up stream by the incoming tide. Thus at Sheerness the water will be driven back 10½ miles, and, apart from mixing actions which are at present neglected, no water from below Sheerness will reach a higher point of the river. The water, which at the end of ebb is at Erith, will be driven back eight miles to Woolwich, and no water from below Erith will reach higher. The range of oscillation given by the diagram, due to the tidal action of a spring tide taken alone, has the following values:—At Sheerness, 10½ miles; at Gravesend, 8 miles; at Greenhithe, 8 miles; at Erith, 8 miles; at Woolwich, 10 miles; at Greenwich, 10½ miles; at London Bridge, 8½ miles; at Putney, 5 miles. The general conclusion is that the tidal action alone effects directly no change in the material water in the river, but merely a reciprocating oscillation over a distance of about eight to ten miles, or in a neap tide very much less.

Total action of upland water and tide.—Take Woolwich for example. The tidal oscillation is ten miles. Hence water at the end of one ebb at Woolwich is driven back about ten miles, less a small amount due to the displacement caused during tidal flow by the upland water. At the end of the next ebb it will have travelled back ten miles, plus the displacement due to the upland water. It will, therefore, be found 2400ft. down stream of its position at the previous ebb. These calculations are entirely independent of float observations, but they ought in a general way to agree with them. In one respect they are more satisfactory than float observations—namely, that they are free from errors due to accidental causes acting on floats in a crowded river, and they mark the mean action of the water as distinguished from the action of its central and surface portions.* Perhaps it may be necessary to point out that these results apply only to the water and suspended matter in the river. There is probably a travel of solid matter along the bed, which follows a different law of progress from that of the water and the matter in suspension in it.

Mixing action which produces the actual condition of the river.—If there were absolutely no mixing action between the water driven up by the tide and that initially in each compartment, the river down to Sheerness would come ultimately to be entirely fresh water, because fresh upland water is continually supplied at Teddington. But obviously, for reasons given above, a partial mixing takes place between the water driven above any section by the tide and the low-water volume previously above the section. If the supply of upland water were stopped, the whole of the water in the river would gradually become of the density of sea water. For however small the mixing action might be, the low-water volume in each compartment would be mixed with denser water from below each tide, and gradually the whole of the water would become of the density of sea water. Hence, the actual condition of the river is due to the balance between the supply of upland water tending to make the whole river fresh and the amount of denser water from below left behind in each compartment, after each tide, in consequence of the mixing action which has gone on during the flow of the tide. Hence the actual saltness of the river gives a measure of the amount of water which is virtually transferred up stream, to replace fresher water transferred down stream. In other words, we can get from the actual saltness in the water a measure of the amount of exchange which goes on between the sea and the river, and which causes a down-stream displacement, additional to the gradual pushing down of the whole water in the river by the upland water entering at Teddington. With a uniform flow of upland water and a uniform height of tide, there would be a fixed point in the river to which sea salt would be carried, and which may be termed the limit of saltness. It is clear, however, that as the upland water increases, the limit of saltness will be driven further down stream, and *vice versâ*, and variation of height of tide will also, probably, affect its position. No extreme accuracy is necessary in fixing the limit of saltness; what is more important is some knowledge of the law of variation of saltness at low-water, and from the limit of saltness towards the sea. The author has no data of the saltness of the river, although he believes such data

* Floats will in general have a greater range than the distances given above, partly because they will be in the fairway of the channel, where the velocities are greater than at the sides; partly because they cannot be made as deep as the river, and therefore have a greater velocity than the true mean velocity of the vertical section in which they float.

exist. A simple assumption will, however, suffice to show how the problem can be dealt with, and will serve to prove that, in any case, the exchange of river and sea water, due to mixing actions neglected in the preceding calculations, is, in volume, not a very large factor in tidal action. Suppose that at the end of each ebb the river is fresh down to Greenwich, and that from Greenwich to Sheerness the water increases uniformly in saltness. Let the saltness at Sheerness be x_s lb. of salt per cubic foot of water. At any point l miles below Greenwich the saltness will be:—

$$x = \frac{l}{41} x_s = 0{\cdot}0244 l x_s$$

Now let Q be the quantity of upland water supplied per tide. Let this come into the space extending l miles below Greenwich. Then in each tide, Q cubic feet of fresh water enter the compartment, and Q cubic feet of a mean saltness $\frac{1}{2}x$ are driven out. Since, on the average, the saltness at the end of each ebb must be the same, $\frac{1}{2}x$ Q lb. of salt must have been left behind by the denser tidal water—in consequence of the mixing of tidal and low water during the flow of the tide. The action is equivalent to the transfer, from Sheerness into the compartment considered, of Q_s cubic feet of sea water given by the equation,

$$x_s \, Q_s = \tfrac{1}{2} x \, Q$$
$$Q_s = \frac{x}{2x_s} Q$$
$$= 0{\cdot}0122 \, Q \, l$$

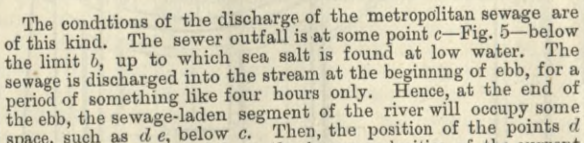
The table below has been calculated by taking the upland water at 2000 cubic feet per second, or $Q = 9 \times 10^7$ per tide. The volumes are in cubic feet per tide. The results are plotted in Fig. 3, for comparison with the tidal volume, but it has been necessary to exaggerate the ordinates ten times. Hence, the whole effect of the mixing action which occurs from the driving up of the salter down-stream water to mingle with the low-water volume, is, on the assumptions made as to the saltness of the water, equivalent to transferring up stream a volume of sea water equal to $\frac{1}{220}$th to $\frac{1}{430}$th of the tidal column passing each section. Conversely, the quantity of river water carried seawards in each tide is the same. Hence, the total replacement of water above any section in each tide by pure water is the sum of the upland water and the tidal water left behind, estimated as sea water. Thus, from above Sheerness, there pass out to sea in each tide $(4{\cdot}5 + 9)\ 10^7$ or 135,000,000 cubic feet previously forming part of the low-water volume, or about one and a-half times the volume of upland water. But this is only $\frac{1}{161}$th part of the whole low-water volume between Sheerness and Greenwich. The total replacement above each section and its ratio to the low-water volume are given in the following table:—

Distance from Greenwich. Miles.	Section considered.	Q_s Quantity of water estimated as sea-water left above section after each tide.	Total volume above section in cubic feet. Low water.	Total volume above section in cubic feet. Tidal.	Ratio of water from down stream estimated as sea-water left after each tide to total tidal volume.	Total low-water volume between Greenwich and section considered.	Total replacement each tide by upland and sea-water in cubic feet.	Ratio of total replacement in low-water volume below Greenwich.
0	Greenwich	0	56×10^7	115×10^7	0	0	9×10^7	∞
4	Woolwich	$0{\cdot}5 \times 10^7$	94 ,,	168 ,,	1-336th	38×10^7	9·5 ,,	1-4th
12	Erith	1·5 ,,	263 ,,	332 ,,	1-221st	207 ,,	10·5 ,,	1-20th
17	Greenhithe	2·1 ,,	469 ,,	475 ,,	1-226th	413 ,,	11·1 ,,	1-37th
22	Gravesend	2·7 ,,	733 ,,	633 ,,	1-223rd	677 ,,	11·7 ,,	1-58th
41	Sheerness	4·5 ,,	2238 ,,	1937 ,,	1-430th	2182 ,,	13·5 ,,	1-161st

The exchange of river water and sea water, therefore, when the mixing action is taken into account, is not very considerably greater than that due to the upland water alone. And no probable assumption as to the saltness of the river would, the author thinks, very much alter this conclusion. The general effect of these calculations is to show that the exchange of river water and sea water takes place much more slowly than is commonly supposed.

Transfer of material up stream.—The saltness of the water has been used to prove an exchange of river water with the sea. But the saltness of the river water proves also a transfer of material up stream. If, at low water, saltness extends to Greenwich, then at high water it will extend about ten miles higher up, that is, a distance equal to the tidal range. Whatever cause carries salt up stream will also carry sewage.

FIG. 5.



The conditions of the discharge of the metropolitan sewage are of this kind. The sewer outfall is at some point *c*—Fig. 5—below the limit *b*, up to which sea salt is found at low water. The sewage is discharged into the stream at the beginning of ebb, for a period of something like four hours only. Hence, at the end of the ebb, the sewage-laden segment of the river will occupy some space, such as *d e*, below *c*. Then, the position of the points *d* and *e* can be ascertained from the known velocities of the current or from float experiments. Now let Q be the volume of upland water per tide, Q_2 the volume of sewage per tide, σ the sewage density of the water in the segment *d e*, or the number of cubic feet of sewage per cubic foot of river water. Each tide the segment *d e* will receive Q cubic feet of river water from up-stream, and Q_2 cubic feet of sewage, and will lose Q cubic feet of sewage-laden water. Consequently, the sewage density will be—

$$\sigma = \frac{Q_2}{Q}$$

Thus, if $Q = 9 \times 10^7$ and $Q_2 = 1 \times 10^7$, the sewage density will be one-ninth, or the sewage segment *d e* will contain one part of sewage to eight parts of river water.*

Volume of sewage carried up stream.—During the tidal oscillation in each tide, part of the water from below *d* is left behind, mixed with the low water volume above *d*—Fig. 5. The water of replacement, from below, which at the next succeeding low water is left behind above the point *d*, must come directly and chiefly from the segment *d e*. Let s_d be the saltness at *d*; Q, as before, the volume of upland water per tide at the date considered. Then $\frac{1}{2} s_d$ will be the mean saltness of the river between *b* and *d*; also, $\frac{1}{2} s_d$ Q will be the quantity of salt in the water of replacement above *d*. Let Q be the volume of water from the segment *d e* which passes up stream to replace part of the low-water volume. Then $\frac{1}{2} s_d \, Q = s_d \, Q_d$; $Q_d = \frac{1}{2} Q$;
that is, the volume of replacement water left above *d* in each tide is half the volume of the upland water. It should be pointed out, that the simplicity of the result arrived at as to the amount of replacement water, is due to the simplicity of the law assumed for the variation of saltness. But since the replacement water left behind above *d* comes from the segment *d e*, in which the sewage density is σ,† the quantity of sewage carried up-stream in each tide will be— $\sigma \, Q_d = \frac{1}{2} \sigma \, Q$.
Merely to have some idea of the importance of this transfer, let

* Probably variation of height of tide diminishes this ratio by virtually lengthening the segment *d e*, which receives the sewage. But the effect of variation of tidal height is not here considered.

† Or at all events from down-stream, where the sewage density is not less.

the following values—not very improbable for the Thames—be assumed:—

$$Q = 9 \times 10^7 ; \; Q_2 = 1 \times 10^7 ; \; \sigma = \tfrac{1}{9}$$

Then the quantity of sewage transferred up-stream in each tide is—

$$\tfrac{1}{2} \times \tfrac{1}{9} \times 9 \times 10^7 = 0{\cdot}5 \times 10^7,$$

or a quantity of sewage equivalent to half the whole sewage volume entering the river in each tide. This seems a surprisingly large volume, but it must be remembered, first, that the water which exchanges with the water of replacement carries sewage back again; and, second, that the segment *d e*, from which the water of replacement comes contains the sewage of many tides. Thus, if the volume of *d e* is taken at 400×10^7, there will be the sewage of $\frac{400}{9} = 44$ tides in the segment *d e*. The general effect of the mixing action, so far as sewage is concerned, is this: If there were no mixing action, the sewage would never at low tide exist in the water above the point *d*. At high tide it could only be taken above *d*, a distance somewhat less than the tidal oscillation. The mixing action carries the low-water sewage limit up to the point *b*, and at high water it ranges above *b* to a distance nearly equal to the tidal oscillation.

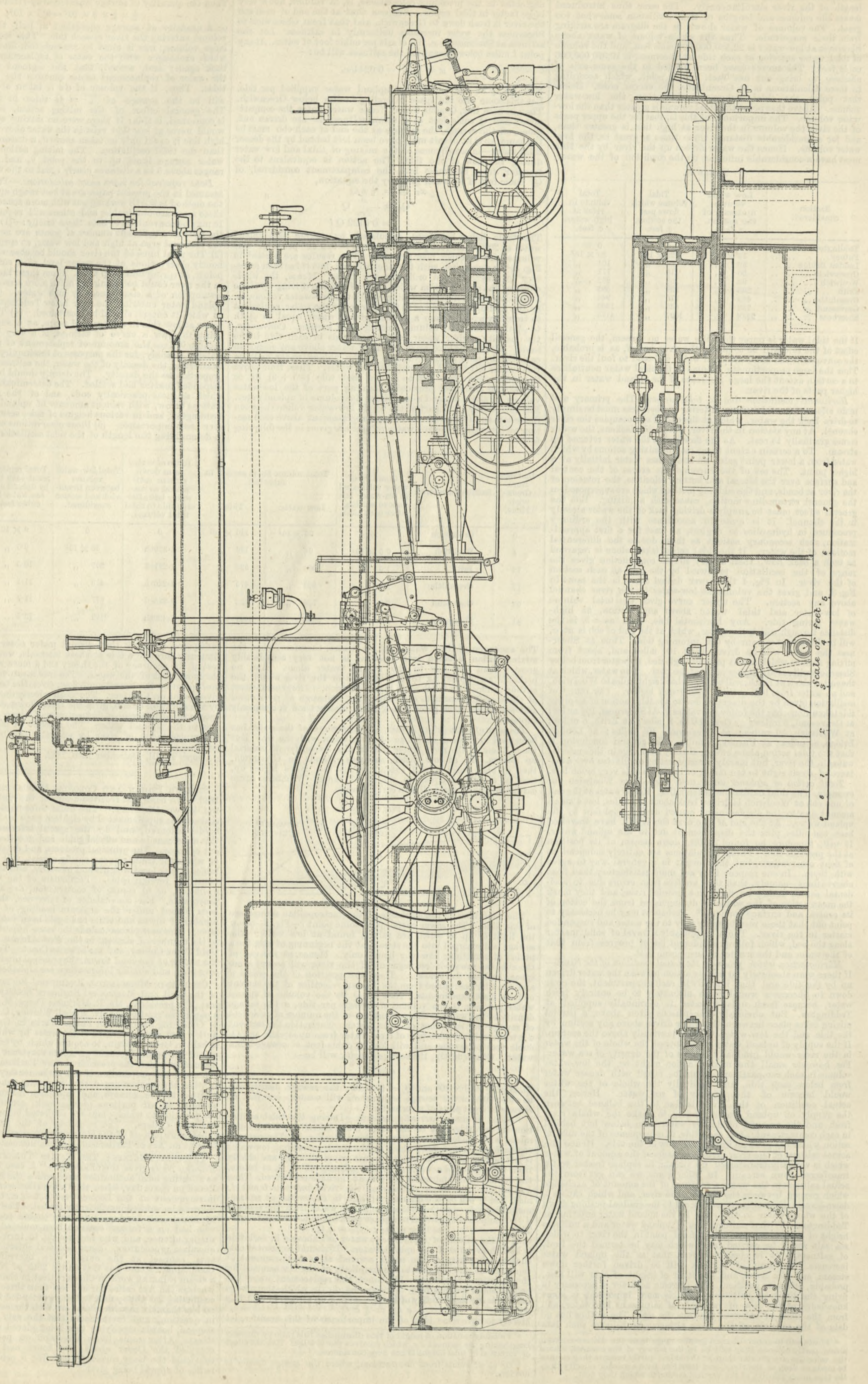
Data required for more exact calculations.—The numerical data assumed in the present paper are at best rough approximations, but the method is worth working out with more accurate materials. Of these some are obtainable, and others will require to be observed. It may be convenient to note these briefly:—(1) Cross sections of the river at a sufficient number of points are necessary for finding the sectional area at high and low water, at spring and neap tides. (2) The tidal lines of the river should be observed by taking half-hourly observations of the water level at a sufficient number of points, at spring and neap tides. From these the volumes of water in the river could be calculated much more accurately than on the assumption of a simultaneously high water. (3) The volume of upland water entering the river below Teddington, and the points at which it enters, should be ascertained. (4) The saltness of the water at low tide in springs and neaps, at a sufficient number of points to draw a curve of saltness, is a very important datum, because it fixes the amount of replacement of river water by sea water. Possibly, for the purposes of this inquiry, it might be easier to ascertain the density of the water, the saltness being assumed in proportion to the density. The density should be ascertained after suspended matter had settled. The determination of the limit at which saltness practically ends, and of the saltness at a few stations below, with various amounts of upland water entering at Teddington, and in various heights of tide, seems to the author of very great importance. (5) Float observations would be very useful in determining the length of the tidal oscillation. But the author is disposed to think that current meter observations, taken continuously through a tide at short intervals, would afford a better test of the accuracy of the theory and a more reliable measure of the movement of the water. The true mean velocity during flow, multiplied by the duration of flow, gives the travel up-stream at a given point on the river. The mean velocity during ebb, multiplied by the duration of ebb, gives the travel down-stream. The difference is the displacement down-stream of the contents of the river due to the upland water. The amount of displacement due to the replacement of river by sea-water can be ascertained independently.

Cooper's Hill, December 12th, 1882.

STREET'S INDIAN AND COLONIAL MERCANTILE DIRECTORY FOR 1883.—We have just received a copy of the ninth issue of this now well-known Directory. The usual information of the directory character is supplemented by eighteen page and double page maps, border coloured, and by the special information which makes this a mercantile and official guide and gazetteer to India and all our colonies. The principal products, and details as to the articles of which the trade returns chiefly consist, will also be found; also tables of the local weights and measures, and the value in English money of foreign coins. Particulars of the various railways in operation, or in course of construction, are also supplied where practicable. For convenience of reference, this information has been placed under the separate heading of "Railways." The number of towns and cities has again been increased since the last issue. The new places include the more important trading towns, to the number of sixteen, in the West African settlements, on the Gold Coast Colony, and the Liberian Coast. To facilitate reference the names of the chief towns, the principal products of the different countries, and similar information, are alphabetically arranged.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—At a meeting of the Civil and Mechanical Engineers' Society, held on the 18th inst., the president, Mr. R. Harkness Twigg, M.I.C.E., in the chair, a paper was read by Mr. H. Michell Whitley, C.E., on the "Process of Obtaining Sanction for Public Works in Great Britain." The author first drew attention to the terms by which landed property is held in Great Britain, to acquire which by compulsory powers is one of the main objects of an Act to construct public works, after discussing which the procedure before Parliament was described, especially the preparation of the parliamentary plans and sections; in this the author urged that more time should if possible be allotted to the surveys, and especially insisted on the need of accuracy in all portions of the work, considering the vigorous examination to which plans are subjected before the Examiners of Standing Orders. The remainder of the paper dealt with the subsequent process of the bill until it received the Royal Assent and became an Act of Parliament. A long discussion ensued.

TRACTION ENGINES: THE TABLES TURNED.—The *Shropshire Evening News* gives the following:—"A case of some importance as affecting local authorities came before the Shrewsbury Borough Bench on Saturday, when the Corporation were summoned for an infringement of the Locomotives Act—*i.e.*, by allowing a steam roller to be worked insufficiently tended. The information was laid by Mr. Isaiah Lindop, a traction engine proprietor, of Shifnal, who had on a former occasion been mulcted in a penalty for a similar offence, and who now sought to turn the tables upon his quondam prosecutors. Some technical objections raised by defendants' counsel at the outset were overruled by the Bench. Complainant's case was that on the 28th of November last he saw a steam roller at work in Chester-street in charge of two men only, whereas the Act called for not less than three. The evidence was conflicting on this point, it being contended for the defence that no less than six men were sent out with the engine on the morning in question, and furthermore that the said road was virtually stopped, boards signifying this being placed at either end of the street. After some lively discussion on points of law, which occupied the Court about two hours and a-half, the Bench convicted the body corporate, inflicting a penalty of £5 and costs, notice of appeal being given."



PASSENGER LOCOMOTIVE, DANISH STATE RAILWAYS.

DESIGNED BY MR. OTTO BUSS, AND CONSTRUCTED BY HERR BORSIG, BERLIN.

(For description see page 74.)

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*** *This week we publish a Double Number of* THE ENGINEER *containing the Index to the Fifty-fourth Volume. The Index includes a Complete Classified List of Applications for Letters Patent during the past six months, together with a list of Abstracts of Specifications published during the same period. Price of the Double Number*, 1s.

TO CORRESPONDENTS.

*** *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.*

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D. R., SUBSCRIBER.—*The address is* 32, *Queen Victoria-street, E.C.*

ENGINEER.—*If you consult our advertising columns you can have no difficulty in obtaining what you want.*

A. B —*Water supply to small towns. See* THE ENGINEER, 10*th March*, 1882, 24*th March*, 1882, 2*nd June*, 1882, 30*th June*, 1882, 5*th January*, 1883.

M. H. T. P.—(1) *Steam is invisible.* (2) *We are kept on the earth by the force of gravitation.* (3) *The air has weight; about* 13 *cubic feet of it weigh* 1 *lb.*

BOILER FUEL ECONOMISER.—*A letter addressed to "Economiser," the writer of a letter on the above subject in a recent impression, awaits his application for it in our publisher's office.*

J. P. B (Manchester).—*Many thanks for your suggestion. We had already thought of it, but there are at present difficulties, practical and otherwise, in the way of its adoption, which possibly may be overcome before long.*

J. B.—*As little or no evaporation takes place in the use of hot water heating apparatus, little trouble from incrustation need be anticipated. Ordinary spring water will answer perfectly to fill up the pipes with, to begin, and the supply may be subsequently kept up with rain water if it is available.*

J. R.—*Concerning the deep sea sounding machine, we can only refer you to Dr. Siemens, Queen Anne's-gate, Westminster. If you like to send a sketch of your railway brake we will give you our opinion concerning it, but we may say at once that the invention of brakes is a waste of time, because the railway companies will not have anything to do with them.*

EXCENTRIC.—*Goodeve "On the Steam Engine," Rigg "On the Steam Engine." For examples of modern locomotives and marine engines we can only refer you to* THE ENGINEER. *There is no special recent work on such subjects. You may consult Shock's "Treatise on Boilers," treating almost entirely of marine work, and Sennett "On the Marine Engine." All these books have been reviewed in* THE ENGINEER.

GEORGE JUNIOR.—(1) *You may get the small centrifugal pump for supplying soap-water to dies from almost any of the makers of centrifugal pumps, for whose address you may consult our advertising columns.* (2) *Even though you put your name on the shares, you are not at liberty to use the letters R N F or the combinations of these adopted by the original manufacturers.* (3) *Corrugated iron is corrugated between dies; generally three corrugations are effected at a time. For an account of the galvanising process see* THE ENGINEER, *Oct.* 26*th*, 1866.

CREOSOTING PLANT.

(*To the Editor of The Engineer.*)

SIR,—I shall be glad to receive from your readers the names and addresses of makers of creosoting plant, with particulars and price.

Lincoln, January 23rd. CREOSOTE.

BRISBANE AND PORT DARWIN RAILWAY.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers inform me to whom the contract of the railway from Brisbane to Port Darwin, Queensland, is let, as notified in the pages of THE ENGINEER? A. S. E.

Pall-mall, S.W., January 18th.

THE STRENGTH OF VOLUTE SPRINGS.

(*To the Editor of The Engineer.*)

SIR,—Will any reader have the goodness to tell me what pressure will be required to compress a volute spring made out of ⅜in. plate, say 9in. diameter at base, and 13in. long? Please give the rule for any size.

Sunderland, January 22nd. J. A.

FINISHING BRASS CASTINGS.

(*To the Editor of The Engineer.*)

SIR,—Referring to the letter of your correspondent "Brass" in your late issue, the best machinery for producing brass cocks, valves, &c., has been designed and used by the Americans. They have not only aimed at finishing brass work with the greatest possible despatch, but have endeavoured at the same time to produce the highest class of workmanship, and are producing all the different parts, such as nuts, bushes, spindles, valves, &c., of such accuracy that each piece is interchangeable, or, in other words, any nut, bush, &c., will fit any cock or valve. At the Centennial Exhibition in Philadelphia, seven types of these machines were exhibited, and the lathe which took the prize was that constructed and exhibited by Mr. Cooper, of the celebrated firm of Cooper, Jones, and Cadbury, of Philadelphia. The sole makers of this lathe in this country are Messrs. Smith and Coventry, of Manchester, who have within the last few years considerably improved the Cooper lathe, and secured it by letters patent. Many of them have been introduced, and are producing from 200 to 300 per cent. more work than is done by the old system of hand-turning and chasing, and the work is correct in pitch, parallel and accurate to a degree unattainable before the introduction of this tool. H. HUNT.

21, Trafford-road, Salford, Manchester, January 24th.

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Advertisements cannot be Inserted unless Delivered before Six o'clock on Thursday Evening in each Week.

Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. George Leopold Riche; all other letters to be addressed to the Editor of THE ENGINEER, 163, *Strand.*

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Jan. 30th, at 8 p.m.: Paper to be read, with a view to discussion, "Mild Steel for the Fireboxes of Locomotives in the United States," by Mr. John Fernie, M. Inst C.E.

CHEMICAL SOCIETY.—Thursday, Feb. 1st, at 8 p.m.: Ballot for the election of Fellows. Paper to be read, "On Some Derivatives of Fluorene," by Mr. W. R. E. Hodgkinson, Ph.D., and Mr. F. E. Matthews, Ph.D.

SOCIETY OF ARTS.—Monday, Jan. 29th, at 8 p.m.: Cantor Lectures, "Solid and Liquid Illuminating Agents," by Mr. Leopold Field, F.C.S., A.S.T.E. Lecture I.—Introduction. Classification of fatty Bodies. History of Lighting. Ancient Appliances. Tuesday, Jan. 30th, at 8 p.m.: Foreign and Colonial Section, "Life Among the Turcoman Nomads," by Mr. Edmond O'Donovan. Lieut.-Colonel J. U. Bateman-Champain, R.E., will preside. Wednesday, Jan. 31st, at 8 p.m.: Ninth ordinary meeting, "Ensilage in the United States," by Prof. J. E. Thorold Rogers. Sir B. T. Brandreth Gibbs will preside.

THE ENGINEER.

JANUARY 26, 1883.

BRIGHTON BEACH.

FROM our contemporary, the *Brighton Herald*, we have learned something of the latest phase of the circumstances attending the prosecution of the works at Hove, to which we have, as they progressed, drawn the attention of our readers. We were not unprepared to learn, as we do from that journal, that the action of the Hove Commissioners had called forth a threat of legal proceedings against them by the authorities at the Admiralty. Indeed the matter appears to have gone beyond a mere threat; for we read that a "long-pending action, which was to have been brought" by these authorities, "has been allowed to drop through, each party paying its own costs." We regret that we have no information respecting the nature of the alleged illegal proceedings which were to form the basis of the threatened action. We presume, however, that they were connected with the foreshore rights of which the Government is so strictly tenacious. But if this be so, the proceedings of its representatives at the Admiralty remind us forcibly of the old saying as to shutting the stable door after the steed is stolen. They showed no anxiety to interfere with protective measures when the foreshore was threatened; and only when the local Commissioners had done their best to meet their difficulties did the Admiralty step in to increase them. They are, therefore, well advised, we should say, to have carried matters no further; though, on a complaint made by one of the Hove Commissioners as to that body having to pay its own costs, its chairman expressed the hope that the complainant "might always get out of litigation on such easy terms." In these threatened proceedings we have furnished to us a text upon which we might again dilate as to the necessity of Imperial control of all matters connected with the defence of our foreshores. The Admiralty, as representing the Government, possesses rights connected with them which, in most instances, they are not slow to enforce—as many cases in our legal courts show—when they are infringed by private individuals or by corporations; but it stands by unconcerned when the operations of Nature threaten them, until private or local public interests have been driven to protect themselves, and then, and then only, steps in with harassing interference. Under such conditions we congratulate the Hove Commissioners that they are now to be left to themselves to complete the work they have so energetically begun.

We recently stated that the advice of Sir John Coode had been sought as to the works already executed, on the amount of protection they are likely to afford, and as to the continuance of them on the principle already acted upon, or its abandonment and the substitution of fresh designs. We have now learned more in detail the nature of Sir John Coode's recommendations, though we are unaware as to how far he has expressed concurrence with Mr. Ellice-Clark's plans, upon which operations have to date been carried on. As, however, the works now proposed appear to be a direct departure from the system previously noticed by us, we must conclude that Sir John Coode sees reason to fear that what has been done scarcely promises full success. In our early comments on the groyning system, adopted by the engineer to the Hove Commissioners, we expressed our view that a sea-wall would probably not only be more thoroughly efficacious than the construction of groynes at frequent intervals, but that it could probably be erected at a less cost, and afford less chance of injury to the neighbouring beach under charge of the Municipality of Brighton. At a recent meeting of the Hove Commissioners Sir John Coode's proposals were considered by them. These involve the construction of a sea-wall to extend from the eastern boundary of the parish near the existing toll house to the wall of the West Brighton Estate, opposite Adelaide Mansions. This wall, Sir John considers, should be erected at a distance of 90ft. from the existing lawns, and the esplanade to be so obtained is to be provided with seats, band stands, and proper lighting, to render it a pleasant promenade. The wall itself is to be protected by three concrete groynes in addition to those already completed, and the total cost of all the additional works is estimated at £22,000. We feel no astonishment at reading, in the report of the proceedings, that these proposals aroused considerable discussion and opposition, the latter, indeed, being so successfully maintained that the proceedings terminated in a re-reference of the matter to the General Purposes Committee, which had recommended the immediate raising of the funds required for carrying out Sir John Coode's proposals. Having before expressed our conviction that a sufficiency of time has not yet passed to enable the efficiency of Mr. Ellice-Clark's groynes to be fully tested, we can fully sympathise in the opposition which was offered by the Hove Commissioners, this being chiefly based upon a concurrent opinion, though certain details of the proposals—mainly as to the distance seawards at which the sea-wall should be built—were also much and adversely discussed. The design, as we have said, provides for this on a line 90ft. in advance of its present lawns, and many fears were expressed lest the exposure of the wall to the force of the breaking sea before protecting beach can accumulate may not prove fatal to it, it being contended thereupon that it would be wiser to construct the wall within the line of existing protections. On these points we must await the final decision of the Commission and its Sub-Committee; but apart from the question of stability, it will be as well for them to bear in mind the danger we have often pointed out, and which may be run by extending the works too far, of endeavouring to recover lost ground. Better, as we have often said, to secure what remains, and, while doing so, obviate the risk which will otherwise undoubtedly be incurred of turning the inroad of the sea on to the beach of the neighbouring municipality of Brighton.

We are conscious of oft reiteration of this warning, but it is one which should not be lost sight of. The mention of it brings us once more to the proceedings of the authorities of the last-named town. We have in previous articles called attention to what appears to us to be the suicidal policy adopted by them in allowing the removal of the shingle at the point most proximate to the Hove boundary, and we are glad to see that at one of the latest municipal meetings in Brighton a gentleman directed attention "to the large amount of beach and sand which was being continually carted away from the foreshore." The objection found warm support from other members of the Town Council, and the question is at length to be freely considered by the Beach Committee. How far this will be affected by new schemes entertained, and, we believe, decided upon by the town authorities, it is impossible for us to say until the plans have been fully made public; but those who have watched the development of the Hove works and their effect on the adjacent beach with great attention, have expressed fears that their effect will be to carry on the mischief still further to the eastward, and to cause the undermining of the foundations of the abutment of the West Pier. As far as our information goes, the Municipality proposes the formation of ornamental lawns protected by a sea-wall over a great portion of the beach between the West Pier and the toll house at the Hove boundary, and our friend argues that if this wall is carried out to the line of the present beach, it will, unless fresh beach be accumulated, set up the destructive action above referred to to the eastward. Moreover, he maintains his opposition on the still further ground that a large section of the beach now widely resorted to by children as a healthful recreation ground, will be sacrificed to what is thought to be a merely æsthetic consideration. Upon such a line of objection, however, while sympathising with our youthful friends, it is manifest we can have but little to say in a journal devoted only to engineering considerations, though it would doubtless have weight with the taxpayers of the town. But more important considerations occur to us. Is the danger to which we have so persistently referred now becoming apparent to the authorities of Brighton, and the necessity for protective measures in the early future forced upon their minds? and, if this be so, does it strike them that the comparative failure of the works at Hove proves the greater wisdom and economy of a sea-wall for such protection, and that the enclosure this will necessitate can only be utilised for the projected lawns and promenade? It certainly seems to us to be likely that this is the intent and meaning of these new proposals, and in that case we cannot but see in them the fulfilment of our long-ago prophecy that the independent proceedings at Hove would ultimately force a large expenditure on the adjacent town.

THE STORAGE OF POWER.

PROBABLY at no previous period has there existed such a demand for what we may term portable motive power as that which manifests itself now. Power is wanted to propel street cars and tricycles, to drive washing machines and small lathes, to blow organs, to turn dynamo-electric machines, to propel small boats. We might extend our list considerably, but it is unnecessary, for to every reader of these pages a new field for the exertion of power will suggest itself, varying with the reader's tastes, habits, and ingenuity. There can be no doubt that the inventor who could supply in a really portable form a machine or apparatus which could give out 2 or 3-horse power for a day would reap an enormous fortune. Up to the present, however, nothing of the kind has been placed in the market. Sir W. Thomson startled the world—apparently a long time ago, for events move quickly—with the announcement that he had carried a million foot-pounds in something not much larger than a hat box. But it is really very doubtful if this has been approached in practice. The secondary battery is still a baby. What it may become no one can quite tell. Putting it on one side, we may proceed to consider what are the obstacles which stand in the way of the production of portable power; and, first, it will be well to define precisely what it is we are speaking about. A locomotive or marine engine supplies an example of portable power in the fullest sense of the word; but we do not refer to locomotives or marine engines, but rather to something partaking in its nature of a watch—a something which may be wound up or charged with power in one place, and discharged or run down in another. Thus, for example, in the case, let us say, of a small ivory turnery, a cart would bring to the door every morning a box which would contain power for the day, and would take away the run-down or discharged box to be re-filled. The patron of tricycles would but have to send to the nearest place where they sold power boxes to procure what he wanted; and thus equipped he might make a trip of twenty or thirty miles, only using his legs for the sake of exercise, and permitting his power box to do all the drudgery. Here, we think, is a sufficiently attractive picture; why is it incapable of realisation? Shall we never see such things done? Shall we never see such an announcement as this in the daily papers?—"Messrs. Dyne, Erg, and Co., Power Merchants; power boxes of the most approved construction wholesale and retail. Messrs. Dyne, Erg, and Co. solicit the particular attention of tricyclists to their new Invincible drivers, guaranteed to supply half a horse-power for ten hours at the cost of one penny per hour; weight 30 lb. The lightest for the power in the market."

We may point out to begin with that there is absolutely no difficulty whatever in storing power. Every time a watch is wound power is stored. The difficulty lies then not in storing power but in storing enough of it. In the present day we have learned to talk so glibly of horse-powers that we fail to realise the magnitude of that about which we speak. It is not probable that a tricycle or other road vehicle to carry, say, four persons, could be made which will weigh less than 4 cwt. If we add an equal weight for the power box, and 6 cwt. for four persons, we have a total of 14 cwt., and this cannot be successfully propelled at, say, seven miles an hour on a good road with less than ½-horse power net. This means 16,500 foot-pounds per minute, 990,000 foot-pounds per hour, or in six hours, in round numbers, 6,000,000 foot-pounds. The power expended on a trip of some forty miles would suffice to lift 2678 tons a foot high; it would carry 7 tons to the top of St. Paul's Cathedral. All this power could be got out of 12 lb. of coal; but, unfortunately, not under the conditions. Yet it will be seen that to stow away 2678 foot-tons of power in a box weighing not more than 4 cwt. is not an easy matter. Three different methods of doing what is wanted at once suggest themselves, but they all depend on the same principle—elasticity. We may wind up springs; or we may compress air; or we may use heated water. There is a fourth way, concerning which we may say something presently. For the moment we shall content ourselves with dealing with the obvious, leaving the more recondite for future consideration.

We have the conditions of our problem laid down. Wanted 2678 foot-tons stored in an apparatus which, with all the gear necessary to cause the revolution of the wheels, shall not weigh more than 4 cwt. Springs suggest themselves in an instant—springs to be wound up by a stationary engine. A company has been formed in the United States for supplying spring power for tramcars. Why not extend the principle? Let us see what figures can tell us on this point. It is tolerably clear that our spring must be strong and therefore heavy, and it may be conceded perhaps that the gearing to drive the road wheels cannot weigh less than 1 cwt. If, on the other hand, the spring were attached directly to the driving axle, the moment the brake or other stop was released the vehicle with its occupants would begin a headlong course, not unlike that of the American dog who was tied by his master at the tail end of an express train, "because he was used to being led." Some equalising arrangement must be introduced analogous to the fusee of a watch. A brake could not be employed because it would simply waste power. We have, then, let us suppose, 3 cwt. of spring. But if a spring is to last for some time without breaking it must have no more work stored in it than would suffice to lift it about 60ft. Let us strain a point, however, and suppose that our 3 cwt. of spring could lift 3 cwt 100ft. high; then we have 33,600 foot-pounds, or just power enough to propel our vehicle for two minutes instead of six hours. If we look at the problem from another point of view, we find that no less than 27 tons of spring would be required to supply half a horse-power for six hours. Springs of steel are quite out of the question.

Next comes compressed air, and this is more promising. Indeed, compressed air has been used by several engineers, with comparative success, in propelling vehicles; but it is open to question whether in this way we can obtain what we want. We must have an engine to enable the compressed air to do its work. This, with its appurtenances, will weigh, say, 1 cwt., leaving us 3 cwt. A steel cylinder 6ft. long and 2ft. diameter could be kept under 3 cwt., and yet be strong enough for our purpose. If it were filled with air compressed 31 times, it would contain 4,500,000 foot-pounds. But unfortunately this only represents the power which would be absorbed in compressing 580 cubic feet, or about 45 lb., to 500 lb. or thereabouts on the square inch, and during the compression the air would lose much heat, which would have to be restored, or the loss during expansion would be enormous. It would not be safe to reckon on more than a three hours' run from our air spring, and, considering the difficulty of using air at such an enormous pressure; the cost of pumping it up to the stated density; and the risk inseparable from its use, it is tolerably evident that compressed air will not supply what is wanted.

We have next to consider what may be done with water on the system devised by Lamm, among others, and used for some time in the United States with success. The system would have to be materially modified for use on a small scale. We may take it for granted that at each stroke of the engine a few drops of highly-heated water would be injected into the cylinder, where they would flash into steam. Now, water under an absolute pressure of 270 lb. on the square inch has a sensible temperature of 408 deg., and if we relieve the pressure, part of the water will be converted into steam, the water falling to the temperature normal to the new pressure. Thus if the new pressure were 50 lb. absolute, the temperature would be 281 deg., and $408 - 281 = 127$ deg. units per pound of water; and each pound of steam would require 916 units for its formation; and $\frac{916}{127} = 7{\cdot}29$. That is to say, for each pound of steam produced we must carry 7·21 lb. of water. But half a horse-power could not well be got from a small non-condensing engine for less than 30 lb. of steam per hour, or for six hours 180 lb., and $7{\cdot}29 \times 180 = 1297{\cdot}8$ lb. of water. If the pressure were greatly augmented the quantity of water would be diminished; but the strength of the containing vessel and its weight would have to be enormously increased. Under the conditions, it will be seen that it would not be practicable to obtain a run of more than about one hour or, say, seven miles. But there would be very considerable advantages on the side of steam, or rather hot water storage. The pressure would not be more than half that of air, and there would be practically no difficulty in keeping the water reservoir hot for three hours or more by enveloping it in suitable coatings of felt. We have, as far as possible, avoided the use of figures or recondite reasoning of any kind, our purpose being to show in the simplest and briefest way that it is apparently impossible to devise any mechanical system of storage which will give out half a horse-power for six hours and weigh less than 4 cwt. or 5 cwt.; and it will be conceded that half a horse-power is a very small thing and not competent to effect much. It probably represents the actual work performed per day by a London omnibus horse weighing 9 cwt.; the horse during a part of his working time does much more, but for the remainder he does less. A horse weighing 9 cwt. to 10 cwt. will plough steadily, if well fed, for ten hours a day, and probably developes during that time about 21,000 foot-pounds per minute, or, say, two-thirds of a horse-power; but it does not appear that in this direction we can at all rival nature in providing portable power.

One method of storing power, and only one, remains for consideration, and it is worth it. At first sight, no doubt, many of our readers may reject the idea as representing expedients too full of danger to merit notice. Without further preface we may say that we refer to the use of explosives under proper conditions. A gunpowder engine was made and worked many years ago, and with some success—and another gunpowder engine is now being tried in Germany—but chemistry has made enormous advances since then, and various compounds exist which, while weighing little, and capable of exerting an enormous force, may be burned slowly and without danger. The power stored in gunpowder is very great, amounting to about 70 foot-tons per pound, so that about 40 lb. would suffice to give out half a horse-power for six hours; and by using the principle of subdivision it may not only be burned without danger, but even when carried in moderate quantities, rendered quite safe from exploding; but we do not propose the use of gunpowder as a means of providing portable power. The chemist may help us to something safer, cheaper, and quite as powerful. Gun-cotton, for example, may be burned without exploding, giving off enormous volumes of gas. It remains to be seen, however, whether compressed gas and air may not be burned, as in the existing gas engine, to supply what is wanted. We believe we are correct in stating that gas engines have been tried, and with success, for driving tramcars, although very little has yet been said on the subject. It will be seen, however, that gas cannot supply all that is wanted, nor, indeed, does its use come quite within the scope of this article. Gas is laid on to most houses now, and gas engines are plenty enough, yet they do not quite meet the want which a storage battery may yet, perhaps, be made to supply; and nothing has yet been devised in this line which would be suitable for the propulsion of light vehicles, such as that to which we have given prominence in all that we have just said.

RAILWAY GOODS TRAFFIC IN THE UNITED STATES.

Although the goods traffic carried on English railways is enormous, it is in some respects small by comparison with that dealt with in the United States. In this country the carriage of goods and minerals is subservient to the passenger carrying business; but in the United States the converse is the case. In this country all our great lines are crowded with passenger trains; in the United States the passenger trains are comparatively few, while the goods trains are large and numerous. Here it may be said that goods have to give way to passengers; on the other side of the Atlantic, although it would not be true to say that the converse holds good, it is at least certain that the two classes of traffic have nearly equal rights of way. Here we rely largely on our passenger trade for a dividend; there goods, on properly managed lines, represent the best income. It is not too much, perhaps, to say that the Americans ought to be the most experienced people on the face of the earth in the management of goods traffic, and this being so, what they have to say on the subject is worth hearing. We have a somewhat authoritative utterance on the subject lying before us, in the shape of a paper read before the American Society of Civil Engineers by Mr. W. B. Shinn, on December 20th, 1882, and we propose to consider here some of Mr. Shinn's statements. Whether they do or do not put the American system in a favourable light will be seen presently.

Mr. Shinn's paper is "On the Increased Efficiency of Railways for the Transportation of Freight;" and the thesis of the author is that railways can compete with and beat canals. As far back as 1872 a distinguished American engineer stated "that three-fourths of all the freight from the West to tide-water went by two canals—chiefly the Erie — which left but two millions of tons to be moved by four trunk lines." Mr. Shinn stated in reply that one double line of rail could move 1000 tons per hour, or over 7,000,000 tons per annum, in one direction. Mr. Shinn, in the paper which we are now considering, states that, in 1860, the ton-mileage of the New York Central and Hudson River Railroad, the New York. Lake Erie, and Western Railroad, and the Pennsylvania Railroad, was about equal, and amounted to a little over three-fourths of that of the canal. In 1870 the ton-mileage of each of the roads named equalled that of the canals, and in 1880 it reached twice that of the waterways. This seems to be explained by the fact that the canals could carry no more in 1880 than they did in 1870, while the weight of produce to be moved was enormously increased, and its movement devolved on the railways. As an example of this we may say that, in 1870, the United States exported 20,219,368 bushels of grain; in 1880 they exported no less than 258,119,883 bushels; and taking the whole of their food, oil, and cotton exports, we find that, between 1870 and 1880, they increased 464 per cent. They were valued for the fiscal year ending June 30th, 1870, at £78,554,000, and in 1880 at £167,127,600. Referring to the increase in exports of breadstuffs, provisions, and live animals, Mr. H. V. Poor, in his "Manual for 1881," says:—"The enormous increase of our foreign commerce is due almost wholly to the increased exports of provisions and breadstuffs, the product of that portion of the country most distant from market, and in which railroads have had their widest and most rapid development. It will be seen that of an increase—in value—of exports of 443,000,000 dollars, 329,000,000 dollars was made up of the products of the Western States, these being almost wholly due to the construction of railways within them." Thus it will be seen that the railways have had an enormous increase of work thrown on them within the ten years named. Mr. Shinn shows that the augmented carrying capacity of American railways depends on various conditions, with only the most important of which we have space to deal. One great improvement was the adoption of steel rails. At the end of 1881 there were no fewer than 104,325 miles of railway open in the United States, representing 130,536 miles of permanent way, of which 49,062 miles were laid with steel rails. Another important improvement consisted in doubling track and augmenting siding accommodation. In some cases lines have not only been doubled, but quadrupled, as in this country, two roads being kept for passenger and two for goods traffic. As an example of the work done by an American railway, we cull the following extract from Mr. Shinn's paper:—"The capacity of a single track has probably nowhere received a greater development than on the Pittsburg, Fort Wayne, and Chicago Railway, where was made on 468·3 miles of railroad, of which but 74·3 miles were double track, and having 184·8 miles of sidings and yard tracks—mileage of passenger trains in 1881, 2,015,298; mileage of freight trains in 1881, 7,916,719; mileage of other trains in 1881, 320,897; total train mileage in 1881, 10,252,914. Equal to trains both ways over whole road—passenger trains, 2151·72, or per day, 5·89; freight trains, 8452·61, or per day, 23·16; other trains, 342·62, or per day, 1·09; total trains, 10,946·95, or per day, 30·14; or over thirty trains each way per day for 365 days, excepting working trains, which are calculated for 313 days."

We come now to the duty done by United States rolling stock, and on this point Mr. Shinn furnishes a great deal of valuable information. There has been a gradual augmentation in the power of standard locomotives, and an increase both in the speed of goods trains and in their weight. Thus on the Pennsylvania Railway the standard goods engine of 1872 had cylinders 18in. diameter by 22in. stroke, with six driving wheels 4ft. 2in. diameter, and the load on the Pittsburg division was eighteen loaded cars. The present standard engine has cylinders 20in. diameter and 24in. stroke, and eight driving wheels 4ft. 2in. diameter, and its load is twenty-eight cars. The average train loads on the three lines we have named has increased from 112 tons to 275 tons, counting both ways, and so including returned empties; the whole average increase amounting to 67 per cent. in round numbers. But, perhaps, the most important fact cited by Mr. Shinn is that in consequence of the improvement which has been effected in permanent way, the cost of engine repairs has been largely reduced. On the Pennsylvania road, for example, the cost of engine repairs for every 100 miles run in 1865 was 16·45 dols., in 1870 it was 9·13 dols., in 1879 it fell to 5·30 dols.; in 1880 it rose again to 7·02 dols., while in 1881 it was 6·02 dols. This is still high, as compared with the cost of repairs on several of our railways; and it is to be regretted that Mr. Shinn did not favour his hearers with some statement of the precise nature of this expenditure. As to rolling stock in the shape of cars, that has been augmenting in size, and the standard car on the more important lines now carries 40,000 lb., or nearly 18 tons. The weight of the car is about 10 tons.

Considerable alterations have been made during the last few years in the system of working locomotives in the United States. At one time each "engineer" had his own engine, and when he rested so did his engine. But at present the engines are worked on what is known as the "first in, first out system," and by keeping more men than locomotives, there is more work got out of the latter. On the Pennsylvania railroad in 1870 the average number of miles run per annum by goods engines was 19,244, in 1878 it was 20,000, in 1879 it rose to 24,355, and in 1881 it got up to 27,644, the average ton mileage in the last year being 5,100,000. It must be borne in mind, when comparing this duty with the annual mileage of English engines, that the speeds in this country are much higher than those adopted in any other country for the haulage of goods. The late Mr. J. Edgar Thomson, president of the Pennsylvania Company, stated in 1867 that the speed of a freight train should not exceed six miles an hour. The time-table speed of American goods trains is now fifteen to twenty miles an hour, or one-half to three-fourths of that of most English goods trains, and less than that of English mineral trains; coal trains on some lines are, however, run at over thirty miles an hour in this country. Mr. Shinn speaks strongly on the necessity of getting as much work as possible out of each car, truck, or wagon; and he argues, and with much force, that the remedy for a block of goods on a road is not more cars but more work got out of each car; while he maintains that the more rolling stock any company possesses the smaller will be the quantity of work got out of that stock. In proof of this contention he gives figures; thus on the Union Line there were, in 1876, 3938 cars; the average mileage was 88·85 per day. But in 1882 the company's stock had increased to 6041 cars, and the mileage had fallen to 44·82, or nearly one half. These figures show that during 1877-78 and '79, when the number of cars remained nearly stationary, the average mileage did not change materially, while with the steady increase in the number of cars from 1880 to 1882 there is a more than correspondingly decreased average mileage. While the number of cars in the years 1879-80-81 and '82 were respectively as 1, 1·16, 1·44, and 1·49, the average of miles run per secular day in 1879 bore to that of 1880-81 and '82 respectively the proportion of 1·29, 1·48, and 1·77 to 1.

It must not be assumed, we may remark, that this diminution in efficiency is due wholly to a superabundance of rolling stock; but no doubt it is a powerful influence appertaining in that direction. We regret that we cannot follow Mr. Shinn further on this interesting topic. We fear, indeed, to weary our readers with statistics, which make dry reading; but we cannot resist reproducing the following passage, which is eminently suggestive:—"It is probable that the greatest loss from the non-movement of cars results from their absence on foreign railroads. Not only do many railway officials allow 'foreign cars' to be used systematically in their local traffic, but they allow them to stand on sidings and in yards, and do no good to anyone. A coal company owning 100 cars recently found but forty-two of them in its own trade; the remaining fifty-eight had been absent from a week to two months, and one was found in a furnace yard loaded with ore placed on it nine weeks before! An investigation made by the writer in 1869 showed that the cars of the Pittsburgh, Fort Wayne, and Chicago Railway absent on other railroads in March and October, 1868, had made an average mileage, while so absent, of 20·57 miles per day, for which the Pittsburgh, Fort Wayne, and Chicago Railway Company then received $1\frac{1}{2}$ cents per mile, or the munificent sum of 30·85 cents per car per day. The rate of car mileage has been since reduced, first to one cent, and then to three-fourths of a cent per mile run, so that on the present basis the company would receive for similar mileage 15·42 cents per car per day. As my statements show a generally decreased movement of cars, it is not likely that the present average movement, when on foreign railroads, equals that found for 1868. The only effective way to bring about a prompt return of cars to the railroad of the company owning them, is to make it the interest of the foreign company having them to return them to their owner, which it manifestly is not under present regulations. This can best be effected by a per diem charge for cars when on foreign roads."

Have British traffic managers anything to learn from their American brethren? On the whole very little. It has long been known that American locomotives are much less economical in the consumption of coal than English engines, and we venture to assert that in this country we get quite as much out of our rolling stock, if not a great deal more, than they do in the United States. The adoption of larger trucks than those now used for some classes of traffic might be worth consideration. The Great Western broad gauge trucks, for example, carry much more than narrow gauge trucks, and there was found to be a certain advantage entailed. But so long as the dead weight moved continues to bear the same relation to the paying load, it is difficult to see how anything could be gained by altering the size of trucks. English railroad men will see that English methods of dealing with railway traffic are, after all, not inferior to those adopted elsewhere, and will be disposed to join with us in thanking Mr. Shinn for supplying information which may prove serviceable in refuting charges of extravagance in the conduct of railway traffic which have been brought against us by Americans in times past. Even in railway management Brother Jonathan does not whip all creation.

THE FOUNDERING OF STEAMSHIPS.

THE sinking of the Cimbria and the frightful loss of life attending it, following so quickly as it does on the sinking of the City of Brussels, powerfully draws attention to the utter carelessness or thoughtlessness with which we go to sea or allow owners of iron ships to take us out to sea. Trusting to the reputation of great shipowning companies and their captains, thousands of people weekly take berths in well-known ships, thinking that they will continue to escape from accidents and that the ships are better able than others to withstand danger even if they do not escape it. But the accident occurs and reputation goes, for all ships alike are seen to be mere metallic sheets which break like eggs and sink like stones. We have on several occasions dealt with the various aspects of the peculiar shortsightedness by which our shipowners send ships to sea with insufficient and inefficient bulkheads, and the false economy which leads them to dispense with the pumping power which, for a few hundred pounds, would keep a ship afloat long enough to save all lives or get to shore, if not to get to port. Until passengers, however, begin to inquire for themselves as to the relative structural and equipment merits of steam vessels in which they propose to go to sea, few of the shipowners will do otherwise than build as they have built, equip as they have equipped, and run the risks they have been accustomed to run. High-speed, elaborate fittings, decorations, and sumptuous table are the things chiefly called for by the travelling public—and they are obtained. When complete bulkhead construction, designed as engineers would design bulkheads to do the work which bulkheads ought to be able to do, is demanded by the public, and those ships which are best made in this respect are the best patronised, then shall we get safer ships. It is high time that the general reader should be able to get some useful information on this subject, and that naval matters do excite considerable general interest was proved by the success of the Naval and Submarine Exhibition held at Islington last year. In the catalogue of that exhibition there is a paper which just now has particular claim to public attention. It is an essay on "The Foundering of Steamships, and How to Prevent It; or Design and Equipment *versus* Insurance," by Mr. S. H. Terry, A.M.I.C.E. It is one of several essays which are promised to accompany the second edition of that catalogue. As we do not know where it is to be obtained, we must express the hope that the catalogue, of which it is to form part, will soon make its appearance. After touching upon the loss of life and property at sea during the past eight years, Mr. Terry deals with questions relative to the design and structural strength of bulkheads, referring in particular to the cases of the Teuton of the Arizona, the Douro, and the Yrurac Bat, which afforded excellent examples by failure and by success of the value of efficient bulkheads. The Teuton, it may be remembered, sunk off the Cape, owing to the sudden collapse of one of her bulkheads, three hours and a-half after striking on a sunken rock, and great was the loss of life that followed. Mr. Terry gives some figures showing the utterly insufficient strength given to these bulkheads, which consist usually of plates $\frac{1}{2}$in. in thickness or less, stiffened by a few angle irons, quite incapable of supporting a hydrostatic pressure of 6 lb. or 7 lb. per square inch. The Douro was struck off Cape Finisterre by the Yrurac Bat and sunk in about thirty minutes, the Yrurac Bat sinking in half that time. The Arizona afforded an example of the value of a well-made collision bulkhead when she struck an iceberg in November, 1879, while running, it is reported, at 14 knots an hour, and when her bows for a length of 20ft. were stove in, crumpled and bent in upon themselves, her collision bulkhead—35ft. from her stem—remaining tight. It must, of course, be admitted that the bulkhead of the Arizona had a much better chance of doing its duty than did those of the City of Brussels, the Douro, and probably the Cimbria, for the Arizona struck the iceberg fair ahead, and the bulkhead was not only one of the strongest in the ship, but was one of the least width; while in the City of Brussels the collision seems to have taken place just at a bulkhead, thus knocking two compartments into one; but in this, as in other cases, the ship might have been kept afloat with a consumption of steam insignificant as compared with the boiler capacity on board the ship, as we pointed out in our impressions of 14th April, 1882, and 12th of the present month. Passing on to a consideration of the amount of freeboard as affected by the existing tonnage laws, Mr. Terry devotes a considerable part of his paper to questions of equipment, particularly the means of steering, unprotected stoke-holes, bilge pump suction and discharge pipes, water-ways, water-tight doors and sea connections, boat-lowering apparatus, and certain questions relating to the working of ships. To fitting ships with large pumping power he devotes, and usefully, a good deal of space, and shows that pumps of capacity sufficient to have kept the City of Brussels afloat until now can be had for considerably under £1000, while the pumping power necessary in most cases would cost but a few hundreds. But in an earlier part of his essay, quoting THE ENGINEER of 14th April, 1882, he draws attention to what may be looked upon as an absolutely essential and fundamental reform in the existing tonnage laws. No iron passenger ship can be said to be constructed from the best design, or in the manner most likely to ensure safety in case of collision or running on a rock, unless she is provided with a double bottom. Under the existing tonnage laws, however, these structural cavities are measured as tonnage-carrying space, and thus the shipowner is made by law to pay a high tax for adopting one of the best measures of safety, for of course, as all our readers are aware, the space between the two bottoms is absolutely useless for stowage.

FLUID CARBONIC ACID FOR EXTINGUISHING FIRES.

AN apparatus, devised by W. Raydt, for this purpose consists of an iron cylinder filled with fluid carbonic acid and a large vessel filled with water, which is placed in connection with the iron cylinder in such a way that the carbonic acid shall stream through the water when the apparatus is to be used. Carbonic acid, as is well known, possesses the property of becoming liquid under a pressure of about 40 atmospheres, and occupies then about 1-450th of its bulk in gas. A receiver containg 100 litres, therefore, will hold carbonic acid which, as gas, would occupy 45,000 litres. When used a valve reduces the pressure of the gas to the requisite amount, and all that is necessary is to screw on the conducting pipes, which will then convey to any desired height the water which, in this case, is saturated with carbonic acid, and which more readily and quickly extinguishes fire than does ordinary water. The first great experiment with the Raydt Extinctive apparatus has been made by the Krupp's Fire Brigade, in Essen. The Director and Chief of this fire brigade say that the main advantage of Raydt's method consists in the fact that when dealing with a fire which has broken out, a stream of water can at once be thrown without any preparation whatever, and the stream provided is one of an extreme activity for extinguishing fire. It is said to require little personal attention, and is readily handled. It is intended for use in theatres, factories, and such kind of establishments as are especially exposed to danger from fire, as also for use on board ships. They are of opinion that in many larger theatres, factories, and fires on board ships, by a ready employment of the Raydt Extinctive apparatus, all damage may be avoided. The Berlin Fire Brigade has also recently made an experiment with the Raydt's apparatus, and the Director in that city pronounces himself very well contented with the result. When setting it in order, the adjustment of the jet which is driven by the fluid acid is made once and for all, and when there is no fire the carbonic acid remains unchanged under pressure in the wrought iron cylinder. The fabrication of the fluid carbonic acid is now carried on on a large scale at Krupp's steel factory. F. Krupp, jun., has found a use for it in the preparation of cast steel, and for this as well as other purposes the carbonic acid is prepared at Essen in the liquid form. The pump is so arranged that it can yield daily about 500 kilogs. of the fluid acid. The transport of the latter by rail, in wrought iron cylinders or bottles, is freely carried on. Each bottle before use is submitted to a pressure to test it amounting to one of two hundred and fifty atmospheres, while the gas itself only exerts a pressure of about fifty atmospheres.

COKE PRODUCTS IN DURHAM.

ACCORDING to the statement of Sir Joseph Pease, success has attended the effort of Pease and Partners, Limited, to obtain bye-products from the manufacture of coke at the great works of the company at Pease's West, in Durham. The system that has for some time been in operation is that which has been very successful at Terrenoire in France—the "Simon" system. It may not be generally known that twenty years ago Messrs. Pease attempted by another method to obtain these valuable products, but not with commercial success. There has been, however, a marked change in the condition of the coke trade in that period, and also in the relative value of the materials and products. The coke manufacturer has come to be one of the greatest of the consumers of coal in Durham, and hence the waste that was comparatively small a score of years ago is now very great. It is thus increasingly needful that there should be some endeavour to obtain the waste products that have been so long given off and this need is greatly increased by the fact that the Scotch ironmasters have perfected plant for collecting from the coal that they burn in their blast furnaces the same bye-products. The relative conditions of the iron trade in Scotland and Cleveland would be much altered in favour of the former if the ammonia and tar were only collected there. It is thus found increasingly desirable to utilise the waste products, and thus to cheapen the cost of the production of coke; and though no figures have been supplied, yet we have the statement of Sir Joseph Pease that not only is the attempt to obtain these products commercially successful, but that there is an improved percentage of coke from the altered ovens—a fact that is of great importance.

LECTURES ON ELECTRICITY.

A SERIES of six lectures, rendered the more attractive by the well-known ability of the lecturers, is about to be given under the auspices of the Institution of Civil Engineers. The lectures will be given on set Thursday evenings by members of the Institution, admission being as to its ordinary meetings, that is to say, members, associates, and students will have the right of personal admission, and every corporate member will have the privilege of introducing one friend. Those not connected with the Institution will therefore only gain admission by the introduction of a member, the lectures being free, but not to the general public. The first will be on the 15th February, on "The Progress of Telegraphy," by Mr. W. H. Preece, F.R.S.; the second on the 1st March, on "Telephones," by Sir Frederick Bramwell, F.R.S.; the third on the 15th March, on "The Electrical Transmission and Storage of Power," by Dr. C. William Siemens, F.R.S.; the fourth on the 5th April, on "Some Points in Electric Lighting," by Dr. J. Hopkinson, F.R.S.; the fifth on the 19th April, on "Electricity Applied to Explosive Purposes," by Professor F. A. Abel, C.B., F.R.S.; the sixth on the 3rd May, on "Electrical Units of Measurement," by Sir W. Thompson, F.R.S.

LITERATURE.

Des Ingenieurs Taschenbuch. Herausgegeben von dem Verein "Hütte." Sm. 8vo, pp. 1053. 12th Edition. Berlin. 1883.

THE volume before us is a further proof of the activity of the very useful technological society Hütte, which was established at Berlin about thirty years since for the publication of detailed drawings of plant, machinery, and works' buildings, the designs being furnished by the members themselves, and in all cases restricted to works actually executed. In addition to this principal object, a "Vade-mecum Committee" of the society is entrusted with the duty of revising the "Engineer's Pocket-Book," and the latest result of their labours under its unpretending title is probably the most complete compendium of data in all the branches of knowledge appertaining to engineering practice that has yet appeared. The material is divided into thirteen sections. The first, of 113 pages, is devoted to mathematics and geometry; the second, pp. 114-206, to statics and dynamics; the third, pp. 207-222, to heat, including the general principles of thermodynamics and their application to permanent gases and steam; the fourth section, pp. 223-285, devoted to strength of materials, includes an elaborate discussion of the strength of springs of different kinds, and the list of standard sections for rolled bars adopted by the German engineers and architects; the fifth section, on the "Statics of Building Construction," pp. 286-334, has been considerably extended, and the results of the researches of Launhardt, Weyrauch, Müller, and others, into the stability of various forms of girder and arch construction, have been incorporated; the sixth section, on "Machine Elements," pp. 335-425, has been carefully revised, and additions, mainly from Reuleaux, have been made in the articles on screws, teeth of wheels, bearings, and chains. The American practice of driving belts for large power is given from Radinger's report, and much additional information has been furnished by different manufacturers as to the working strength of ropes and chains. The space devoted to link parallel motions has been abridged, while that on fly-wheels and centrifugal regulators has been considerably increased, the latter may be noted as especially complete. In the seventh section on "Motors," pp. 426-476, the article on tubines has been completely re-modelled, as well as the subject of steam engine calculation, which is given as a partial extract from a forthcoming work by Professor J. Hrabák. Tokei's approximate construction for slide valve diagrams, and a section on the investigation of indicator diagrams, are also new, and tables of the dimensions and duty of Lehmann's air engines and Otto's gas engines complete the additions.

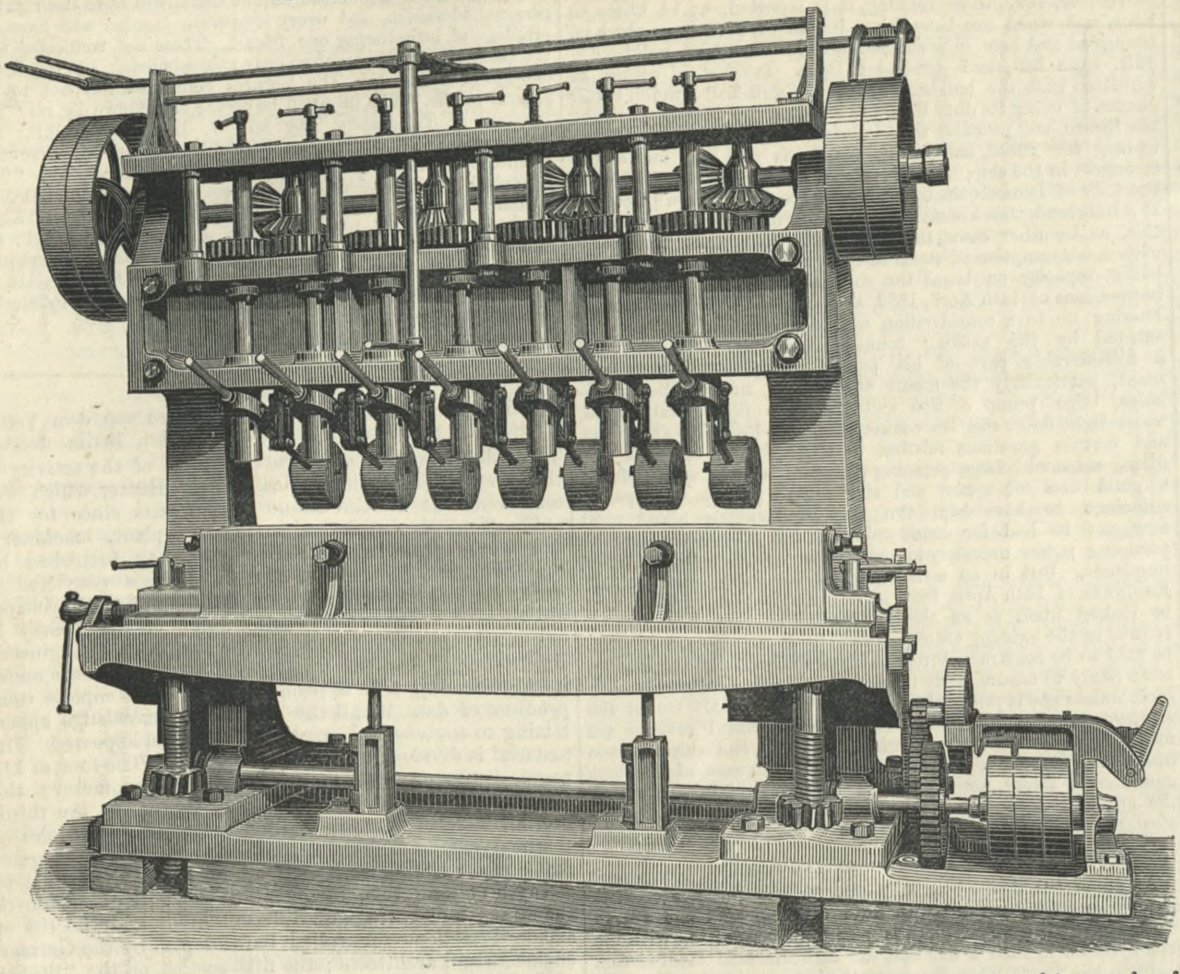
In the eighth section, pp. 477-526, on "Shipbuilding," the rules for the dimensions of ships adopted by Lloyd's and the Bureau Veritas have been omitted, the space being utilised for rules for masting and draughting sails from the "Dutch Memoriaal van de Marine." Froude's method for determining the resistance of ships and the determination of the dimensions of receiver compound engines, both by graphic and analytical methods, are other additions.

The ninth section, on "Railways," pp. 527-662, is very full of matter, whether as regards construction, rolling stock, or working, and will be found of great interest as a full epitome of the principles adopted in the working of railways in Germany. The tenth section, pp. 663-690, devoted to working machines, has been re-modelled as regards machine tools and data concerning Sulzer Brothers' centrifugal pumps and ventilators; pulsometers and steam dredgers are added.

The eleventh section on "Technology," pp. 691-785, contains a very good account of milling processes and other articles on textile industries, flax, cotton, and wool, spinning and weaving, dyeing and printing; silk, however, being omitted, paper manufacture from rags, wood pulp, and straw, brewing, distilling, and sugar manufacture, and gas manufacture. The chapter on sulphuric acid, soda, and bleaching powder has been omitted, as a special pocket-book devoted to chemistry and metallurgy is nearly ready for publication. Part of the latter subject, that of iron smelting, has been retained, and forms the twelfth section, pp. 786-835. This has been considerably increased by data giving the newest practice in Bessemer works, both in the acid and basic processes. The section on the manufacture of malleable iron is also full of interesting matter. In the thirteenth, or final, section of the text, pp. 836-927 devoted to building construction, tables of the results obtained at the Berlin testing station on the strength of stone, brick, cements, and brickwork are added, as well as numerous other details on roofing felt, warming, ventilation, and the valuation, duration, and cost of maintenance of buildings. An appendix, containing a very large number of useful tables—among others, of weights of metals, for the conversion of different mechanical units according to the duodecimal into the metrical scale, and notices of the principal statutes in Germany affecting industrial pursuits, such as patent law, liability for accidents, apprenticeship regulations, official rules as to steam engines and boilers, &c.—brings the volume to 1020 pages, and it is concluded by a very full subject-matter index.

FIRE-BOX ROOF BAR DRILLING MACHINE.

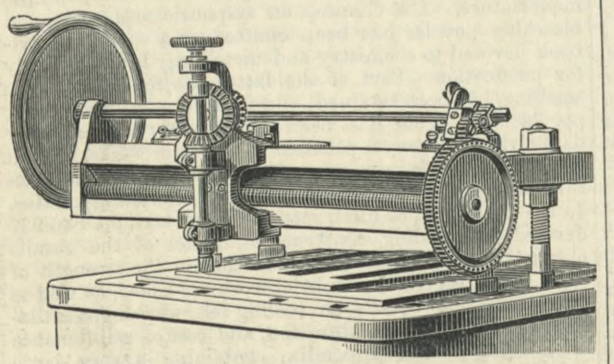
MESSRS. CRAVEN BROTHERS, MANCHESTER, ENGINEERS.



RECENTLY our Lancashire correspondent, in his "Notes" from that district, referred briefly to several special machines he had an opportunity of inspecting at the works of Messrs. Craven Brothers, of Manchester, and we now give an illustration of one of these machines, made by this firm for the Midland Railway Locomotive Works at Derby, where, we understand, it has given very satisfactory results for the special purposes for which it has been designed. The machine, which is constructed for drilling and tapping the roof bars of locomotive boiler fire-boxes, has seven spindles, 8½in. centre to centre, and each spindle is balanced by a weighted lever, with a handle to each, projecting in front conveniently for the attendant. The spindles are driven by bevel and spur wheels, with pulleys on each end of the shaft, one with an open and the other with a cross belt. The roof bar to be drilled is fixed in a trough under the spindles, which is filled with lubricant for drilling and tapping; the table and the trough are raised by a self-acting motion, at the proper speed for drilling, and there is also an independent raising and lowering motion, at a quick speed, by strap power, to take out or put in the roof bar. After the seven holes have been drilled, the drills are taken out of the spindles and taps substituted for them, when the seven holes are tapped. The spindles being balanced, and moving freely through the bearings, the attendant forces down the spindles by the levers in front to start the taps, which feed themselves down by the pitch of the thread. When the taps have got to the required depth the attendant reverses the spindle by moving the strap bar by means of the lever placed in the front of the frame, and the spindles being driven by an open and cross belt they are readily made to run in either direction. The drilling and tapping of the seven holes having been completed, the roof bar, by means of a screw, is moved 4¼in. endways, and the operation, as described above, is repeated for drilling and tapping seven other holes, the fourteen holes when finished having a uniform pitch throughout of 4¼in. The roof bar is held in the trough by the set screws at the sides and ends; when drilled and tapped these are unscrewed and the table lowered by the independent motion. Two spindles fixed on the bed plate pass through the bottom of the trough, and by lowering the table these spindles come in contact with the roof bar and raise it out of the trough.

FLANDERS' STEAM CHEST SEAT MILLING MACHINE.

THIS machine is a companion to the valve seat rotary planing machine illustrated in our impression for January 12th. It is claimed to be the only tool ever adapted to supersede the slow and expensive operation of cutting a groove in the surfaces joining the steam chest seat, with hammer, chisel, and file. It will do the work perfectly, and in one quarter of the time now

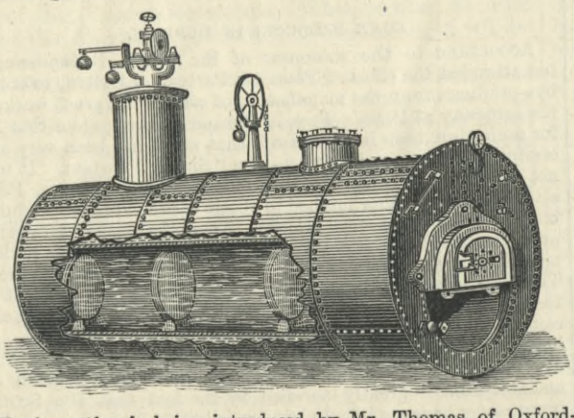


required, without skilled labour, by hand or power. Persons experienced in American locomotive and engine repairs are aware that the surfaces forming the joint between the steam chest and the cylinder become so badly corroded as to cause a leak. It is customary, in order to secure a tight joint for the steam chest where the iron has become corroded, to cut a groove the width of the steam chest sides and then to drive into or fill up the recess or groove thus formed with a brass or copper strip. It has been found impossible to make an even and true surface for the brass or copper joint to rest upon when using the only accessible tools, *i.e.*, the chisel and file. Hence, it is evident that a tool performing this species of repair work satisfactorily and cheaply, will not only save money to its users, but will commend itself solely on its own merits. This machine is also adapted to the drilling either of new holes for studs or the drilling out of old studs when broken off. It is also used for milling out the parts on new work, and for repairing same when eaten away.

It is supported and adjusted to the surface to be grooved or milled by four studs running through two hollow arms, which in turn support the V's or slide. This slide carries a head containing a spindle similar to a drill press, and this head receives a transverse movement by means of the screw, as shown, the milling spindle being driven by bevelled gears and a transverse shaft. The cutting or grooving is performed by a face milling cutter inserted in the end of the spindle, and is fed up and down by means of a screw and small wheel, and when the proper depth for a cut is reached the horizontal movement of the spindle is prevented by means of a check nut on the small screw. The sliding or tool head is fed in either direction by means of change feed gears at the end of the screw, and in case of drilling a hole or milling down to the desired depth of a groove the head can in a moment be made independent of the transverse feed screw, while the spindle is rotated by the driving shaft. But two settings or adjustments of the machine are required for all four sides of the steam chest seat, because, when the groove is finished on the outer side of the valve face, all that is required is to loosen the top nuts on the studs supporting and passing through the arms, lift up the machine and replace it facing the boiler, when, having been secured, work can be resumed. The same applies to the other sides, the forward and back ends; having set it for one and finished the cut, turn the machine about and replace it on the same studs.

GOSLING'S FUEL ECONOMISER.

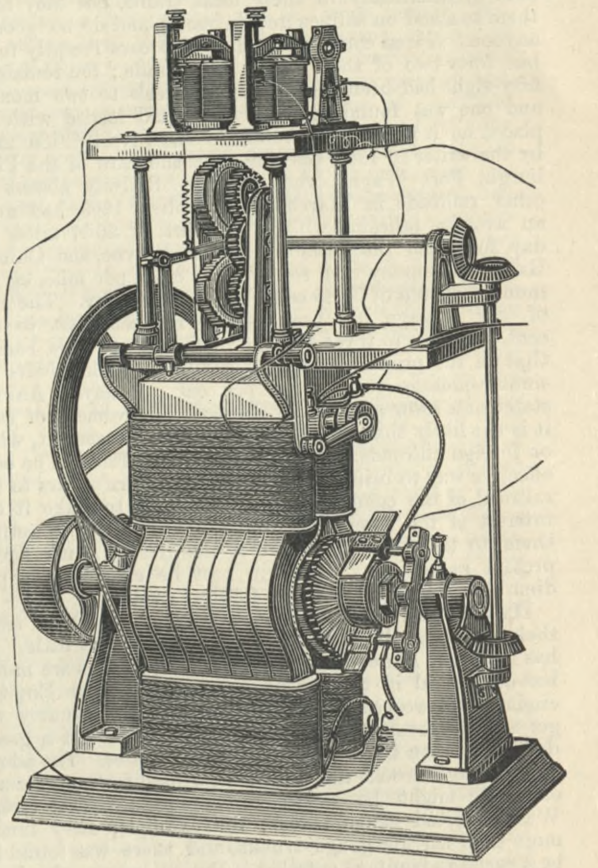
THE accompanying engraving explains itself. The invention consists in placing discs in the flues of stationary boilers to compel the gases to strike against the sides and top of the flues.



The invention is being introduced by Mr. Thomas, of Oxford-road, Manchester. It has, we understand, been fitted to a considerable number of boilers, and is giving great satisfaction.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

THE accompanying engraving illustrating a regulator for dynamo-electric machines, has been patented in the United States by M. Hiram S. Maxim, of Paris. The inventor claims the combination, with a dynamo-electric machine, of brushes arranged to revolve about the commutator, a system of gears for shifting the brushes, a reciprocating lever or pawl arranged to impart movement to the gears in either direction, and an electro-magnet controlling the position of the reciprocating pawl, all substantially as set forth. The combination, with a dynamo-electric machine, of brushes arranged to revolve about the commutator, a system of gears for shifting the brushes, a rock shaft oscillated by the armature shaft, a lever or pawl for imparting movement to the system of gears in either direction, connected with and reciprocated by the rock shaft, and an electro-magnet for controlling the position of the reciprocating pawl, all substantially as herein set forth. The combination, with a dynamo-electric machine, of brushes arranged to revolve around the commutator, a system of gears for shifting the same, a rock shaft and connecting gear between the same and the armature shaft, the said gear being constructed to reduce and convert the movement of the armature shaft, as described; a lever or pawl reciprocated by the rock shaft and arranged for engagement with the brush-shifting gears, and an electro-magnet for controlling the degree of elevation of the pawl,

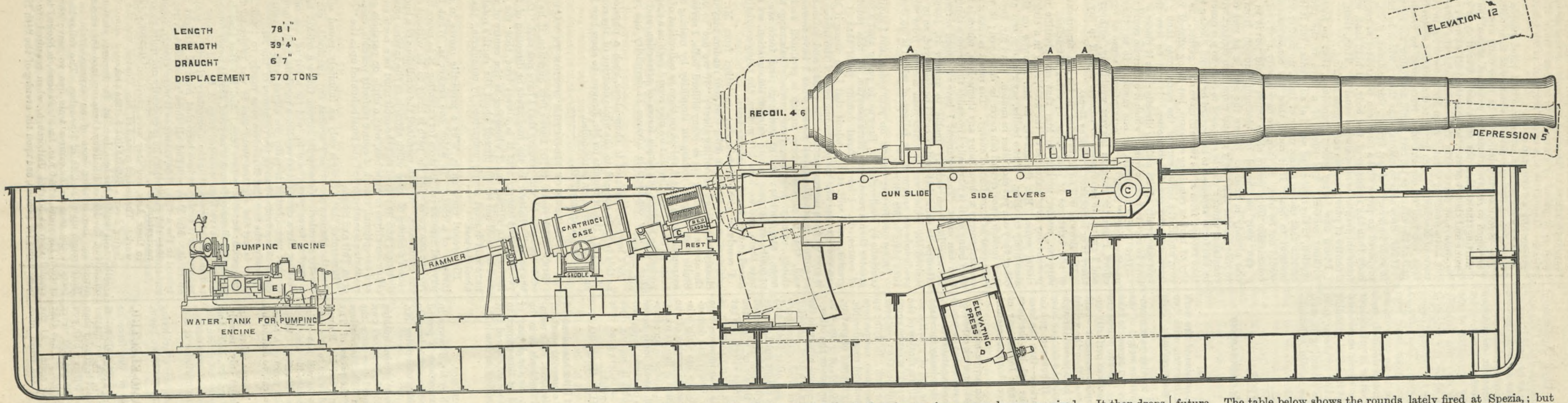


whereby the brushes may be turned in either direction, as and for the purpose set forth. The combination, with a dynamo-electric machine, of a bed-plate secured to the field magnets, a brush-shifting mechanism mounted on said plate, gearing with a revolving brush-holder, a second base or plate supported by standards above the first, electro-magnets mounted thereon, and connections from the same to the brush-shifting mechanism, these parts being constructed and combined in substantially the manner described. The combination, with a dynamo-electric machine and regulator, substantially as herein described, of a normally-open shunting circuit around the field of said machine, and an electro-magnet in a circuit derived from that of the machine, constructed or arranged to close the said shunt circuit, substantially as set forth. In a regulator for dynamo-electric machines, the combination, with a reciprocating pawl and electro-magnet controlling the same, of ratchet wheels formed as described, a revolving brush-holder, and a system of gears between the holder and the ratchet, substantially as set forth.

STEAM POWER ON TRAMWAYS.—Correspondents are writing to the *Leeds Mercury* complaining that, though steam power on tramways is necessary to relieve horses of the fearfully heavy work of ascending Headingley-road, Leeds, and perhaps necessary that tramways may in future be enabled to pay at all, the engines should be made so that they do not eject showers of sparks which would be the cause of fearful accidents if they alighted on some horses' backs, and perhaps worse still if, as ascending the hill with a heavy load, the heavy sparks then thrown out were to alight on loads of hay or more combustible material. The Leeds people are of a practical turn of mind, and accept the inevitable adoption of mechanical power in some form or other with a good grace; but they do not like showers of heavy sparks from tramway engines.

THE MANCHESTER SHIP CANAL.—The decision in this case was given on Tuesday by Mr. Frere, one of the examiners, before whom it as argued on Standing Orders. Petitions have been presented against the Bill alleging that the promoters had failed to comply with the Standing Orders, inasmuch as they had neglected to deposit the necessary plans and sections relating to a low-water channel and other works, and had not made the parliamentary deposit of 4 per cent. The promoters replied that they were not in a position to fulfil these requirements, and stated that their Bill was a "second-class Bill," and one in which, as they took general powers, it was not necessary to specify the exact details. Mr. Coates—Dyson and Co.—represented the promoters; and Sir Theodore Martin, Mr. Pritt, and Mr. J. C. Rees appeared for the petitioners. Mr. Frere, in giving his decision, said that the allegation in the memorials against the Bill stated that the Standing Orders had not been complied with, inasmuch as no plan or section of the low-water channel had been made or deposited. This channel was several miles in length, and it was proposed to construct it in a permanent manner, and with a depth and capacity sufficient to enable ships of a large tonnage to go up to a point on the Mersey where there was no water at low tide. This was acknowledged by the promoters as well as the petitioners to be a work of magnitude and importance such as was rare even in the present day. It was a work of which plans and sections ought *primâ facie* to be deposited. The arguments of Mr. Coates were two-fold. First, he had called attention to the provisions of the Mersey Conservancy Acts, that the conservators had powers to dredge and deepen the channels of the river, or to authorise the same to be done; and, therefore, that this was not a work beyond the powers so given to the conservators. Mr. Frere considered, however, that the work proposed was beyond the powers of the body to whom the conservancy was intrusted. Though the Commissioners had power to deepen and widen the channels of the river for the purpose of maintaining the existing navigation, such a work as was now proposed was not contemplated in their Acts, and they were provided with no funds for such a work. The second ground of Mr. Coates was the impossibility of laying down a definite line for the proposed channel, and of giving plans and sections. He—Mr. Frere—had no doubt that before this portion of the scheme was brought before Parliament plans and sections of the works proposed ought, in compliance with the Standing Orders, to have been deposited, and that the estimate of the cost and the deposit of 4 per cent. on that estimate should have been made. Mr. Frere then said that he would report the case to the House. The Bill will come on appeal before the Standing Orders Committee at its first meeting.

THE HUNDRED-TON ARMSTRONG BREECH-LOADING GUN.



In our number of December 1st last we gave the highest result obtained with the new 100-ton breech-loading gun on its first trials at Spezia. We then mentioned that it had discharged its projectile, weighing 2000 lb., with a velocity of about 1834ft., giving 46,640 foot-tons energy, or exactly double the quantity of stored-up work obtained with our 43-ton gun. We now give a drawing of the gun and carriage, showing the loading arrangements, which have worked admirably. We look upon this as a question of special interest. The medium guns, owing to their small bore and high velocity, have great power of perforation, and produced great results against iron armour; but the advantage of a small bore must be lost when hard armour comes in which cannot be perforated, but which can only be destroyed by shattering. Against such armour large guns with a large amount of stored-up work must tell most. The working of such guns, therefore, is one of the principal mechanical questions of the day. With the drawing herewith we quote a description from the *Times*, December 11th, which was written by an excellent authority and on the spot, but which cannot in the nature of things convey a very definite impression without a figure. The table of velocities and pressure speaks for itself; 16·5 tons is a very moderate pressure for the result obtained. This, indeed, coupled with the stored-up work, supplies us with the chief information as to results. It is said that the gun may be shortly fired against the Schneider steel plate that was lying on the shore awaiting its turn to be mounted and tested. Nothing, however, really depends on this, for the destruction of shields by shot is a test for the shot and the armour rather than the gun. The powers of a gun are, of course, known directly we know the velocity and weight of the projectile it is capable of discharging. The strain to which it was subjected in accomplishing this is told by the pressure, and what afterwards happens to the shot does not affect the question more than the result obtained by any similar projectile, and belongs to another branch of investigation. As a matter of fact this gun is capable of destroying 18in. of armour with such ease that it would only tend to mislead as to its powers to connect the two together. It might be interesting to try whether a very heavy projectile fired at a proportionately low velocity would wreck the plate on a large scale owing to the work being distributed, but we have not heard of anything of this kind, and, as far as we know, the firing at the Schneider plate is a test of plates and projectiles only. The description of the mounting and working of the 100-ton breech-loading gun is as follows:—

The usual trunnions are entirely absent. The gun lies embedded on a sort of sledge carriage, which is a mass of steel, weighing about 14 tons. Projecting rings A A A, which form part of the gun, rest in grooves, and prevent any backward or forward motion of the piece on the carriage, and rotary motion is prevented by strong steel straps. Thus the gun and carriage are securely bound together, having their axles parallel, and recoil together in the same direction. The carriage rests and slides upon the planed surface of two cast steel beams or side levers, B B, of about 10 tons weight each. They are held together by the recoil press, and their front ends pivot vertically on a massive hinge C. Thus the axes of the gun, the carriage, the recoil press, and the slide are all parallel, whatever the elevation, and the difficulty of restraining the rotary motion caused in other systems by recoil is completely got rid of. The whole weight is taken by two powerful hydraulic presses D, which work always together, being acted upon by one common supply pipe. If the muzzle of the gun is to be elevated the hydraulic rams sink, and the slide, pivotting on its front end, is lowered in rear, carrying with it recoil press, gun, and carriage. The reverse takes place when the gun is to be depressed. By this simple arrangement a host of difficulties are at once eliminated, and some terrible strains removed from the system. And not only is there the advantage of harmonious recoil, but the pivoting on the end of the slide enables the gun to be fired through a very small port, which it would fill almost completely. This is an improvement on the Inflexible, where it has been found necessary to attach to the muzzle of the gun a steel shield, formed of 2in. bars, to guard the port from the fire of rifles and machine guns.

The loading arrangements are also extremely simple, and present some features of novelty besides the mere fact that the gun is loaded at the breech. With the exception of bringing up the ammunition and ramming, which are performed by another hydraulic apparatus, the whole business of opening and closing the breech is performed by two levers close together, which are worked by one man. He cannot make a mistake, for nothing can be moved out of its proper order, and whatever position a lever may be in at the end of its last movement, the next act is performed merely by pushing or pulling the lever to the opposite side. One pair of levers works the whole breech-closing apparatus, prepares the gun for loading, or opens the breech after discharge. Another pair of levers runs the gun out and in, and elevates or depresses it. It is impossible to run it back or forward too far, and the whole mighty mass of metal may be managed by the hand of a lady, who cannot possibly make a mistake. If she touches a lever it must be to pull it back or thrust it forward from the position in which it then lies, and no movement that can be made will set anything wrong. All the movements involved in opening the breech, withdrawing the breech screw, replacing and closing the breech, can be performed in less than one minute. No damage can be done in the heat of action, and the gun cannot be fired till the operation of loading and closing the breech has been completely performed. The whole process seems like magic, so simple is it, so easy, and so certain. The most inexperienced person can learn the movements in five minutes.

The hydraulic pumps are worked by a small steam engine E, which is governed in its rate of work by the pressure of water produced. It never ceases work, but when no movement is required of any of the parts its action is feeble and only keeps up a certain normal pressure. But if any motion of the system is required and the touch of a lever opens the way for water to create that motion, the engine instantly sets off briskly and continues to act till the cessation of movement tells it that its services are no longer required. It then drops back at once to its slow and feeble action. The engine is seated on a tank F, from which the pumps draw their water, and to which the water is returned after being exhausted from the various cylinders and pipes. Behind and across the breech of the gun, but entirely separate from it, is a slide bed similar to that of a lathe, and on this bed moves a saddle which carries the loading tube and a rest for the breech screw when drawn out of the gun. Now let us suppose that the gun has been fired and requires to be loaded. By touching the levers for elevating and running back, the gun is brought into the loading position exactly. It cannot go too far in either direction. A touch on another lever brings the saddle into its proper position, unlocking and turning the breech screw as it comes. A touch on the third lever brings up a piston from the rear and makes it engage a catch in the breech screw. The same lever moved in the opposite direction draws out the breech screw upon a bed made to receive it on the saddle G, which is then drawn out of the way by a reverse movement of the lever which brought it up. As the saddle moves sideways, that part of it containing the loading tube comes into position exactly behind the rear end of the bore. The small piston which withdrew the breech screw now pushes the loading tube into the gun, the object of the tube being to protect the threads of the female breech screw from abrasion by the shot. All is now ready for loading, which is performed as in the muzzle-loading 100-ton gun. The projectile and its two half-charges are always kept ready on trolleys, which rise by hydraulic pressure from their places in the magazines, and arrive between the hydraulic rammer head and the breech of the gun. Other levers thrust them forward into their places; the loading tube is withdrawn and the breech closed by a reversal of the different movements just described, which do their work more quickly than the description of their action can be read. The breech of the gun cannot be moved till all is complete, and the piece cannot be fired unless the breech is accurately closed and locked to prevent its opening.

When mounted in the Italia and Lepanto, for which they have been designed, these 100-ton breech-loaders will be *en barbette*—that is, they will be elevated so as to fire over the top of the battery, as in the French ships, but there will be this advantage, that, whereas in French men-of-war the men working the gun are exposed to the fire of small arms, machine guns, and shrapnel, not a single man will be exposed in the Italian ships. The whole of the machinery, which—though elaborate to describe, is simple and massive in reality—will be under an armoured deck. The only break in protection by the deck is the portion through which the rear part of the gun descends, and that will be covered by the mass of metal above it composing the gun.

Having now described the gun, the method of mounting, and the process of loading, it remains to tell what the piece has actually done and to explain why such huge wea: ons are required for the ships of the future. The table below shows the rounds lately fired at Spezia,; but it should be remarked, first, that the strength of the gun is calculated to bear with safety a pressure of 29 tons per square inch, while the highest yet reached is only 16·5 tons; secondly, that though the greatest charges ever yet fired in a gun have now been much exceeded, the powder chamber has room for a much larger charge than any used at Spezia; and, lastly, that there is an evident intention on the part of the Italians to try even more powder, experimentally at any rate. Indeed, it is not improbable that they may, as they did with the muzzle-loading 100-ton gun, increase the charge till it passes the limits of safety, for the sake of experiment. Such a course would be interesting to scientific artillerists, but might damage the confidence of the Italian navy in its guns, and the Italian people in their navy. It is also probable that the breech-loader will be fired at the Schneider steel plate, which is still untouched.

No. of round.	Powder charge.		Projectile weight.	Velocity—feet per second.	Pressure in bore of gun—foot-tons per square inch.
	Weight.	Description.			
1	496	Fossano	—	1433	10·9
2	551·2	Do.	—	1496	11
3	551·2	Do.	Chilled 1974	1512	11
4	606·3	Do.	Do. 1942	1593	11·35
5	606·3	Do.	Do. 2001	1609	11
6	661·4	Do.	Do. 2005	1676	12·5
7	661·4	Do.	Do.	1686	12·4
8	716·5	Do.	Do.	1767	13·6 14·1
9	771·6	Do.	Do.	1833	16·5
10	716·5	Do.	Do.	1761	14·5
11	496	Prismatic	Do.	1423	9·3
12	551·2	Do.	Do.	1506	10·4 10·3
13	551·2	Do.	Do.	Not taken	11·6
14	771·6	Fossano	Do.	1831	16·4
15	606·3	Prismatic	Do.	1607	12·8 12·5
16	606·3	Do.	Do.	Not taken	13·5 13·6
17	716·5	Fossano	Do.	Do.	13·8 13·7
18	771·6	Do.	Do.	Do.	15·9 16

With regard to the preceding table, it is to be remarked that both Fossano—Italian—powder and prismatic—German—powder were provided for the experiment, but, finding that there was little to choose between them, the committee decided to adhere to their own explosive. Rounds 13, 16, and 18 were fired with almost the full elevation possible, namely, 11 deg. 50 min., and therefore did not register their velocity because they passed over the screens instead of through them. The range out to sea was evidently enormous, but formed no part of the test trial, and was therefore not measured. The shot was 18·4 sec. in the air before touching the water. Round 17 was fired with almost full depression, namely, 3 deg. 50 min., and plunged into the sea below the screens, throwing up a magnificent column of water about 100ft. high.

The results of these experiments have shown that guns weighing 100 tons can be manipulated with greater ease by means of hydraulic power than the 12-ton 9in. gun without it. The whole apparatus takes up very little room, and is perfectly simple in its character. There is no reason why a gun of 150 or 200 tons should not be manipulated with equal ease.

LOCOMOTIVE ENGINES—DANISH STATE RAILWAYS.

We illustrate this week a standard passenger train locomotive for the Danish State Railways, six of which have been working for about four months, and given every satisfaction. The designs were prepared in the office of Mr. Otto Buss, locomotive superintendent of the line, at Aarhus, and the locomotives were built to them by Herr Borsig, in Berlin. The execution of the workmanship is excellent in every respect, and does high credit to the builder.

The weight of the engine empty is 28·8 tons, in working order 31·6 tons, *i.e.*, 19·6 tons on the coupled wheels and 12 tons on the truck, which latter is constructed on the Pennsylvanian system. The weight of the truck is 2·9 tons. The weight of the tender with 7 tons of water and 3 tons of coal is 19 tons. On a trial trip one of the engines hauled ten carriages, the total weight of which was 91 tons, a distance of sixty-eight English miles in one hour and forty-five minutes, three stops excluded, a speed of about thirty-eight miles an hour, with perfect ease, though this line has long and sharp curves, and many gradients 1 in 100; the longest of the latter is full five English miles in length. The engines have been tried several times at a speed of sixty English miles an hour, and proved to be very steady. We give the following dimensions in English measure:—Grate area, 14·04 square feet; heating surface, fire-box, 76·1 square feet; 140 tubes, 1⅞in. outside diameter, 707·5 square feet; diameter of driving wheels, 5ft. 6½in. English; diameter of truck wheels, 2ft. 6½in. English; rigid wheel base of engine, 8ft.; total wheel base of engine, 21ft. 5in.; total wheel base of engine and tender, 37ft. 8in.; diameter of cylinders 16in., stroke 22in.; boiler pressure, 142 lb. per square inch. Both engine and tender are furnished with Hardy's continuous vacuum brake, which has given every satisfaction on the Danish lines. The tender is carried on two axles with a wheel base of 9ft. 10in., its length being limited by the turntables.

We are indebted to Mr. Bass for the drawings from which our engravings have been prepared, and for the preceding information.

FOUR FORTHCOMING AGRICULTURAL EXHIBITIONS.

We have before us particulars of four important forthcoming agricultural exhibitions, all of either a national or international character, and it will doubtless be serviceable to many readers if we here place on record some information concerning them. We take them in the order in which they will be held.

First, then, comes an exhibition fixed to take place in Lisbon in May next, under the auspices of the Central Portuguese Agricultural Association, and under the presidency of his Majesty Don Fernando. In the programme, which has only just come into our hands, we notice that the chief objects include the selection of the best ploughs for the culture of the vine, and that trials will be held of machinery, &c., used in the production of wine and butter, in harvesting, thrashing, or grinding corn, in raising water, &c. Live-stock, and every species of agricultural and horticultural produce will be exhibited, as well as native and foreign agricultural machinery and implements, harness, &c. The exhibition of live-stock will last one week, but all other exhibits, except those of a perishable nature, will remain on view for two months. As regards the premiums offered for competition, we have no knowledge, but we believe that this information, together with fuller details, may be obtained from the secretary to the Royal Central Portuguese Agricultural Association, Rue do Principe, Palacio do Dugue de Cadaval, Lisbon, to whom applications from intending exhibitors must be addressed before the end of February.

Another exhibition which is likely to attract a number of British agriculturists, is that announced as an International Colonial and General Export Exhibition to be held at Amsterdam, extending from May till October. The programme is one of the most comprehensive which we have seen for a long time, and we can only indicate some of the features which will more immediately interest readers of The Engineer. Passing over the first or "colonial" section, we come to the second, which will comprise articles for export to the colonies and trans-oceanic possessions, arranged in six groups, viz., furniture and upholstery; clothing, linen, and accessories; dietary, chemical products, and modes of packing them; machinery and implements, and means of transport; building, and articles of export exclusively for the use of the native population.

Already great efforts are being made to secure a good representation of English exhibits at the International Agricultural Exhibition to be held at Hamburg from the 3rd till the 10th of July, about a week before the annual show of the Royal Agricultural Society of England, the Council of which have appointed delegates to officially represent them at Hamburg. We are informed that an influential English committee is now in course of formation for the purpose of promoting exhibits being sent from this country. The exhibition was originally announced as one of "animals connected with agriculture," and a general impression has, therefore, prevailed that the show would be confined to live stock. This, however, is an erroneous idea, for the seventh section will consist of stables, fittings, machinery, and implements, arranged in four distinct classes:—(*a*) Arrangements and fittings for cattle in pasture; (*b*) fittings, &c., for use of stalled cattle; (*c*) separate fittings and arrangements for stables; and (*d*) utensils for tending, feeding, and employment of animals. In the last-named class will be found utensils necessary for the tending and feeding of animals in pasture or in stables; veterinary and shoeing arrangements; gearing required for draught cattle and beasts of burden; means of transport, carts, wagons, field tramways; and machines for compressing and baling hay and straw intended for transportation, and for tearing and pressing turf litters. Gold, silver, and bronze medals, and "honourable mentions" will be distributed. "Special honorary prizes" may also be awarded.

Lastly, we call attention to our own Royal Agricultural Exhibition, fixed to be held at York on Monday, July 16th, and four following days. This year there are to be no field "trials" of an important nature, unless there happens to be a vigorous competition for the £25 prize for an efficient portable straw-compressing and binding machine, to be worked in conjunction with a thrashing machine. An interesting competition may, let us hope, result from the offer of £100 "by a member of the Royal Agricultural Society," whose name does not publicly appear, for the best equipped dairies—one where the principal object is butter-making, and the other where the principal object is cheese-making—£50 being offered in each case. There are, in addition, the ten silver medals which in recent years have been annually placed at the disposal of the judges to be awarded in cases of sufficient merit in new implements exhibited, such implements to be shown to be entirely new either in principle or in improvements; and the judges are also, as usual, empowered to make special awards of medals for efficient modes of guarding or shielding machinery, especially when worked by steam, from contact with persons immediately engaged in attending to such machinery while at work. The fees for space remain substantially the same as those in force at Reading.

LETTERS TO THE EDITOR.

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

FLYING MACHINES.

Sir,—The discussion is now reduced to the question of the work done by a bird when hovering. You deal, however, with two points in your remarks—(1) the method of its measurement; (2) its actual amount.

(1) The reason of my having hitherto failed to catch your meaning is now clear. You took, in conjunction with the weight of the bird, its wing velocity; but at the same time you meant to take the hypothetical velocity of the falling bird. The two things are entirely different. The illustration of the boat was perfectly unnecessary to make the matter clear. A simple statement would have sufficed. The work done is, then, rather more than the weight of the bird multiplied by the distance it would have passed through in any given time at the constant velocity attained sooner or later after falling from rest with outspread wings. If, however, you do take the wing velocity—as suggested in your article—then the force to be taken with it is not the weight of the bird, but the force exerted at the centre of pressure of the wing. Either way of treating the matter would be theoretically correct, but not practical—from want of complete data.

(2) But in applying the former method you arrive at a result which I quite fail to understand. You say that the work expended by the bird in hovering will probably be the same that it would expend in flying upwards at the above-mentioned constant velocity. Now the bird in falling from rest would have its velocity increased until the resistance of the air just equalled the pull of gravity, w. This is proved by the fact that to ensure the uniform motion of the falling weight in Atwood's machine the other weight must be equal to it. The reaction of the cord in this case supplies the resistance to the falling weight which the air does to the bird. In flying up at the constant velocity, there would be a resistance, not perhaps quite so great as in falling with spread wings, but still considerable. Let this be w_1. But in hovering evidently only the pull of gravity, or w, acts on the bird. Thus you appear to say, $w + w_1 = w$. There are here decidedly mistaken views on one side or the other.

In conclusion, I may point out that you do not allude to the question of soaring. All that you say refers to a bird hovering without motion—as a whole—relative to air or wind, either horizontally or vertically. To judge from hawks and other birds, this latter requires considerable effort. The whole weight must, we are quite agreed, be supported. Not so with soaring; this is effected when either the bird is in motion through the air or when the wind effects the same result with a minimum of effort. What action supplies the small force that, as shown by my diagram, is necessary, is not well understood. Probably it is an imperceptible wave action of the flexible wing, which Mr. Breary has demonstrated, does take place, and which Dr. Pettigrew has fully discussed. Some explanation is needed of the graceful soaring of the albatross, which for hours together scarcely deigns to flap its wings, or the still more majestic flight of the gigantic condor in an atmosphere less than half as dense as that in which small birds hover with such apparent labour. Until this fact is otherwise explained most people will continue to think that the bird in soaring does derive assistance from the air, and will refuse to believe that it is only upward currents which aid to sustain its weight.

University College, Bristol, January 23rd. H. S. Hele Shaw.

[We fail to see that Professor Shaw's present letter has advanced matters in any way. Apparently he gives up the hovering question, and concedes that he does not know how birds hover. We maintain, as we have done from the first, that all that birds do in the air they perform by violent muscular effort, for the display of which they are specially constructed. It will be time enough to discuss other matters, such as soaring, when we are assured that our correspondent has given up the hovering problem as insoluble. Let us discuss one thing at a time.—Ed. E.]

THE PRINCIPLES OF MODERN PHYSICS.

Sir,—That you regard the subject dealt with by Mr. Browne in your last impression—page 38—as possessing importance is proved by the space you have given to it. I am therefore emboldened to hope that you will permit me to say something concerning Mr. Browne's view.

With his criticism of Mr. Stallo's book I have at present nothing to do. I shall confine all that I have to say, to Mr. Browne's own theories. It will be seen that he has advanced once more the view he put forward in the series of papers on "The Foundations of Mechanics," which appeared last year in the pages of The Engineer. I attacked these views at the time, and Mr. Browne having replied to my criticisms in what seemed to me to be a very inadequate way, retired from the field. I hope he will not retire this time, but will feel bound either to substantiate his assertions or acknowledge that he is wrong. Nothing else will suffice. When a man advances a theory at great length in the pages of a scientific journal, he is bound, I think, by all precedent, to defend his theory, or confess that he has been mistaken.

I hold with the German school to which Mr. Browne refers, that in the universe we have to deal with two things only, namely, matter and motion. Mr. Browne, as I understand him, holds that we have to deal with nothing save force and space, attraction and repulsion. He substitutes for matter aggregations of force centres, and motion he regards not as an entity, but as an attribute or condition.

Now, I contend (1) that an isolated force is incapable of achieving anything; (2) that no force can be exerted, so far as we know, without motion.

The reason why an isolated force can achieve nothing is that the resistance is invariably the measure of the force *as regards the resistance.* Thus, suppose we have a force x operating on a body y, whose resistance to the force $x = z$, then no matter what the amount of x may be, its effect on y cannot be greater than z. I have urged this view on Mr. Browne in letters which you have done me the honour to publish, and Mr. Browne has never advanced a single argument to confute my assertion. What that assertion means I have explained over and over again. At the risk of being wearisome I give illustrations of the truth once more. There cannot be a greater pull at one end of a rope than there is resistance at the other. A mass of matter falling to the earth is impelled by gravity with no more force than it resists gravity. The thrust of a screw propeller is no greater than the resistance of the ship, and so on.

It is an unfortunate circumstance that most people regard this proposition as stating something contrary to their daily experience, or rather to what they believe to be their daily experience. They will argue, How can a train be propelled unless the pull of the engine is greater than the resistance? Yet if you point out to them that it is not greater, because the pull at one end of a draw bar cannot be more than the resistance at the other, they yield you but a doubting assent. Even Mr. Browne has in his "Foundations of Mechanics" been driven to commit the absurdity of stating that the pull at one end of a trace must be greater than the pull at the other, or the cart would not follow the horse!

If Mr. Browne is to maintain the theory which he has laid down in your impression of last Friday, third column, p. 38, he must be prepared to prove that a force can be greater as regards a given body than the resistance of the body. I hold that, whatever the force the resistance must always equal it. Thus, then, we see that a centre of pure force can accomplish nothing.

I turn now to my second proposition, that no force can exist without motion. The effect of a force is the production of motion, in the mechanical world at all events; but it it absolutely certain that matter cannot move of itself, no matter what force is brought to bear. If it could then the conservation of energy would not be true. If, then, we have a body x at rest, there is no conceivable force centre alone which could put it in motion, for x can only be moved by obtaining motion from something else already in motion. Before the body x at rest can be made to move, some other body y must come into contact with it. The resistance which x may be supposed to offer to y is exactly balanced by the force supposed to be exerted by x, and y being then free to take motion from x, the two will move on together, the total quantity of motion remaining constant, but being shared between the two, and if the bodies were of the same mass then y would take from x exactly one-half its motion. It will be seen that force in this case really effects nothing directly; but it places y in a condition to receive motion from x which it otherwise could not do.

Here I wish to digress for one moment to say that although I use the word "force" in its conventional sense as expressing an effort, I use the word, as lawyers would say, without prejudice, and I am not to be supposed to commit myself to say either that there is or is not such a thing as force.

Mr. Browne will no doubt bring up his old argument in favour of the existence of pure force by citing attraction. It will, I suppose, matter nothing to him that no scientific man in the present day ever makes use of the word, save in a strictly conventional sense. But the answer to Mr. Browne on this point is absolutely crushing. If two bodies, say x and y, can attract each other they can put each other in motion. But Mr. Browne knows that motion once created can never be destroyed; it will always re-appear as some form of energy. The result is that x and y have created energy without losing any themselves, which is impossible. This being so, it is physically impossible that such a thing as attraction can exist. This argument I have advanced before, and Mr. Browne has been entirely unable to answer it, though he did attempt to show that motion could be destroyed, as in the case of melted ice, which was no hotter than the ice from which it was produced—an argument the fallacy of which is no doubt by this time plain to Mr. Browne.

I must not further trespass on your space, and I shall therefore conclude by challenging Mr. Browne to prove that a force can be greater than a resistance. Mere assertion on this point will not, of course, do. I have offered definite proof that it cannot be greater, and I will at once admit that I am wrong if Mr. Browne can prove to me that the pull on one end of the tie-bar of a train is greater than the resistance at the other; and to make matters as simple as possible, I shall repeat what I have more than once said, that in all cases where motion is produced we have three things, namely, resistance, force precisely balancing that resistance, and motion; and as resistance and force are equal and opposite, and appear on both sides of the equation, we may eliminate them, and we have left motion, the thing sought to be produced in the case of the railway train.

I conclude with the following quotation from Mr. Browne's criticism on Mr. Stallo, in order that your readers may understand clearly what it is I am writing about: "If we are to conceive of the atoms as nothing but so many billiard balls, I agree with Mr. Stallo that we gain nothing in simplicity by making those balls extremely little; but if we look on them as collections of centres of force so bound together that we may regard each as a single centre, possessing nothing but simple forces of attraction and repulsion, then a very considerable advance in simplicity has really been attained."

As I have endeavoured to show above, such a physical concept as this is flatly opposed to the whole doctrine of the conservation of energy; it now remains for Mr. Browne to show how his theory and this doctrine can be reconciled. Φ. Π.

London, January 20th.

THE LAWS OF PROJECTILE MOTION IN VACUO.

Sir,—With regard to Mr. Dare's first question, if he reads my sentence again he will perceive that I have not said "the result is the same" whatever be the magnitude or direction of the initial velocity; but simply that it is always true that the projectile moves in an ellipse, one of whose foci is the centre of the earth. And he need not trouble himself about the earth's rotation; all I have said is most simply understood by considering the earth at absolute rest.

His second question is, Why a projectile moves in an ellipse instead of a circle? To which one answer is, What but metaphysical reasons can be given for expecting it to move in a circle? No one can guess what the path is likely to be without examining the conditions. Newton examined the conditions of a body moving round a centre of force which attracts as the inverse square of the distance; and he proved that the orbit must be a conic section, *i.e.*, either an ellipse or hyperbola, with a circle or parabola as limiting and exceptional, though of course perfectly possible, cases; but the reasoning is mathematical, and must be hunted up in the "Principia," or in Tait and Steele.

Remember that a circle is only an infinitely round ellipse, and that the chances are ∞ to 1 against any particular ellipse being exactly circular. Moreover let anyone throw a cricket ball, or use a garden force pump, and he will *see* a bit of the orbit; it is nothing like a circle; it is very like a parabola, and commonly goes by that name, but it is really an ellipse with the centre of the earth as one focus—barring the resistance of the air.

Lastly, the fact that B revolves so as nearly to touch A at one point is not the slightest proof that it was projected from A at that point; but it may have been. And the fact that B revolves at a great distance from A is no proof that it never formed part of A; it may have been separated from A by all manner of causes not taken into account in the elementary theory of projectiles in vacuo, but it could not have been shot from A straight into such an orbit. Mr. Dare will find all these statements virtually contained in the article, if he examines it more closely, together with some other things on which he is evidently not quite clear yet.

January 20th. Oliver J. Lodge.

CONTINUOUS BRAKES.

Sir,—An inquiry has been held at St. Pancras station by the officials of the Midland Railway Company into the circumstances attending the breaking loose of an express train at Market Harborough upon the 24th of November. The following are the facts of the case:—The express train due to leave the central station, Liverpool, at 4.5 p.m. for St. Pancras, is booked to make a special stop at Market Harborough, when required, to take up passengers for London, and upon the evening of the 24th November this extra stop was made. The express was drawn by two engines, Nos. 822 and 1478, both fitted with steam brakes upon the coupled and tender wheels; the vehicles composing the train were fitted with the Clayton modification of the Sanders-Bolitho vacuum—generally known on the line as the two-minute brake. The brakes were applied in the usual way to stop at Market Harborough. When the train was coming to rest the passengers in the rear vehicles felt a very severe jerk; nothing serious, however, was apprehended, and as soon as the station duties were complete the signal was given and the train started, no one being the least aware that the jerk felt had broken the screw coupling between two vehicles. The driver of the second engine finding that he could not maintain any vacuum, wisely decided to stop at Desborough to examine the brake. It was then found that the coupling was broken, the hose-pipes of the Clayton so-called automatic vacuum brake were pulled apart, and that the rear portion of the train was simply hanging by the side chains extended to their full length. The passengers in the rear carriages were naturally much alarmed when they found that they had run a distance of about five miles and ascended the well-known Desborough Bank, which is a gradient of 1 in 132, with side chains only; had these chains also given way a very serious accident might have followed. The guard's van in the rear was of course provided with the two hand scotches, as recommended by Messrs. Bramwell and Cowper in their report upon the Sanders and Clayton brakes, dated May 3rd, 1881, but it is very doubtful indeed if there would have been time to use the scotches before the rear part of the train might have run back down the incline.

The Clayton brake is said to be automatic, but the fact that a train left a station and ran for about five miles with a broken coupling and the hose pipes pulled apart, and yet that the brake did not stop the train, proves it was not self-acting in case of accident, and that it does not fulfil the conditions of the Board of Trade. Most certainly any system of continuous brake which leaks off in less than two minutes cannot be considered either efficient or safe.

In my letter which appears upon page 390 of your last volume, attention is directed to the fact that the Midland Company does not make a correct return of the failures of this particular brake, and at the present time a very strong feeling exists at Bradford in favour of petitioning the Board of Trade to appoint an inspecting officer to hold an inquiry into the circumstances attending a collision between a passenger train and the buffer stops at that town. The inhabitants state that on the 27th June, 1882, an express train drawn by engine No. 174, came into violent collision with the buffer stops at the Midland station, Bradford. It appears the engine had a steam brake upon the coupled and tender wheels, and that all the vehicles had the Clayton vacuum brake. The cause of the accident was "the failure of the brakes to stop the train when required," the result being that many of the passengers were severely shaken. The railway company's officials held a private inquiry, but the inhabitants very justly say that as this accident was quite as serious, and of the same class as those at Portskewet pier and Liverpool Central station, it deserves as much attention and public investigation.

This Bradford collision does not appear in the "Returns of Accidents during the six months ending June 30th, 1882," nor is the failure of the vacuum brake recorded in the "Continuous Brakes Return" for the same period, and as the case was not reported, no inspecting officer of the Board of Trade held any inquiry into the circumstances.

If the "Returns" are to be of any real value some steps will have to be taken to compel certain companies to furnish correct information. CLEMENT E. STRETTON.

40, Saxe Coburg-street, Leicester,
January 20th.

THE PREVENTION OF SCALE IN STEAM BOILERS.

SIR,—In your article last week you recommend the use of pure caustic soda. Will this have any effect on the boiler fittings made of brass? For a long time I used a mixture of oak bark and 70 per cent. caustic soda. This prevented the deposit of scale, but had such a destructive action on the plugs of the water gauge taps, that I had to give the mixture up. A reply through your paper will greatly oblige H. M.

Widnes, Lancashire, January 22nd.

[Caustic soda, if used in excess, may cause trouble with brass fittings, but we have never heard any complaints when it was employed with due caution.—ED. E.]

SIR,—Referring to an article in your issue of Friday, 19th inst., on "Boiler Incrustation," you recommend caustic soda as a preventive, and state in the last paragraph:—"When the water from a boiler which is treated with caustic soda is used for dyeing purposes, in addition to the lime, the caustic soda also removes all the iron." If you admit this, what, then, will caustic soda do inside a boiler which is entirely made of iron? As regards actual cost of common or caustic soda you must take into consideration that it passes along with the steam into the engine, destroys the packing, and severely attacks the brass boiler fittings, which consequently require frequent regrinding. You also state that a 20-horse power boiler requires to be kept clean from scale—you make no mention of corrosion or pitting—3 lb. of caustic soda, at 2d. per day, that is, £9 per annum for 360 working days. Our composition we guarantee free from any kind of soda or acid. It cannot injure metal of any kind, and will not affect steam for bleaching, dyeing, brewing, distilling, or any other purpose. It is superior to caustic soda, and can even be drunk with impunity, whilst its cost for a 20-horse power boiler is £4 per annum only, against £9 for caustic soda.

We may mention that many manufacturers of caustic soda, whose names we enclose for your private information, have been using our composition for a considerable period, in preference to their own manufacture, common and caustic soda, which cost them comparatively nothing, and no doubt if you would ask these firms' opinions, you would get every possible information on the subject.
THE DISINCRUSTANT MARSEILLAIS COMPANY.

Manchester, January 22nd.

REMARKS ON AN ORGAN BY STEAM, BUILT BY AN AMERICAN.

SIR,—In the *Brooklyn Illustrated Messenger* there is the account of an immense organ worked by steam, built at Fancytown, in Kentucky, by Mr. Idlestory, a rich American manufacturer of that town. In this organ the sound is not obtained by means of wind from the bellows, but by steam passing through the pipes, which are constructed after the system of steam engine whistles. The above-named newspaper alludes to the great difficulty which had to be surmounted of making the steam act so as to have a constant and regular pressure; and this was only obtained by means of a special system of safety valves, which discharge two functions at the same time. It furthermore mentions that the sound of this organ was wonderfully effective, and was heard at the distance of 7000 or 8000 metres. Finally, it concludes by saying that an American genius has found the means of making the whole of a town enjoy the sound of one instrument!

Now, Sir, allow me to call your attention to these statements, though not for the purpose of raising useless arguments as to the initiator of this invention, as that I leave to Mr. Idlestory, of Fancytown, but for the satisfaction I crave of being mentioned in this affair, and to offer one more document to history—if such history will ever be written—regarding the application of steam to musical instruments.

I was in Melbourne during the last International Exhibition, which you may remember was open from the 1st October, 1880, to the 30th April, 1881, and visiting the grand organ of that Exhibition, the same idea which occurred to Mr. Idlestory presented itself to my mind, that is to say, the possibility of applying steam to music by the means of an organ, the pipes of which would function, more or less, like the whistles of the engines. The greatest difficulty which struck me for the execution of my idea was how to obtain a constant and regular pressure on one octave which would at the same time distribute different pressures on the lower and higher keys. After much thought, I concluded that this difficulty might be overcome by a system of safety valves, and, looking again at the organ, to my great surprise I saw that this was what Mr. Idlestory accomplished.

In my place most probably you would have kept your ideas to yourself, have waited for an opportunity to impart them to some organ-builder, and, after due experiments, have obtained a patent. But knowing by experience that with my profession I could not achieve this, I tried instead to have a few words on the subject published in the *Argus* of Melbourne, so as to leave in that country where such cordial hospitality had greeted us, the *souvenir* of an Italian name.

With the assistance of my friend, Mr. Alfredo Bonnefoi, I compiled an article, which I showed to Signor G. Annovazzi and Mr. F. Eaton, employé in the Melbourne Treasury, and then took it to the *Argus* office. As is usual in such cases the editor kept my manuscript, promising to let me have an answer as soon as my article had been read by a competent judge. In the meantime, as some days elapsed before the answer came, I went to Mr. George Fincham, who had built the great organ of the Melbourne Exhibition, and asked his opinion. He, as an experienced person, thought my ideas practical, as by the system of safety valves vapour might be substituted for the wind which is blown into the pipes by bellows.

At last I received the following answer, which was written by Mr. Neily, one of the *Argus* reviewers, and I will ever keep that document as a precious autography:—"The idea of applying steam to musical instruments is not at all new, as in the year 1850 there was in the Cremorne Gardens in London a small instrument called 'Calliope' constructed after the above-named principle. Also in Melbourne some years ago a like instrument was built with steam whistles of graduated sizes, but the result was not successful, as the sound it produced was most infernal. It would be impossible to employ steam in organ pipes for many reasons, such as expansion, contraction, corrosion, and other destructive influences."

After such a sharp reply I withdrew my manuscript from the *Argus* and thought no more about it. But I speak of it now, as Mr. Idlestory alluded to it, saying I was perfectly in the right, and kindly gave me his reasons for thinking me so.

Thanking you sincerely for the trouble I may perhaps be giving you, I wish to state, first, that notwithstanding it afforded me much satisfaction to know that my idea of applying steam to musical instruments was not a new one, still I am none the less convinced that by proposing a system of safety valves I had suggested the means of preventing the infernal noise of the "Calliope" instrument. Secondly, that having imparted my ideas not only to the *Argus* and Mr. Neily, but also to several friends of mine in Melbourne at a time when many Americans were visiting that country, it is not improbable my suggestions may have crossed the Pacific and have been put into execution in America. Lastly, that my article to the *Argus* having been sent in December, 1880, I should feel much obliged to Mr. Idlestory if he can prove his patent to be dated at an earlier period. P. D'AMORA.

January 24th.

[It is unnecessary to reproduce our correspondent's article referred to in his letter, as that letter is sufficiently explanatory. By safety valves, he means reducing valves for regulating the pressure in the different sound boards of the organ.—ED. E.]

THE MANCHESTER SHIP CANAL.

SIR,—I beg to submit to you a plan which I think will obviate the almost insuperable difficulties connected with keeping open a channel, even with the assistance of training walls, of such a shifting and variable character as that portion of the Mersey through inadequacy of designs for which the present Bill has been rejected.

My suggestion is this: that from Garston to Runcorn a canal be cut, beginning at a point south of the entrance to the Garston Docks, and terminating at a point north-west of Runcorn Bridge, passing through the townships of Garston, Speke, Halewood, and Ditton. This would avoid all opposition consequent on interfering with the present channel of the river between the points named.

Objection might be raised by the River Weaver Navigation, the Shropshire Canal Company, and the Bridgewater trustees that the canal would take the major portion of the flood water, and there would therefore be a strong inducement for the river to silt up opposite their respective outlets, and impede the navigation. This might be prevented by having dock gates at the Runcorn end, which would be kept closed as far as might be compatible with the passage of ships through the canal during the retreat of the tide in fresh water floods, thus giving the old channel the advantage of all the scouring influences it has at present. But this would be a matter for careful investigation.

The land that would be required is low-lying, and offers no constructional difficulties. The canal might approximately follow the contour of the shore, to avoid large severances of land and public road bridges.

The route would be considerably shortened, and, I believe, the cost would be far less, and more accurately ascertainable, and the works of a more permanent character than the river course. The difference between the costs of maintenance would also be immensely in favour of the land cut.

Birkdale, January 24th. J. GLOVER.

COMPOUND ENGINES.

SIR,—In reference to your correspondent, Mr. John Turnbull's letter, I am inclined to think that he has placed the saddle on the wrong horse, whether I have or not, in showing indicator diagrams taken from a pumping engine with a very slow piston speed, as none of my fellow engineers expect anything else but a good result. If the speed of piston had been high there would have been great credit due to his patent simple automatic cut-off gear, but I am sorry to say that the case is just the reverse. If his pumping engine was making, say, 200ft. per minute, which is above the average speed for pumping engines, and he distinctly states the engine was moving at a very slow speed, if he was to speed his engine to 500ft. per minute it would tell upon the steam ports and travel of valves, whether the steam could be maintained to point of cut-off or not, and we are all aware when we increase the piston speed we diminish the area of steam ports. He also states that my throttle valve was nearly closed, which caused the wire drawing. I must beg leave to say that the throttle valve was propped wide open at the time the diagrams were taken, and the expansion valves wound up only just to keep the proper speed. The steam ports in the old cylinder were only 3in. by 10in., travel of valves 6½in., with a piston speed of 420ft. per minute. The throttle valve is still in the same position as it was in the old cylinder, propped wide open with steam ports 26in. by 2in., with the same travel to valves as the old cylinder, which shows the cause of the imperfections in the diagrams taken from the old cylinder.

I should take it as a great favour if Mr. Turnbull would give some indicator diagrams from some modern mill engines with a higher piston speed, say 500ft. per minute, with about the same area in ports as I have given from my old cylinder; then I can see whether his patent simple automatic cut-off gear will improve a small steam port or not, and be better satisfied than I am with the last report which he gave. The speed above mentioned is not considered very high in Bradford, as we have engines running over 800ft. per minute. These are the engines to apply his patent simple automatic cut-off gear to, when he would not find as good a result from them as he finds from his pumping engine, unless there was sufficient area in the steam port and sufficient travel of valves.

I defy Mr. Turnbull, or any other engineer, to come much nearer the boiler pressure than I stated in the previous number of December 22nd, 1882. REUBEN BRAMHALL.

Bradford, January 23rd.

STEAM ON TRAMWAYS.

SIR,—Your correspondent, Mr. J. R. Wilson, challenges the advocates of "steam on tramways" to cite a single instance in which tramways have been worked by steam more cheaply than by horses. The engines made by Messrs. Kitson, of Leeds, and working on one of the Glasgow tramways, are evidently unknown to him.

This tramway was originally worked by horses, then for six years by steam under contract, and for the last two years by engines purchased from Messrs. Kitson by the tramway company. The tramway is not in good order, and was not from the first, but the steam traction is performed with perfect success financially, and to the satisfaction of all the parties concerned.

I can give the results in figures if necessary, but the mere fact that Scotchmen have purchased engines after five years' cautious trial will to most minds be conclusive evidence. "Steam on tramways" is both a successful and paying enterprise.

With respect to haulage by rope, it seems strange that our American cousins have tried it for eight years, but have only adopted it in two places. If the profit is so great as the Hallidie Company assert, how is it that American capitalists are not alive to their own interests? I agree with your correspondents that the mechanical difficulties and the cost of maintenance will be very great. HENRY HUGHES.

Leicester Machine and Engine Company,
Leicester, January 23rd.

SIR,—The letter of your correspondent, Mr. J. R. Wilson, in your issue of the 19th inst., contains its own answer, so far as his remarks relate to the economic working of steam tramways, as he admits that he does not possess trustworthy statistics on the subject.

As we were the first to work steam regularly on tramways, we have collected a great many facts bearing on the point, and shall be happy to give Mr. Wilson, if he will communicate with us, statistics and information regarding the successful working of steam tramways in all parts of the world, including Dewsbury, Batley and Birstal, Stockton-on-Tees, The Hague and Scheveningen, Leyden and Katwyk, Barcelona and San Andrés, and Sydney, New South Wales. MERRYWEATHER AND SONS.

Greenwich-road, London, January 23rd.

[As the facts to which Messrs. Merryweather refer will no doubt prove generally interesting, we suggest that they should send them to us for publication.—ED. E.]

CHILLED CALENDER ROLLS.

SIR,—Replying to "A Constant Reader," I beg to say from my experience that English rolls are never so accurately ground as those of American manufacture, unless, of course, ground by the patent American machine. Some English rolls may have been turned out as hard as American, but the former are uncertain—or variable—whereas the latter are never soft when sent here.

Your correspondent's concluding remarks are not *apropos*, as English rolls of the very best make are always considerably cheaper than any that can be imported from the United States, so English paper-makers are compelled, by economy, to avoid buying in their own country what is comparatively "cheap and nasty."

January 13th. PAPER-MAKER.

RAILWAY SPEEDS.

SIR,—Will you allow me, in reply to your correspondents, to say that my information was derived from page 317 of "Bradshaw," and that I was exact to the figures, in that page, and also as to time on page 320. Whether the distance from Glasgow to Kilmarnock is really "24 miles 28 chains," "about 28 miles," or 33¾, as in "Bradshaw," I am not able to say but evidently the time-table is open to question. HENRY BARCROFT.

Bessbrook, Co. Armagh, Ireland,
January 15th.

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

(*From our own Correspondent.*)

THE iron trade shows very little alteration on a week ago. Orders are slightly more numerous now than at the earlier date, but the majority of the buyers still seem to be hanging fire. By thus remaining out of the market they hope to secure for themselves still better terms than those now possible. I hear of prominent instances this week, however, of the "bears" having had to come to vendors' terms. And these instances will increase in number if sellers are wise enough to remain tolerably firm. Consumers of pig iron are known to have as yet made much smaller purchases than is usual at this period of the year. Still there have this week been sales of hematites; in one case of 500 tons in a line. Such pigs were this afternoon in Birmingham priced at 65s. per ton. Native all-mine pigs were again 67s. 6d. to 65s. Staffordshire part-mines vary, according to mixture, from 55s. to 50s.; and cinder pigs from 42s. 6d. to 40s. Foreign pigs are quiet all round at 51s., delivered, for Lincolnshires, and 50s. to 48s. 6d. for Derbyshire and Northampton brands.

The rolled iron masters had less expectation this afternoon than previously of an increased number of orders from America, as an outcome of the tariff legislation now going on in the States. The belief is growing that the tactics of the protectionists are too well planned to allow of a Bill being passed by this Congress. This circumstance naturally did not tend to strengthen prices to-day. Yet the marked-bar people refused to give way in their quotations. £8 12s. 6d. remained Earl Dudley's price, £8 the price of two or three of the other list houses, and £7 10s. that of the New British Iron Co., Phillip Williams and Sons, and others. Unmarked bars varied from £7 down to £6 easy. Hoops were obtainable down to £6 12s. 6d.; gas strip was abundant at £6 10s.; and nail rods were offered at £6 5s.

Galvanised sheet makers refrained from buying, yet the black sheet makers did not press for orders. The chief makers keep fairly full of work. Actual selling prices may be given as: Singles, £7 15s. upwards; doubles, £8 10s. to £8 15s.; and lattens at £9 10s. easy.

Furnace coal is still quoted in the Dudley district at from 10s. to 11s.; forge coal, 10s.; and steam or locomotive 9s. and 10s. Steam coal from the Cannock Chase pits may, however, be had at from 6s. 6d. to 7s., and slack for engine purposes at from 3s. to 5s. The leading qualities of the Cannock Chase fuel were quoted to-day—Thursday—in Birmingham: Deep, 10s.; shallow, 9s.; seconds, 8s.; and common, 7s., all long weight.

Constructive engineers continue in the receipt of a good number of inquiries for bridge and roofing work needed by home and foreign railways. The inquiries are such, however, that it is clear that they are being made in other engineering districts likewise, and in most cases the lowest bidder will carry off the work. As competition is keen, prices keep low. Some of the best foreign inquiries now to hand are on South American account, and relate to pier and railway work.

A few of the most favoured concerns in the district have work ahead for quite nine months. The Bridge and Roofing Company, of Darlaston, is very busy. The important railway extensions of the London and North-Western Railway Company in Birmingham, and the intended new arcade in the same town, are together furnishing the company with a good deal of roofing work. The Patent Shaft and Axletree Company, of Wednesbury, is busy upon the steel bridge for India, and also in its wheel and axle departments.

For use in connection with the Severn tunnel operations, the last instalment of a contract for 200 contractors' wagons has just been sent from the engineering yard, at Darlaston, of Messrs. Carter, Ford, and Co. The wagons are similar in design to an ordinary underground colliery wagon, but are of more substantial manufacture. The last of six bridges for a leading English railway is about to be despatched by the same firm.

The contract for railway rolling stock, spoken of by your Sheffield correspondent last week as having just been given out by the Caledonian Railway Company to two Birmingham firms, is for, in all, fifteen first-class and forty third-class passenger carriages, and five passenger brake vans. The contract for the first-class work and the brake vans has been secured by the Birmingham Railway Carriage and Wagon Company, Limited, of Smethwick; and that of the third-class work by Messrs. Brown, Marshalls, and Co., Limited, of the Britannia Works, Birmingham. The third-class carriages are of the new pattern designed for the Caledonian Co.'s through service by Mr. Drummond, the locomotive superintendent. They are 35ft. long, divided into six compartments, are on six wheels, and internally are liberally fitted up for third-class passengers. The wheels and axles of the third-class will be manufactured by the Patent Shaft and Axletree Company, of Wednesbury. The springs will in all probability come from Sheffield. Messrs. Brown, Marshall, and Co. have recently completed a contract for seventy first-class carriages for the Victorian Government.

The locomotive air engine, as I mentioned in a recent report, has been succesfully introduced for underground work at the Cannock and Rugeley Collieries, Hednesford. The engine is one of Lishmary and Young's, and has been made by the Grange Iron Company, near Durham. It has a pair of 4½in. cylinders with 8in. stroke, and is fitted with all the working parts of an ordinary steam locomotive. The receiver—the substitute for the boiler—is 6ft. 6in. long by 3ft. 6in. diameter, and is made of plates of Siemens steel. The engine is now working at a pressure of 300 lb. per square inch, but it will stand a pressure of 500 lb. It is situated at a distance of 1200 yards from the bottom of the shaft. It goes into the stalls and brings the coal direct from the face of work, a distance of 250 yards, delivering it to a station at the bottom of the trough fault. At this point a hauling rope takes hold of the different trains and draws them up to where the main hauling engine takes them to the shaft. This main engine is stationed on the surface. It has a 32in. cylinder, and, besides hauling, it compresses the air necessary for the small locomotive. The air cylinder of this main engine is 20in. diameter with 5ft. stroke, and the air is compressed to 65 lb. per square inch. At this density the air is conveyed down the shaft in large receivers and is taken along the mine for a distance of 850 yards. Here a pair of 12in. cylinder engines work a 5in. compressor, which further compresses the air up to 300 lb. per square inch. It is then fed into a small receiver and is taken to a point at which the air locomotive can be charged, an operation that only occupies half a minute.

The condition of trade at the present time, as experienced by the Union Railway Company, of Birmingham, and by the Railway Rolling Stock Company, of Wolverhampton, would seem to differ considerably. The former company reports that during the past half year operations have been satisfactory and profitable, but a less cheerful state of things is reported by the latter concern. The Union Company has made a profit on the half year of £4280, which enables the directors to recommend a dividend at the rate of 10 per cent. per annum on the ordinary shares. The Wolverhampton company show a profit on the half year of £3060, which is a decrease in income, arising chiefly from reduction of the interest balance and very heavy repairs, and the directors of this latter company are only able to recommend a dividend at the rate of 3 per cent. per annum on the ordinary shares. The reserve fund of the Birmingham company stands at £15,000, and that of the Wolverhampton company at £6000 odd.

The steam tramways in North Staffordshire have not yet proved a very profitable undertaking. At the annual meeting last week of the company which carries on this business, the profits for the year were shown to amount to only £1271, and the dividend recommended was 1s. 6d. per £10 share. The Wilkinson engine, constructed on an entirely new principle, had been worked with success on some of the lines, and the directors had arranged for the supply of fifteen of these engines as soon as possible. The chairman stated that arrangements were in progress for carrying heavy goods over the line during the night. The report was adopted, and a committee of shareholder, was appointed to advise with the directors.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Buyers in the iron market still come forward very cautiously, and it is only by concessions in price that they are induced to give out orders of any importance. The margin between the views of buyers and sellers as to values is, however, being gradually lessened, but this is being accomplished more by producers coming down to meet consumers than by buyers being brought up nearer to makers' prices. In pig iron a difference of not more than 1s. per ton seems to stand in the way of a considerable weight of business being done; but in manufactured iron it is still difficult to fix to any particular concession which would lead to anything like large orders being placed, as, although fair inquiries are put forward, when they do result in offers these are generally at figures so low that they scarcely seem to be in view of actual business.

At the Manchester market on Tuesday there was again only a very moderate amount of business doing. Lancashire makers of pig iron announced a reduction of 1s. per ton upon their last week's rates, and this concession brought forward orders to a fair extent. The basis on which business was done was 46s. 6d. less 2½ for forge and foundry qualities delivered equal to Manchester, and this is now the quoted price for local brands of pig iron. Although for some time past Lancashire makers have been securing very little new business, there have been sufficiently large deliveries against old contracts to keep the furnaces going without any material accumulation of stocks, and they are now fairly well off for orders for the remainder of the quarter. For district brands of pig iron quotations remain at 46s. 10d. to 47s. 10d. for Lincolnshire and 48s. 6d. to 50s. for Derbyshire less 2½ delivered equal to Manchester A few small sales of Lincolnshire have been made at about the above figures, but for anything like large quantities buyers do not come within 6d. to 1s. per ton of makers' prices, and at present sellers are not disposed to give way. For Derbyshire iron there has been little or no inquiry.

Business continues very quiet in the finished iron trade, and the pressure here and there for specifications is an indication that forges are getting short of work. Nominally list rates are still unaltered, and makers show a disinclination to give way for forward contracts. Prices, however, are weak, and makers are willing to meet buyers so far as present specifications are concerned. When business is done, which is only very limited in quantity, the basis of actual selling prices is about £6 5s. to £6 7s. 6d. for ordinary bars, £6 17s. 6d. to £7 for hoops, and £8 5s. for good qualities of sheets delivered into the Manchester district.

I hear of large inquiries being in the market for steel plates.

A few months back I referred to a new principle which has been introduced by Messrs. W. Hulse and Co., of Salford, into the construction of lathes, by which an independent action is given to the separate slides. The first of these lathes, which has been specially designed for ordnance work, has just been completed by the firm. The machine is of somewhat massive construction, weighing about 80 tons, and having a length of about 60ft. A number of improvements in details have been worked out in the machine, but the special feature is that the screw shafts, of which there are two—one running along each side of the machine—are stationary, whilst the nuts revolve. By this arrangement the inconvenience arising from all the slides driven from a revolving shaft being compelled to travel in the same direction is avoided. Each slide works independently, travelling in any direction as desired, and can be stopped or started without interfering with the work of the other slides. The machine is constructed to carry four slides, but any number can be added as required, as the screw shafts being stationary, are subject to comparatively little or no strain, and can follow any increasing length of machine that may be necessary. The machine can be put to boring, turning, screwing, surfacing, or any work to which a lathe can be applied.

The extensive sewage works which have been constructed by the Corporation of Salford from the designs of Mr. Arthur Jacob, the borough engineer, are now practically complete, and in the course of a few weeks it is expected will be in operation. As descriptions of different portions of the works have on several occasions been already given in THE ENGINEER, it is not necessary now to enter into any details of their construction. The object of the works is to deal with the sewage of Salford, which at present is discharged direct into the Irwell by the process of precipitation similar to the method adopted at Leeds. For this purpose a series of concrete tanks, twelve in number, and having a total area of 102,857 square feet, and capable of holding 720,000 cubic feet, has been constructed. Into these tanks the sewage, mixed with lime, will be pumped, and after the solid matter has been precipitated, the effluent water in a comparatively pure state will be allowed to flow into the river. The tanks are all completed, and the lime-mixing machinery, which is driven by a pair of 25-horse power turbines actuated by the water from the tanks as it flows into the river, is in working order. At the pumping station some slight delay has been caused owing to the speed of the engines having to be reduced; but the alterations necessary are being completed this week. A couple of the tanks are already in use for the reception of the sewage from a portion of the Pendleton district; but as the lime-mixing has been done by hand, this scarcely affords an opportunity of forming any opinion as to the results which may be obtained when the works are in full operation, and with a good deal of the Salford sewage highly charged with chemical matter some little experience will no doubt be required before the process can be applied in the most effective manner. The construction of the works has occupied a period of something like four years, and has been carried out by Messrs. Pilling and Co., contractors, of Manchester and Bolton. The pumps and engines, of which illustrations and descriptions have been given, have been supplied by Messrs. James Watt and Co., of Birmingham and London, and the turbines came from the North Moor Foundry Company, Oldham.

The check given to the Manchester Ship Canal Bill by the decision of the Examiner of the House of Commons, that the promoters have failed to comply with the Standing Orders, is generally regarded as likely to throw out the Bill for the present session. But the promoters, speaking through their official journal, the *Ship Canal Gazette*, give expression to the belief that so important a measure will not be allowed to be thrown out on purely technical grounds; but that they are not over confident of success is evident from their appeal to their friends and supporters to "nerve themselves to perhaps more determined efforts during the next few weeks." There is a feeling in the district that an attempt has been made to push the matter forward too rapidly, and that it will be no disadvantage, as regards the probable ultimate realisation of the project, if the delay affords an opportunity for more mature consideration. The canal scheme was specially referred to by Sir E. W. Watkin at the half-yearly meeting of the Manchester, Sheffield, and Lincolnshire Railway Company on Wednesday. So far as the Manchester, Sheffield, and Lincolnshire Railway Company were concerned, he declared distinctly that there had been no opposition of any kind to the scheme. Sir Edward Watkin was, in fact, in favour of the development of the canal system, but he did not look very favourably upon the manner in which it was proposed to carry out such development as put forward in the Manchester Ship Canal, nor did he think it was an undertaking in which the Corporation of Manchester had a right to spend the ratepayers' money.

I referred last week to a number of new mills which were being floated in the Oldham district, and which gave promise of considerable orders being given out to machinists. I may now add that the share capital for the mills has been subscribed without difficulty, and the price per spindle at which they can be constructed is generally calculated to be 21s. to 22s., a figure much below that at which the present modern mills have been built.

The coal trade continues only quiet for the time of the year, and many of the pits are not working more than four to five days a week. The pressure of plentiful supplies on the market is causing a weakness in prices, and in some cases there has been a giving way of about 6d. per ton on house fire coals. At the pit mouth the average prices are 10s. for best coals, 8s. for seconds, 6s. 6d. to 7s. for common house fire coals, 6s. to 6s. 6d. for steam and forge coals, 4s. 6d. to 5s. for burgy, 3s. 6d. to 4s. for good slack, and 3s. to 3s. 6d. for common sorts.

The shipping trade is dull, and steam coal is offered freely at the high level, Liverpool, or the Garston Docks, at 7s. 6d. to 7s. 9d. per ton.

Coke is in fair demand at about late rates.

In the Ashton and Oldham districts the sliding scale is in operation for the regulation of miners' wages, and the result of the making up of the books for the closing quarter of last year is an indication of how little ground there was for the recent agitation for an increase of wages, in which the men generally were successful in obtaining the concession of a ten per cent. advance. The actual selling price of coal in the above districts shows that the men are not entitled to any advance, and although in other Lancashire districts the men have received an advance of 10 per cent., the rate of wages has to remain unchanged at the Ashton and Oldham collieries.

Barrow.—The week's business in the hematite iron market has been quiet, and the orders placed in the hands of makers have been few and unimportant. The yield of the furnaces is well maintained, and makers are not likely to reduce the output in any direction, as the probabilities are that with the opening of the spring season, if not before, there will be a very satisfactory trade. The increased uses for Bessemer steel will necessitate a larger consumption of pig iron, and the utility of hematite iron for other purposes than steel manufacture is showing itself in forge work, the tin-plate industry, and in other directions. Although stocks have accumulated to some extent, they are expected soon to be reduced. The value of hematite pig iron is steady, and 53s. 6d. may be noted as the current price for mixed Bessemer samples. The steel trade is well off for orders both in the rail and merchant departments. The shipbuilding trade is fairly employed, and it is expected that new orders will result from the many inquiries now being received.

The steamer Duchess of Edinburgh, built for the South-Eastern Railway Company by Messrs. J. and G. Thompson, Glasgow, has been bought by the Barrow Steam Navigation Company for the Barrow and Isle of Man trade. It has been determined to lengthen her by the addition of 10ft. before the funnels, and as she has already steamed 17½ knots per hour, it is expected this addition to her length will enable her to steam fully 18 knots.

The Furness Railway Company has put down a measured mile at Seascale, on the Cumberland coast, for the use of local shipbuilders.

THE SHEFFIELD DISTRICT.

(*From Our Own Correspondent.*)

THERE is very little movement in the iron trade. Merchant bars are at present making £7 per ton, with a fair inquiry, but no weight of orders. Ten years ago merchant bars were quoted at £15 to £16 per ton. At the same date steel rails, which are now at £5 2s. 6d. to £5 5s. at the works, were freely ordered at £15 to £18 per ton.

The Yorkshire miners, speaking by their delegates at a Conference held at Barnsley, on Monday, have resolved on carrying out the policy of restricting the output recommended by the Leeds Conference. What the miners aim at is to work five days a week, and eight hours a day from bank to bank. A deputation was appointed to wait on the employers and request an interview. The colliers desire to knock off work on Friday, and "play" till Monday. There is a strong feeling generally in South Yorkshire against Sunday labour in mines, and it is desired to make Saturday a complete holiday. At present the glut in the London market, so far as house coal is concerned, is causing a natural restriction, and there are several collieries at which only three days a week are being worked. The agitation is to include West as well as South Yorkshire. The Thorncliffe miners—Messrs. Newton, Chambers and Co., Limited—are stated to be opposed to the policy of restriction.

Messrs. Ward and Payne, the well-known edge tool manufacturers, have offered a bonus of £200 to any workman who submits such designs, or ideas for designs, for the manufacture of cast steel firmer and socket chisels, as will tend materially to reduce the cost of production, whilst at the same time maintaining the quality and style. The offer is open to the workmen in Messrs. Ward and Payne's employ for three months, and if they fail to take advantage of it within that time, it will then be thrown open to the public. I understand the workmen are energetically taking up the matter, and the result will probably be the invention of some means whereby 25 per cent. will be saved in the cost of production.

In the file trade there is a movement for the reduction of wages. During last April the employers agreed to restore the grinders, cutters, and single-hand forgers to "statement price," which sometime before, during a period of depression, had been reduced by ten per cent. Now the manufacturers state that trade has again declined, and urge that the ten per cent. should be taken off. The matter has been remitted to a committee of the File Manufacturers' Association.

Sheffield students have again been very successful in the Goldsmiths' Company's competition. Mr. Robert Needham, who has been fortunate enough to win honours on previous occasions, has carried off the first prize, £15, for the design for a claret jug, the cost of which, when manufactured, is not to exceed £25, and in the design for a salad bowl, the cost of which, when manufactured, shall not exceed £50. He is awarded a gratuity. This makes five prizes, three of which are first prizes, this student has taken in three successive years. He is now entitled to apply for the £100 travelling scholarship granted by the company. Two other Sheffield students have done well. Mr. Walter Bullas carries off the second prize for a silver cup, six inches in height, to be chased from a design supplied by the company; while Mr. Stuart Thorpe takes the second prize, £15, for a centre-piece for flowers only, not to exceed six inches in height, the cost when manufactured not to be more than £100.

The first sales of ivory for the year, which have just been held at Liverpool, are important to Sheffield cutlery manufacturers and others, as the supply of high-class ivory was exceptionally large—over 50 tons, the whole of which was disposed of in one day at a little over £960 per ton. The brokers had calculated on an advance of from £3 to £4 per ton on the October rates, but their expectations were not realised, and the result was that though fine large tusks fetched full prices, medium sizes went a little easier, and there was a decline of £3 in ivory used for billiard balls and bangles, the latter for the adornment of the wrists and ankles of African belles. If a substitute could be found for ivory in billiard balls, and the African ladies could be persuaded to abandon the fashion of wearing ivory bangles, the trade would be immensely relieved. As it is, though the upward tendency has been checked, the prices paid at Liverpool will prevent Sheffield cutlers making any concession to their customers.

The Mayor and Master Cutler are endeavouring to enlist the the active sympathy of local manufacturers in the forthcoming International Fisheries Exhibition. Sheffield has but little connection with fishing affairs except in the item of knives for herring fishers and wire for netting purposes; but it is believed that there are small specialities for the fishing business produced in Sheffield, and it is the Master Cutler's desire especially that the Sheffield district should be as well represented as possible.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

AT the Cleveland iron market, held at Middlesbrough on Tuesday last, there was a better attendance than on any previous market day this year. Not much business was, however, done. Inquiries for iron of all kinds were numerous, but purchases were concluded only for small lots. Merchants offered No. 3 g.m.b. at 42s. 6d. per ton; but only small quantities could be had at that figure. Makers' quotations ranged from 42s. 9d. to 43s. 6d. for No. 3, and most of them would close at 43s., but few buyers were disposed to give so much. It is now generally believed that prices have reached the turning point and that a better state of things will be reported soon.

On Monday last the stock of Cleveland iron in Messrs. Connal and Co.'s Middlesbrough store was 92,336 tons, being a reduction of 2445 tons for the week

During the last few days the shipments from the Tees have been very poor. The totals for the month, up to Monday night, were as follows:—Pig iron, 45,823 tons; and manufactured iron and steel, 14,340 tons.

The finished iron trade shows some slight signs of improvement. Consumers have evidently come to the conclusion that prices are not likely to be lower, and are more ready to contract. Some business has been done during the last few days for early delivery; but manufacturers are not willing to book ahead at current prices. The prices quoted on Tuesday were as follows:—Ship plates, £6 7s. 6d. to £6 12s. 6d. per ton; shipbuilding angles, £5 7s. 6d.; and common bars, £5 12s. 6d., f.o.t. at makers' works, less 2½ per cent. Puddled bars, £4 net at works.

The Middlesbrough Fire-brick Company commenced on Monday last to manufacture bricks at its new works. The works are situated on the Marshes, near to Messrs. Jones Bros.' Rolling Mills, and cover about an acre of land. They have good railway connection with the main line, and with all the ironworks between Newport and Middlesbrough. They have also lines connecting them with the riverside wharves. The company is producing fire-bricks from fire-clay, which it brings from Scotland by sea. It also intends to make ganister fire-bricks and ground ganister for Bessemer converters. Three burning kilns and drying sheds capable of turning out 100,000 bricks per week have been built. The bricks are to be equal to the best Scotch bricks, and will be very much cheaper.

The Skerne Ironworks at Darlington have again been brought to a standstill, owing, it is said, to the company being unable to pay the interest due to the debenture-holders. It is believed that all the other financial obligations of the firm have been met. The company and the debenture-holders have now mutually agreed to appoint a firm of London accountants as receivers, and it is expected that the works will be put into operation again as soon as some satisfactory arrangement can be come to.

On Monday evening last, Colonel Beaumont delivered an address to the members of the Cleveland Institution of Engineers on the Channel tunnel. Mr. E. F. Jones, president, occupied the chair, and the address, which was illustrated with numerous diagrams, was listened to with the greatest interest. Colonel Beaumont estimates the cost of constructing the tunnel at £4,000,000, and thinks the whole of the work could be completed in four years. An animated discussion followed, in which the views both of promoters and opponents were well put forward. The preponderance of argument was, however, decidedly in favour of permitting the work to proceed with all speed, a view which was endorsed and emphasised by the president in winding up the discussion.

The annual meeting of the Board of Arbitration for the manufactured iron trade is fixed for the 31st inst. At that meeting the revised constitution of which the employers have given formal notice will be considered, and probably adopted, though possibly with some slight modifications. It is understood that on account of the recent heavy fall in the prices of manufactured iron, the employers will give notice for a 7½ per cent. reduction of wages, to come into effect at the expiration of Sir J. W. Pease's award, the last Saturday in February. This notice will also be considered at the meeting of the board to be held on the 31st inst.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow pig iron market has been very dull since last report, with little fluctuation in prices. Of speculative business there was not so much as in the preceding week. But, although the warrant market is inactive, and prospects are said not to be satisfactory, there is not wanting evidence that a good legitimate business is being done. The shipments of Scotch pigs compare very favourably with those at the same date in 1882, and there is also a considerable improvement in the imports of Cleveland iron, which appears to be getting more in request among our manufacturers. The inquiry from the United States is at present quiet, and the reports from New York not at all cheering. There is, likewise, a want of briskness in the continental demand. At home, on the other hand, the inquiry for pigs is very good, although present quotations are not so firm as those of a few weeks ago. Three furnaces have been put out for repairs at Calder, so that there are 106 in blast as compared with 109 at the same date last year. Stocks in Messrs. Connal and Co.'s warrant stores are still decreasing, the reduction in the past week amounting to upwards of 1100 tons.

Business was done in the warrant market on Friday forenoon at from 48s. 4d. to 48s. 5d., and down to 48s. 3d. cash, while the afternoon quotations were from 48s. 3d. to 48s. 3½d. cash, and 48s. 6d. to 48s. 6½d. one month. The market was flat on Monday forenoon, at 48s. 3d. to 48s. 3½d. and 48s. 2d. cash, and 48s. 5d. one month. In the afternoon business was done at 48s. 2d. to 48s. 3d. cash, and 48s. 6½d. one month. On Tuesday forenoon transactions were at 48s. 3d. to 48s. 2d. cash, and 48s. 5d. one month, the feeling being very quiet in the afternoon, at 48s. 2d. to 48s. 1½d. cash. Market was flat on Wednesday at 48s. to 47s. 10d. cash, and 48s. 3½d. to 48s. 2d. one month. To-day—Thursday—business was done at 47s. 10d. cash, and 48s. 1½d. one month.

The quotations of makers' iron show little alteration on those of last week. They are as follows:—Gartsherrie, No. 1, f.o.b. at Glasgow, per ton, 63s. 6d.; No. 3, 54s.; Coltness, 67s. and 55s. 6d.; Langloan, 67s. and 56s.; Summerlee, 62s. 6d. and 52s. 6d.; Chapelhall, 63s. and 53s.; Calder, 63s. and 61s. 6d.; Carnbroe, 55s. 6d. and 51s.; Clyde, 53s. and 50s. 9d.; Monkland, 49s. 6d. and 48s.; Quarter, 49s. and 47s. 6d.; Govan, 49s. 6d. and 48s.; Shotts, at Leith, 65s. 6d. and 56s.; Carron, at Grangemouth, 53s. (specially selected, 57s. 6d.) and 52s.; Kinneil at Bo'ness, 49s. 6d. and 48s. 6d.; Glengarnock, at Ardrossan, 55s. 6d. and 50s.; Eglinton, 50s. 6d. and 48s. 6d.; Dalmellington, 51s. and 49s. 6d.

There is plenty of work at most of the malleable ironworks carrying out contracts on hand, but some apprehension prevails that prospective employment may not be quite so good. This feeling may probably be due to the present backward condition of the market, and better inquiries may be heard of soon. In the meantime the quotations of malleable iron, although not materially altered, are a shade easier. Common bars are quoted at £6 5s. to £6 10s. per ton; ship-plates, £7; and boiler plates, £7 10s. Very good shipments of iron and steel manufactures are being made from the Clyde, indicating that the various departments of the engineering and hardware trades are in an active condition.

The coal trade has suffered considerably from the strike on the Caledonian Railway; but within the past few days considerable progress has been made in bringing forward the supplies that were interrupted last week. There is still, however, a scarcity of wagons, and the railway arrangements will necessarily be in a somewhat disjointed state for some days to come. At the different ports there are good shipping orders obtainable, and the inland trade has been quickened by the deprivations consequent on the strike. Great dissatisfaction still prevails among the railway servants of all the companies on the matter of long hours; and if this question is not speedily dealt with, in all likelihood the union influence will increase, and difficulties like that through which we have passed will again arise.

The three explosions which occurred within a few hours of each other in Glasgow on Saturday night—one greatly damaging a gasholder at the Tradeston Gasworks, shattering one or two small houses and injuring nine persons; a second destroying an unoccupied shed at one of the stations of the Caledonian Railway; and a third wounding a number of persons on a bridge at the Port-Dundas Canal—have caused some uneasiness in the minds of the authorities and the public. The theory of the gas officials is that the gasometer explosion was caused by dynamite externally applied, and in this they are supported by Mr. Hawksley, of London. The circumstances of the explosion are now being fully investigated on the part of the Home-office. It was only for a couple of days after the occurrence that the supply of gas was insufficient in the district served by the Tradeston Works, the pressure being afterwards restored by turning on a portion of the supply from the other gasometers.

Powers will be sought in the first session of Parliament to lay down tramways on the public road between Glasgow and Paisley.

A number of good contracts have been received by different Clyde shipbuilders within the past few days, and the shipbuilding trade is very active.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

The parliamentary campaign has been opened by a liberal act on behalf of the opponents to the Barry Dock Bill, and it must be admitted by the promoters also. They have all agreed to withdraw opposition in the form of memorials, so that the examiners can report Standing Orders complied with, and each Bill be enabled to go before the Select Committee, where the merits and demerits of the rival schemes will be shown. It is expected that the Bute Sidings' Bill will be unopposed in committee, the Barry Dock promoters having no *locus standi*. The Barry Dock scheme will be opposed by Lord Bute, the Taff Vale Railway, and several of the large landowners of Glamorgan. At no period can I remember such absorbing interest as is now aroused. The fight will be a battle royal. A large portion of the Corporation of Cardiff have given in their adhesion to the Barry scheme. On the other hand, the opponents have not been idle, and the Marquis of Bute and the Taff Vale Railway are in conjunction, with a well prepared plan of campaign. The unanswerable arguments of the Taff, to my thinking, are the fullest facilities of their line to suit all the southern needs of the Rhondda—the east being well cared for by Newport, and the west by Swansea—coupled with reduced freights; and the new dock now in hand by the Marquis of Bute, which will give all extra dock accommodation required.

The coal trade is in excellent condition, so far as best qualities are concerned. I note, however, a falling off in second qualities, and the price of small steam is not so stiff as it was.

The exports last week were fairly maintained, a little more vigour being perceptible at Swansea than of late. It is an encouraging fact that the last year's business shows that Swansea exported over two million and a-half tons of coal and patent fuel. During last week the coal exports alone from Swansea were close upon 30,000 tons, and the patent fuel 6940 tons. Both industries are in good condition and somewhat atone for the wretched condition of things in the tin-plate districts. It is much to be feared that the liquidators of the Briton Ferry Works will close the establishment. This place employs 600 men and boys, and is the direct support of several people.

A similar disaster has occurred in the Forest of Dean to the Great Western Forest of Dean Coal Consumers Company. An order having been issued for winding-up the company, 500 men will, it is feared, be thrown out of employ.

Cyfarthfa Works have been re-started in earnest, though on a small scale. This week sixteen puddling furnaces were re-lit, and this has been very acceptable to the district, as 200 extra hands will be required. The re-start in iron is understood simply to supply requirements for the works in the processes now being carried on for converting them into steel works. This is being industriously carried out, but some time must elapse before the beds for the machinery ordered from Leeds can be completed.

An alarming rumour was in circulation in Cardiff on Wednesday to the effect that a large firm trading in iron ore, and having important connections in South Wales, had succumbed, but up to date I have not been able to verify it.

There has been a good deal of speculative work in Bilbao iron ore in the past. At present trade seems to have got into a settled state, and a fair weekly average of 20,000 tons is cleared at Newport and Swansea. The Welsh ironmasters are now wholly dependent upon this ore, and no one seems inclined to adopt the Thomas-Gilchrist process with phosphoretic ores.

The Neath people are up in arms against the desire of the Swansea Bay and Rhondda Railway and the Great Western Railways to deepen the channel of the Neath river, divert, and bridge it. A public meeting is announced to prepare a formal opposition.

An application has been made to wind up the Milford Docks Company, Limited. I am glad to note that the preliminaries are now in progress for the new docks at Cardiff. The necessary stone is to be had from the Pwllypant quarries.

Iron trade generally is brisk; tin-plate slack, except in the larger works.

Society of Arts.—The following papers are set down for reading at the meetings of the Society of Arts during the part of the Session after Christmas:—At the ordinary meetings—W. K. Burton, "The Sanitary Inspection of Houses;" General Rundall, "The Suez Canal;" Professor Thorold Rogers, M.P., "Ensilage in the United States;" Sir Frederick Bramwell, F.R.S., "Some Points in the Practice of the American Patent Office;" J. H. Evans, "The Modern Lathe;" A. J. Hipkins, "The History of the Pianoforte;" Prof. George Forbes, "The Electrical Transmission of Power;" D. Pidgeon, "Recent Improvements in Agricultural Machinery;" Wilfrid Cripps, F.S.A., "English and Foreign Silver Work, with some remarks on Hall-marking." In the Foreign and Colonial Section—Edmond O'Donovan, "Life among the Turcoman Nomads;" Rev. J. Peill, "Social Conditions and Prospects in Madagascar;" Robert W. Felkin, "Egypt: Present and to Come;" W. Delisle Hay, "Social and Commercial Aspects of New Zealand." In the Applied Chemistry and Physics Section—C. F. Cross, F.C.S., "Technical Aspects of Lignification;" Walter G. McMillan, F.C.S., "Chemical Means for Preventing or Extinguishing Fires;" W. N. Hartley, F.R.S.E., "Self-purification of River Waters;" R. W. Atkinson, B.Sc., "The Formation of Diastase from Grain by Moulds;" "James J. Dobbie, D.Sc., and John Hutchinson, "On the Application of Electrolysis to Bleaching and Printing." In the Indian Section—Charles H. Lepper, "Overland Commercial Communication between India and China, *viâ* Assam;" W. S. Seton-Karr, "Agriculture in Lower Bengal: with some Notice of Tenant Right, &c.;" J. M. Maclean, "Private Enterprise in India;" C. Purdon Clarke, "Some Notes on the Domestic Architecture of India."

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

16th January, 1883.

244. Door Latches, W. Wright, Droylsden.
245. Preserving Composition for Ships' Bottoms, J. H. Barry, Clapton.
246. Preserving Alimentary Substances, C. M. Pielsticker, London.
247. Treadle Mechanism for Sewing Machines, A. M. Clark.—(*G. B. Ward, New York.*)
248. Pickers for Weaving, R. Lister, Keighley.
249. Self-acting Spinning Mules, J. Brook, Eccleshill.
250. Cooling Beer, &c., H. J. Haddan.—(*W. Nussbech, Berlin.*)
251. Cranes, H. J. Haddan.—(*Dajour et Bianca, Paris.*)
252. Railway Car Brakes, H. J. Haddan.—(*J. F. Mallinckrodt, Ohio.*)
253. Registering Gauges for Tides, &c., R. J. Rudd, Croydon.
254. Porous Silicious Materials for Filtering, &c., A. Frank, Charlottenburg, Prussia.
255. Runner Catches for Umbrellas, W. G. Attree, London.
256. Portable Railways, H. Woods.—(*B. G. Chapman, Lima, Peru.*)
257. Filtering Saccharine, E. P. Alexander.—(*P. Casamajor, Brooklyn.*)
258. Governor for Marine, &c., Engines, J. Munro, West Croydon.
259. Boring Rock, H. H. Lake.—(*A. Cantin, Paris.*)
260. Centre Board Vessels, P. M. Justice.—(*J. S. Birch, New York.*)
261. Electro-telegraphic Systems, P. M. Justice.—(*T. M. Foote, Brooklyn.*)
262. Cork Jackets, H. H. Lake.—(*E. Cogswell, U.S.*)
263. Locks, H. H. Lake.—(*J. P. White, U.S.*)
264. Steam Generators, A. Clark.—(*M. Barse, U.S.*)
265. Separating Solids of Different Gravities, T. B. Sharp, Smethwick.
266. Reducing Cereals to Flour, W. H. Williamson, Wakefield.

17th January, 1883.

267. Knitting Machines, J. Adams, Philadelphia.
268. Chains, W. Ralston, Manchester.
269. Chaplets for Holding Cores in Casting, W. H. Haley, Bradford.
270. Stamping Letters, A. Hoster, London.
271. Holding Scarves in Position, D. Appleton.—(*N. H. Baldwin, U.S.*)
272. Treating Fecal Matters, G. W. von Nawrocki.—(*J. Swiecianowski, Warsaw.*)
273. Stoppering Bottles, J. Sceats, Norbiton.
274. Preserving Alimentary Substances, T. F. Wilkins, London.
275. Applying Alternating Currents to Producing Light, A. Muirhead, London.
276. Glass Coverings for Keys of Musical Instruments, B. Kohl and K. Voigtritter, Dresden.
277. Carts for Discharging Mud, S. Clarkson and J. Ross, Hull.
278. Calculating Apparatus, A. J. Boult.—(*A. Seignon, Marseilles.*)
279. Blue Colouring Matter, F. Wirth.—(*M. Kalle and Co., Germany.*)
280. Bricks, &c., J. H. Starling, Erith, and E. A. May, Belvedere.
281. Mechanical Musical Instruments, H. H. Lake.—(*American Automatic Organ Company, Boston.*)
282. Electric Batteries, M. R. Ward, London.
283. Fitting Screw Propellers to Ships, A. Morris, London.
284. Sugar, A. Fryer and J. B. Alliott, Nottingham.
285. Electric Lamps, J. Unger, Germany.
286. Thrashing Machines, J. H. Johnson.—(*J. Montandon, sen., Paris.*)
287. Electric Accumulators. H. H. Lake.—(*N. de Kabath, Paris.*)
288. Regulating Electric Currents, H. H. Lake.—(*N. de Kabath, Paris.*)

18th January, 1883.

289. Arresting Sparks from Flues, E. de Pass.—(*R. M. Howling, Ballarat.*)
290. Fastenings for Blinds, J. D. Sprague, London.
291. Corsets, H. C. Leprince, Paris.
292. Salts of Strontia, &c., W. A. Rowell, Newcastle-on-Tyne.
293. Salts of Strontia, &c., W. A. Rowell, Newcastle-on-Tyne.
294. Hydraulic Machinery for Pumping, W. Donaldson, Ambleside.
295. Covering Electric Wires, W. T. Glover and G. F. James, Manchester.
296. Driving Belts, G. Hebblethwaite, Huddersfield.
297. Automatic Locking Devices, G. Macaulay-Cruikshank.—(*S. H. Raymond and C. N. Shepard, U.S.*)
298. Floating Basin for Oyster Culture, A. J. Boult.—(*L. Anschitzky, Austria.*)
299. Ventilating Tramway Carriages, G. W. von Nawrocki.—(*L. von Vöneky, O. Suter, and J. Lehmann, Berlin.*)
300. Motive-power Engines, H. G. Williams, London.
301. Waist Bands, E. Dastot, Brussels.
302. Brewing, H. E. Newton.—(*J. Puvrez, Lille.*)
303. Railway Signalling, W. J. Adams, London.
304. Furnaces, J. Mackenzie, Stockton-on-Tees.
305. Loading Merchandise, H. Bessemer, London.
306. Electric Illuminating Apparatus, H. V. der Weyde, London.
307. Alarm Guns, W. Burgess, Malvern Wells.
308. Electric Signalling Apparatus, W. Walker.—(*C. D. Tisdale, Boston, U.S.*)
309. Factory Chimney Shafts, S. Hart, Hull.
310. Grinding Cement, &c., H. H. Lake.—(*C. Jouffray, France.*)
311. Tricycles, H. V. der Weyde, London.
312. Type Writers, J. J. Raggett, Aston.

19th January, 1883.

313. Heathrugs, B. Taylor, Broomhouse.
314. Pipe Connections, R. F. C. Tonge, Pendleton, and J. Westley, Radcliffe.
315. Cylinders for Breaking up Fibrous Materials, J. D. Tomlinson, Rochdale.
316. Dynamo-electric Machines, F. H. Relph.—(*J. Olmsted, New York.*)
317. Secondary Batteries, H. J. Haddan.—(*E. Boettcher, Leipzig.*)
318. Hurricane Lanterns, &c., H. J. Haddan.—(*A. Schindler, Schweidnitz.*)
319. Machines for Making Buttons, H. J. Haddan.—(*H. Ulbricht and J. Hortig, Chemnitz.*)
320. Furnaces, B. Harlow, Macclesfield.
321. Switch for Increasing, &c., Electric Currents, F. Mori, Leeds.
322. Electric Lamps, F. Mori, Leeds.
323. Dressing Combs, H. G. A. de Bysterveld, Paris.
324. Securing Corks in Bottles, R. Howard, Luton.
325. Wood Screw, H. H. Lake.—(*Harvey Screw Company, New York.*)
326. Gas Engines, C. T. Linford and W. E. Cooke, Birmingham.
327. Netting Machinery, J. H. Johnson.—(*Messrs. Galland and Chaunier, Paris.*)
328. Ventilating Macintoshes, H. Sax, Spitalfields.

20th January, 1883.

329. Steam Boilers, J. Boulton, Ashton-under-Lyne.
330. Groynes, A. Dowson, London.
331. Coupling Railway Trucks, J. Darling, Glasgow.
332. Treating Sewage, J. Young, Kelly.
333. Foot Mats, E. P. Alexander.—(*C. Cheswright, Bordeaux.*)
334. Hansoms, H. Brockelbank, London.
335. Distilling Coal Shale, B. P. Walker, Birmingham, and J. A. B. Bennett, King's Heath.
336. Preventing Freezing of Water, J. W. Blakey, Leeds.
337. Glauber's Salt Free from Iron, H. J. Haddan.—(*B. Schmaltz and C. A. Loewig, Schoenebeck.*)
338. Small-arms, W. Hebler, Bern.
339. Telephonic Apparatus, J. Graham, London.
340. Coke Ovens, R. H. Brandon.—(*E. Franzen, Liège.*)
341. Moulding, &c., Stone, F. Trier, London.
342. Railway Couplings, F. Attock, Newton Heath.
343. Spinning Machinery, E. Tweedale and J. R. Barnes, Accrington, and R. Riley, Habbergham.
344. Sizing Machines, E. Tweedale and A. Hitchon, Accrington.
345. Combination Tools, &c., W. Brierley.—(*P. Frost, Breslau, Germany.*)
346. Applying Size to Yarns, G. Eaton, Manchester.
347. Cricket Appliances, G. G. Bussey, Peckham.
348. Voltaic Batteries, R. H. Courtenay, London.

22nd January, 1883.

349. Telephone Apparatus, C. A. Teske, London.
350. Bascules, H. J. T. Piercy, Birmingham.
351. Coupling Railway Wagons, S. A. Croft and R. Lomax, Manchester.
352. Fire-resisting Doors, J. M. Hart, London.
353. Locks, J. M. Hart, London.
354. Working Railway Signals, W. Robertson and E. P. Holtham, London.
355. Sounding Signals, E. P. R. Boehm.—(*D. W. J. Blancke, Merseburg.*)
356. Metal Canisters, G. L. Cumberland, London.
357. Dynamo-electric Machines, H. H. Lake.—(*H. R. Boissier, New York.*)
358. Ships' Sleeping Berths, H. H. Lake.—(*Huston Ships' Berth Company, U.S.*)
359. Glove Fastenings, F. R. Baker, Birmingham.
360. Moulding Socketted Pipes, G. Smith, Leicester.
361. Electric Lamps, H. H. Lake.—(*H. Boissier, U.S.*)
362. Producing Aluminium Alloys, G. B. de Overbeck.—(*H. Niewerth, Hanover.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

204. Classification of Colours, B. J. B. Mills, London.—A communication from J. Pittiot, Lyons.—*13th January*, 1883.
247. Treadle Mechanism for Sewing Machines, A. M. Clark, Chancery-lane, London.—A communication from G. B. Ward, New York.—*16th January*, 1883.
258. Engine Governors, J. Munro, West Croydon.—A communication from G. Keith, Cienfuegos.—*16th January*, 1883.
261. Electro-telegraphic Systems, P. M. Justice, Southampton-buildings, London.—A communication from T. M. Foote, Brooklyn, U.S.—*16th January*, 1883.
267. Knitting Machines, J. Adam, Philadelphia, U.S.—*17th January*, 1883.
289. Arresting Sparks from Flues, E. de Pass, London.—A communication from R. M. Howling, Ballarat.—*18th January*, 1883.
307. Alarm Guns, W. Burgess, Malvern Wells.—*18th January*, 1883.
325. Wood Screws, H. H. Lake.—A communication from the Harvey Screw Company, New York, U.S.—*19th January*, 1883.

Patents on which the Stamp Duty of £50 has been paid.

200. Supporting Bodies in Water, W. C. Brown, Sheffield.—*16th January*, 1880.
218. Counting Votes, &c., H. C. Symons, London.—*17th January*, 1880.
249. Fire-arms, W. R. Lake, London.—*20th January*, 1880.
263. Producing Anhydrous Sulphuric Acid, W. L. Wise, London.—*21st January*, 1880.
310. Punching Machines, J. Turner, London.—*23rd January*, 1880.
368. Anti-fouling Composition for Ships' Bottoms, T. Trebell, London.—*27th January*, 1880.
221. Self-acting Hydraulic Rams, J. Blake, Accrington.—*17th January*, 1880.
243. Purifying Waste Waters, J. C. Mewburn, London.—*20th January*, 1880.
314. Rope Stoppers, W. M. Bullivant, London.—*23rd January*, 1880.
316. Feeding Boilers, E. Davies, Llandinam.—*24th January*, 1880.
226. Coal Screens, C. Armstrong, London.—*19th January*, 1880.
435. Surgical Bandage Cloth, R. J. Winter and H. W. Taylor, London.—*31st January*, 1880.
246. Tanning Hides, C. D. Abel, London.—*20th January*, 1880.
256. Breech-loading Mechanism for Ordnance, G. Quick, London.—*21st January*, 1880.
259. Felt Carpets, W. Mitchell, Waterfoot.—*21st January*, 1880.
268. Obtaining Glucose from Ligneous Materials, A. M. Clark, London.—*21st January*, 1880.
287. Flooring, T. Wharam, Hyde.—*22nd January*, 1880.
294. Self-cocking Fire-arms, J. Dickson, Edinburgh.—*23rd January*, 1880.
317. Straining Paper Pulp, H. White, Denny.—*24th January*, 1880.
365. Crushing Stone, G. Dalton, Leeds.—*27th January*, 1880.
489. Driving Mechanism for Sewing Machines, W. R. Lake, London.—*4th February*, 1880.
543. Purifying Coal Gas, C. C. Walker, Lilleshall, and W. T. Walker, London.—*7th February*, 1880.
731. Steam Generators, J. Bellamy, London.—*19th February*, 1880.
313. Steelyards, J. Chater, London.—*23rd January*, 1880.
323. Winding, &c., Yarn, J. and T. A. Boyd, Shettleston.—*24th January*, 1880.
343. Gas-motor Engines, C. D. Abel, London.—*26th January*, 1880.
382. Foot Warmers, C. D. Abel, London.—*28th January*, 1880.
490. Water-closets, W. J. and A. T. Bean, London.—*4th February*, 1880.

Patent on which the Stamp Duty of £100 has been paid.

170. Supplying Fuel to Furnaces, M. H. Smith, Halifax.—*15th January*, 1876.
212. Sewing Machines, W. E. Gedge, London.—*19th January*, 1876.
319. Treating Oleaginous Seeds, A. B. Lawther, Liverpool.—*26th January*, 1876.
185. Cleaning Skins, J. J. Johnstone and J. Straiton, Bootle.—*18th January*, 1876.
284. Buffers, R. H. Hepburn, Sheffield.—*25th January*, 1876.
531. Marbled Papers, J. Huntington, Darwen, and W. Cadman, Leeds.—*10th February*, 1876.
240. Refining Sugar, H. H. Murdoch, London.—*20th January*, 1876.
482. Metallic Alloys, P. M. Parsons, Blackheath.—*7th February*, 1876.
862. Protecting Iron Surfaces, F. S. Barff, Kilburn.—*29th February*, 1876.
242. Pressing Woollen Fabrics, G. H. Nussey and W. B. Leachman, Leeds.—*21st January*, 1876.

254. Combing Cotton, J. M. Hetherington, Manchester. —21st January, 1876.
459. Weighing Small Coal, J. Thomas, Aberdare.— 4th February, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition, 9th February, 1883.*)

4354. Endless Platforms of Grain Straw Gathering, &c., Machines, P. Robinson, Saxby.—13th *September*, 1882.
4360. Noble's Wool Combing Machines, T. Wharton and R. Smith, Bradford.—13th *September*, 1882.
4361. Self-acting Mules, J. Dransfield and J. Issett, Dewsbury.—13th *September*, 1882.
4370. Apparatus for Grinding, &c., H. Slack, Sheffield —14th *September*, 1882.
4371. Dyeing, &c., Hanks, J. Conlong, Blackburn.— 14th *September*, 1882.
4381. Match-boxes, W. R. Lake, London.—A communication from A. Widestrôm.—14th *September*, 1882.
4391. Plates for Secondary Batteries, N. C. Cookson, Newcastle-upon-Tyne.—15th *September*, 1882.
4400. Separating Tin from Scrap Metal, C. D. Abel, London.—A communication from F. A. Reinecken and L. Poensgen.—15th *September*, 1882.
4401. Compression Pumps for Ammonia Gas, C. D. Abel, London.—A communication from A. Osenbrück.—15th *September*, 1882.
4411. Regenerating Peroxide of Manganese, G. W. von Nawrocki, Berlin.—A communication from The Verein Chemischer Fabriken.—16th *September*, 1882.
4412. Locking Points, &c., by Electricity, S. Brear and A. Hudson, Bradford —16th *September*, 1882.
4417. Friction Clutches, W. A. Barlow, London.— 16th *September*, 1882.
4423. Composition for Preserving Wood, &c., W. R. Lake. London.—A communication from A. Buzolich and T. K. Smith.—16th *September*, 1882.
4424. Preventing the Deposit of Sand, &c., W. R. Lake, London.—A communication from H. E. Hargreaves.—16th *September*, 1882.
4430. Water-closets, J. Imray, London.—Com. from R. H. Lecky and J. Hay.—18th *September*, 1882.
4456. Harvesting Sugar Cane, &c., T. D. Stetson, U.S.—A communication from W. C. Dollens and G. H. Zschech.—19th *September*, 1882.
4457. Connecting Lamps to the Shafts of Bicycles, &c., J. Lucas, Birmingham.—19th *September*, 1882.
4482. Handles for Table Cutlery, H. and T. W. Hall, Sheffield.—20th *September*, 1882.
4511. Storing, &c., Electricity, J. D. F. Andrews, Glasgow.—21st *September*, 1882.
4527. Electro-magnetic Engraving Machines, B. J. Carter, London.—A communication from G. McKendree Guerrant.—22nd *September*, 1882.
4566. Governing Apparatus, B. Fowler and W. Daniel, Leeds.—25th *September*, 1882.
4570. Treating Leaves, &c., for Obtaining Fibre, A. V. Newton, London.—Com. from The Sanford Universal Fibre Company.—26th *September*, 1882.
4603. Spinning Rings, B. J. B. Mills, London.—Com. from J. Schütt & J. Warnholtz.—28th *September*, 1882.
4811. Door Stops, &c., A. J. Boult, London.—A communication from G. R. Elliott, J. M. Winslow, and T. E. Clary.—10th *October*, 1882.
5254. Driving Tram-cars by Electricity, A. Reckenzaun, Leytonstone.—3rd *November*, 1882.
5297. Treating Fibre-bearing Leaves, &c., H. C. Smith, Richmond.—6th *November*, 1882.
5334. Decorticating, &c., Rice, J. H. C. Martin, Walthamstow.—8th *November*, 1882.
5648. Drawing, &c., Wire, H. Roberts, Pittsburgh, U S —28th *November*, 1882.
5649. Zinc-coated Wire, H. Roberts, Pittsburgh, U.S. —28th *November*, 1882.
5791. Stoppers for Bottles, P. P. Deslandes, Jersey. —5th *December*, 1882.
5870 Increasing the Efficiency of Telephones, W. R. Lake, London.—A communication from A. E. Dolbear.—8th *December*, 1882.
5928. Tubular Structures, H. N. Maynard and H. J. Cooke, London.—12th *December*, 1882.
6058. Treating Alkaline Salts, &c., C. A. Faure, Paris.—19th *December*, 1882.
6093. Looms for Weaving, J. Laird, jun., Forfar, N.B. —21st *December*, 1882.
6143. Disinfecting Compounds, I. S. McDougall, London.—23rd *December*, 1882.
6149. Extraction of Saccharine Matter from Vegetable Substances, C. D. Ekman, W. B. Espeut, and G. Fry, London.—23rd *December*, 1882.
6169. Silica Fire-bricks, &c., H. Edwards, Braich-y-Cymmer, and H. Harries, Glyn Neath.—27th *December*, 1882.
6232. India-rubber, &c., H. Gerner, London.—30th *December*, 1882.
6238. Discharging Fire-arms, N. G. Green, London. —Partly a communication from J. L. Galt and J. P. Freeman—30th *December*, 1882.
12. Toilet Apparatus for Ships, H. J. Haddan, London.—Com. from D. Wellington.—1st *January*, 1883.

(*Last day for filing opposition, 13th February, 1883.*)

4267. Handles for Table Cutlery, J. Fee, Sheffield. —7th *September*, 1882.
4426. Pumps, T. Willoughby, Leeds.—18th *September*, 1882.
4427. Valves, W. Lloyd, Newport.—18th *September*, 1882.
4433. Knife Cleaning Machine, C. W. Spong, London. —18th *September*, 1882.
4444. Nails and Screws, S. Beaven, Brazil.—19th *September*, 1882.
4448. Hermetically Sealed Vessels, W. A. Barlow, London.—Com. from A. Luger.—19th *September*, 1882.
4449. Range and Register Grate, W. Y. Stevens, Bristol.—19th *September*, 1882.
4454. Transmitters for Speaking Telephones, W. P. Thompson, Liverpool.—A communication from F. Milliken, J. W. Brown, and H. D. Hyde.—19th *September*, 1882.
4462. Chimney Tops, J. McPhail, London.—19th *September*, 1882.
4465. Manufacturing Biscuits, G. Baruch, Austria. —19th *September*, 1882.
4466. Closing, &c., Ventilator Frames, E. Edwards, London.—A communication from A. Descaves and D. Halut.—19th *September*, 1882.
4467. Joining, &c., the Ends of Rails, E. E. Talbot, London.—19th *September*, 1882.
4468. Nut-locks, C. A. Snow, Washington, U.S.—Com. from L. Triplett, jun.—19th *September*, 1882.
4477. Manufacture of Soap, J. Glover, Silcoates.— 20th *September*, 1882.
4480. Tablet Diaries, J. W. Cochrane, Glasgow.—20th *September*, 1882.
4489. Gas Motor Engines, F. W. Crossley, Manchester. —20th *September*, 1882.
4498. Sugar Mills, E. Death and J. Ellwood, Leicester. —21st *September*, 1882.
4555. Dynamo-electric Engines, A. Lalance and M. Bauer, Paris.—25th *September*, 1882.
4705. Domestic Vessels, T. A. Brown, Surrey.—3rd *October*, 1882.
4757. Mixing Water with Gas, &c., E. de Pass, London.—Com. from E. Körting.—6th *October*, 1882.
4832. Telephones, J. H. Johnson, London.—Com. from L. de Lockt-Labye.—11th *October*, 1882.
4883. Electric Lamps, P. R. de F. d'Humy, Clapham Rise.—14th *October*, 1882.
5101. Rotary Engines, &c., T. S. Greenaway and A. Kitt, London.—26th *October*, 1882.
5108. Galvanic Batteries, P. R. de F. d'Humy, Clapham Rise.—27th *October*, 1882.
5191. Combined Reaping and Sheaf-binding Machines, W. McIntyre Cranston, London.—A communication from W. A. Wood.—31st *October*, 1882.
5616. Exhausting, &c., Fluids, H. S. Stewart, London.—25th *November*, 1882.
5758. Fountain Penholders, J. E. Cousté, London.— 2nd *December*, 1882.
5778. Window Sash Fastenings, J. D. Sprague, Upper Norwood.—5th *December*, 1882.
6070. Pressing Horns, &c., for the Manufacture of Combs, D. Stewart, Aberdeen.—20th *December*, 1882.
6072. Artificial Horizons for Quadrants, &c. W. E. Gedge, London.—A communication from S. Pattee. —20th *December*, 1882.
6088. Rotary Knitting Machines, W. Cotton, Loughborough.—20th *December*, 1882.
6164. Producing Electric Light, A. M. Clark, London. —A communication from L. Gerard and W. V. Bonsor.—23rd *December*. 1882.
127. Looms for Velvet, W. E. Gedge, London.—Com. from H. Morel & J. B. Poncet.—9th *January*, 1883.
267. Knitting Machines, J. Adams, Philadelphia, U.S. —17th *January*, 1883.
289. Arresting Sparks from Funnels, &c., E. de Pass, London.—A communication from R. Howling. —18th *January*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 17th and 19th January, 1883.*)

5525. Dynamo-Electric Machines, W. H. Akester, Glasgow.—17th *December*, 1881.
3388. Attachments for Boots, &c., G. Rate and T. Chattaway, Leicester.—17th *July*, 1882.
3456. Closing the Mouths of Bottles, C. E. H. Cheswright, London.—20th *July*, 1882.
3476. Chambers for Electrical Apparatus, W. A. Barlow, London —21st *July*, 1882.
3487. Maintaining Draught in Chimneys, E. Edwards, London.—22nd *July*, 1882.
3490. Cutting, &c., Fire-wood, J. Rowley and H. Vulliamy, London.—22nd *July*, 1882.
3497. Treating Sewage, &c., T. H. Cobley, Dunstable. —22nd *July*, 1882.
3499. Grain Elevators, J. McAuley, Bootle.—22nd *July*, 1882.
3511. Flush Cisterns, W. Wright, Plymouth.—24th *July*, 1882.
3516. Surgical Supports, &c., H. Hides, Surbiton.— 25th *July*, 1882.
3532. Secondary, &c., Batteries, G. L. Winch, Madras.—25th *July*, 1882.
3536. Union Joint for Pipes, W. H. Beck, London.— 25th *July*, 1882.
3539. Producing Fabrics, J. Jowitt and G. S. Page, New York, U.S.—25th *July*, 1882.
3540. Thermo-dynamic Engines, J. Hargreaves, Widnes.—26th *July*, 1882.
3556. Boat-lowering Appliances, C. Grayson, Liverpool.—27th *July*. 1882.
3565. Adjusting Ventilators, H. Morris, Manchester. —27th *July*, 1882.
3566. Looms for Weaving, T. Singleton, Darwen.— 27th *July*, 1882.
3589. Manufacture of Casks, &c., S. Wright, Egremont.—28th *July*, 1882.
3613. Stoves, A. C. Henderson, London.—31st *July*, 1882.
3660. Musical Instruments, P. Ehrlich, Saxony.— 2nd *August*, 1882.
3681. Facilitating Telephonic Communication, J. Cowan, Garston.—2nd *August*, 1882.
3773. Sulphites, &c., J. Imray, London.—8th *August*, 1882.
3897. Regenerative Hot Blast Stoves, B. Ford, Middlesbrough-on-Tees, and J. Moncur, Cumberland. —15th *August*, 1882.
3903. Carriage Axles, W. R. Lake, London.—15th *August*, 1882.
3950. Treating Peaty Turf, &c., P. J. Friedrichs, London.—18th *August*, 1882.
3981. Steam Engines, J. Shanks and J. G. Lyon, Arbroath, N.B.—19th *August*, 1882.
4090. Heating Appliances, W. Thornburn, Boroughbridge.—26th *August*, 1882.
4241. Purifying Steam Boilers, &c., M. Coulson, Spennymoor.—6th *September*, 1882.
4586. Locomotive Brakes, W. M. Lendrum, Blatherwicke.—27th *September*, 1882.
4679. Hack Cap for Bricks, J. D. Lampard and F. Coppen, London.—2nd *October*, 1882.
4872. Bridles for Horses, &c., J. G. Heinisch, Belgard.—13th *October*, 1882.
5182. Telegraph Printing, J. Imray, London.—31st *October*, 1882.
5193. Preventing, &c., the Passage of Heat and Moisture, W. T. Whiteman, London.—31st *October*, 1882.
5195. Automatic Weighing, &c., Apparatus, W. T. Whiteman, London.—31st *October*, 1882.
5298. Running Metals into Moulds, F. Asthöwer, Annen.—6th *November*, 1882.
5691. Looms for Weaving, P. I. Garin-Moroy, France. —29th *November*, 1882.
5723. Attrition Mills, T. L. Sturtevant, Framingham, U.S.—1st *December*, 1882.

(*List of Letters Patent which passed the Great Seal on the 23rd January, 1883.*)

3410. Passenger Tickets, J. A. Francis, Newington Butts.—18th *July*, 1882.
3421. Railway Carriages, W. P. Thompson, Liverpool.—18th *July*, 1882.
3506. Carrying, &c., Coal, E. O. Greening and H. J. Collins, London.—24th *July*, 1882.
3507. Railway Chairs, J. Revell, Dukinfield.—24th *July*, 1882.
3517. Burglar Proof Safes, W. Corliss, Providence, U.S.—25th *July*, 1882.
3522. Metallic Wolfram, &c., C. J. L. Leffler, Sheffield.—25th *July*, 1882.
3526. Direct-acting Rotary Engine and Pump, E. G. Brewer, London.—25th *July*, 1882.
3533. Taps, W. Hunt, Scarborough.—25th *July*, 1882.
3537. Cutting, &c., Metal Washers, W. P. Thompson, Liverpool.—25th *July*, 1882.
3576. Distributing, &c., Electricity, J. Hopkinson, London.—27th *July*, 1882.
3577. Caustic Soda, &c., A. J. Boult, London.—27th *July*, 1882.
3596. Manufacture of Hats, R. Wallwork, Manchester.—29th *July*, 1882.
3597. Awnings for Hammocks, &c., O. Seydel, Birmingham.—29th *July*, 1882.
3600. Tricycles, &c., J. P. Dalby, Leeds.—29th *July*, 1882.
3603. Buttons and Fasteners, C. Daggett, London.— 29th *July*, 1882.
3610. Obtaining Products from Blast Furnaces, J. Alexander and A. K. McCosh, Lanark.—31st *July*, 1882.
3615. Looms for Weaving, J. Hopkinson, Birstal.— 31st *July*, 1882.
3616. Galvanic Batteries, J. R. Rogers, London.— 31st *July*, 1882.
3618. Discharging Oil on Agitated Water, J. Gordon, jun., Dundee.—31st *July*, 1882.
3651. Preventing Incrustation in Steam Boilers, W. E. Gedge, London.—1st *August*, 1882.
3658. Steam Pumps, W. W. Beaumont, London.—1st *August*, 1882.
3712. Cores, &c., of Electro-magnets, S. C. C. Currie, London.—4th *August*, 1882.
3714. Sulphurous Anhydride, S. Pitt, Sutton.—4th *August*, 1882.
3715. Dressing Waste Silk, S. C. Lister, Manningham.—4th *August*, 1882.
3752. Transmitting Electricity, T. J. Handford, London.—5th *August*, 1882.
3755. Electrical Meters, T. J. Handford, London.— 5th *August*, 1882.
3756. Dynamo, &c., Electric Machines, T. J. Handford, London.—5th *August*, 1882.
3817. Securing Doors, &c., H. J. Haddan, London.— 10th *August*, 1882.
3949. Supplying Electricity for Light, &c., T. J. Handford, London.—17th *August*, 1882.
3955. Incandescing Electric Lamps, T. J. Handford, London.—18th *August*, 1882.
3961. Secondary Batteries, T. J. Handford, London. —18th *August*, 1882.
3976. Electric Lights, T. J. Handford, London.— 19th *August*, 1882.
3986. Connecting, &c., Railway Rolling Stock, F. Barnes, Reading.—19th *August*, 1882.
3991. Incandescing Conductors, T. J. Handford, London.—19th *August*, 1882.
3995. Underground Conductors, T. J. Handford, London.—21st *August*, 1882.
3996. Dynamo, &c., Electric Machines, T. J. Handford, London.—21st *August*, 1882.
4375. Hydraulic Lifts, J. S. Stevens and C. G. Major, Battersea.—14th *September*, 1882.
4459. Treating Middlings, W. R. Lake, London.— 19th *September*, 1882.
5067. Treating Waste Materials, E. Davies, London. —24th *October*, 1882.
5232. Breaking, &c., Flax, J. Shinn, Philadelphia, U.S.—2nd *November*, 1882.
5285. Artificial Dung, S. Walter, Berlin.—6th *November*, 1882.
5411. Furnaces for Heating Iron, W. Felton, Wilden. —13th *November*, 1882.
5416. Lubricator Attachments for Engines, P. M. Justice, London.—14th *November*, 1882.

List of Specifications published during the week ending January 20th, 1883.

3038*, 4d.; 4491*, 4d.; 4544*, 4d.; 5223*, 4d.; 1391, 4d.; 2418, 6d.; 2518, 2d.; 2520, 6d.; 2567, 6d.; 2633, 6d.; 2634, 6d.; 2647, 8d.; 2649, 6d.; 2652, 6d.; 2657, 8d.; 2663, 6d.; 2673, 6d.; 2675, 6d.; 2682, 1s. 2d.; 2684, 6d ; 2694, 6d.; 2696, 6d.; 2698, 6d.; 2706, 6d.; 2708, 4d.; 2713, 2d.; 2716, 4d.; 2718, 6d.; 2721, 6d.; 2723, 6d.; 2726, 2d.; 2731, 6d.; 2732, 6d.; 2734, 6d.; 2739, 6d.; 2742, 6d.; 2743, 6d.; 2746, 6d.; 2747, 6d.; 2748, 6d.; 2749, 6d.; 2750, 6d.; 2752, 6d.; 2753, 8d.; 2755, 8d.; 2756, 6d.; 2757, 6d.; 2759, 6d.; 2764, 10d.; 2767, 6d.; 2768, 10d.; 2769, 6d.; 2771, 4d.; 2778, 6d.; 2779, 6d.; 2786, 6d.; 2796, 4d.; 2798, 2d.; 2800, 2d.; 2801, 2d.; 2802, 8d.; 2805, 4d.; 2807, 4d.; 2809, 2d.; 2812, 2d.; 2814, 1s.; 2815, 8d.; 2817, 2d.; 2820, 4d.; 2831, 2d.; 2833, 6d.; 2835, 2d.; 2836, 8d.; 2842, 2d.; 2843, 2d.; 2845, 2d.; 2851, 6d.; 2853, 2d.; 2854, 2d.; 2859, 2d.; 2860, 2d.; 2861, 2d.; 2862, 2d.; 2864, 4d.; 2866, 2d.; 2869, 2d.; 2880, 6d ; 2882, 2d.; 2888, 2d.; 2891, 2d.; 2892, 2d ; 2895, 4d.; 2898, 6d.; 2899, 2d.; 2902, 4d.; 3008, 1s.; 3016, 4d.; 3029, 6d.; 3070, 6d.; 4179, 6d.; 4930, 6d.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for The Engineer *at the office of Her Majesty's Commissioners of Patents.*

1391. Processes in Preparing Tablets or Surfaces for Printing from, *F. Rath, London.—22nd March*, 1882.—(*A communication from M. Komaromy, Hungary.*) 4*d.*

This relates to the preparation of gelatinous surfaces for printing from.

2418. Stays and Corsets, *A. Ottenheimer, Stuttgart.—22nd May*, 1882. 6*d.*

The object is to render the bones less liable to fracture at sides of the waist immediately above the hips.

2518. Improvements in Compounds for Electrical Insulation, &c., *G. S. Page, Stanley, Jersey State, U.S., and Strand, London.—26th May*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the mixture of various mineral substances with pseudo carbons, cellulose, leather, and horn substances, &c.

2520. Machines for Breaking Coke, *H. J. H. Thomas and J. Somerville, Old Kent-road.—27th May*, 1882. 6*d.*

This relates to machines having a revolving cylinder with blades or cutters formed thereon, and a series of fixed blades or cutters fitted in a frame.

2567. Improvements in Heating by Electricity, &c., *Oswald Rose, Manchester.—31st May*, 1882. 6*d.*

This consists in passing a current of electricity through a coil of wire or carbon placed inside a water heater, so as to heat the wire or carbon and also the water, the latter when heated being distributed through the building on the Perkins or high-pressure system.

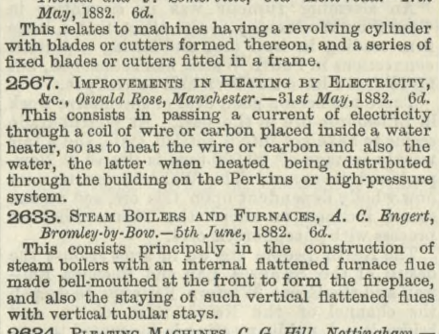
2633. Steam Boilers and Furnaces, *A. C. Engert, Bromley-by-Bow.—5th June*, 1882. 6*d.*

This consists principally in the construction of steam boilers with an internal flattened furnace flue made bell-mouthed at the front to form the fireplace, and also the staying of such vertical flattened flues with vertical tubular stays.

2634. Pleating Machines, *C. G. Hill, Nottingham.—5th June*, 1882. 6*d.*

This relates to the arrangement and mode of actuating the blade F, for pushing forward the fabric in pleats or folds between the rollers L, which are caused to rotate slowly. B is the driving shaft, and on it is an eccentric, by which the blade F is actuated. The blade F has a number of slips, so as to form a kind of comb, and enable it to exercise a more uniform pres-

2634



sure. A worm on shaft B gears with a wheel on an inclined axis, which also carries a worm gearing with a wheel on the shaft of lower roller L. The upper and lower rollers are geared together. M is a pressing roller driven from the lower roller, and serving to form a band in the centre of the pleated fabric by pressing moistened threads upon it.

2647. Metal Tubes, *J. Robertson, Govan.—6th June*, 1882. 8*d.*

This refers specially to the mode and means of grinding and polishing or finishing tubes of iron or steel, and to improvements in the construction and arrangement of apparatus for rolling the tubes and effecting the grinding or polishing operations.

2649. Pique Glove Sewing Machine, *J. Helyar, Yeovil.—6th June*, 1882. 6*d.*

This consists in imparting to the "looper" a reciprocating vertical motion, *i.e.*, in a direction perpendicular to the plane of the looper, in addition to the alternate circular motion which it has hitherto alone received, and in providing said looper hook with a notch, whereby, in conjunction with such vertical motion, to catch and hold the needle thread and prevent missing stitches.

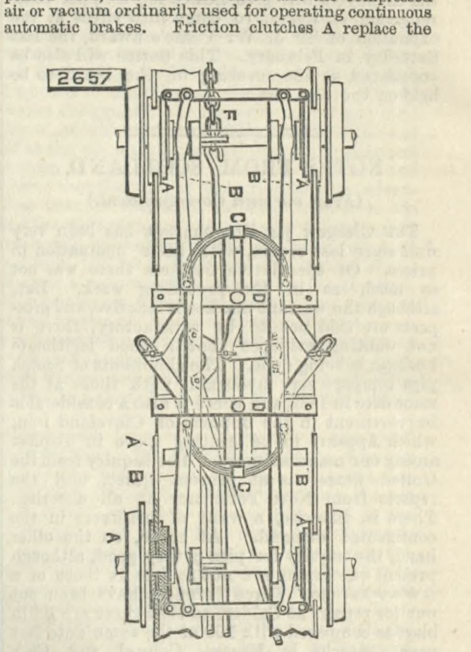
2652. Date Indicators or Calendars, *W. R. Lake, London.—6th June*, 1882.—(*A communication from J. Cussons, Virginia, U.S.*) 6*d.*

This relates to the employment of three pivotted dials, one of which contains characters indicating the day of the week, while the other two contain respectively ten and three large figures or numerals, which figures placed in proper relation are adapted to exhibit jointly any required day of the month.

2657. Railway Brakes, *A. E. Harris, Finsbury-pavement.—6th June*, 1882. 8*d.*

This relates to a continuous automatic railway brake, in which the ordinary brake blocks are dispensed with, and in some cases also the compressed air or vacuum ordinarily used for operating continuous automatic brakes. Friction clutches A replace the

2657



blocks, and are actuated by levers B pivotted to a cross frame, and connected at their inner ends on each side of the frame by a pin taking into a slot. D is a sliding frame by which the levers are actuated, such frame being moved in either direction by means of a system of levers, rods, and links connected by means of a chain E to a pulley. The spring C tends to force the ends of the levers apart, and so put the brakes into operation.

2663. Machinery for Drying and Pulverising Blood, &c., *J. Farmer, Salford.—7th June*, 1882. 6*d.*

This consists of a fixed steam casing of a twin cylindrical form with closed ends, in which casing revolve two hollow steam-heated axles, each provided with a series of blades or beaters, which latter are set at varying angles, and so arranged that when they revolve they pass between each other.

2673. Manufacture of Gas for Illuminating Purposes, &c., *W. R. Lake, London.—7th June*, 1882.—(*A communication from A. Binnie, New Zealand.*) 6*d.*

This consists essentially in the manufacture of gas for illuminating and other purposes by the combined use of air, water, and animal fat, or its alternatives, in comparatively minute quantities, the water being first reduced to steam, the animal fat or alternatives to a heated gas, and the air being supplied in suitable quantities, and the whole mingled together in a heated vessel so as to form a homogeneous gas.

2675. Improvements in Telephones, *H. Alabaster, South Croydon, T. E. Gatehouse, Camberwell, and H. R. Kempe, Barnet.—7th June*, 1882. 6*d.*

This relates to a telephonic receiver, which is constructed as follows:—At each end of a suitable case the inventors fix a plate, and between these plates they stretch an iron or steel wire, round which are closely wound two coils of insulated wire. One of these, which may be of coarse wire, connects the poles of a local battery; the other coil, preferably of fine wire, is connected to the line at its one end, and to the earth at its other end. Electrical undulations produced by speaking into a transmitter connected with this receiver are reproduced in the iron or steel wire, and also the two plates, which latter reproduce the original speech. Two ear pieces and tubes are connected to the plates.

2682. Treating Carbonaceous, Bituminous, Calcareous, and other Substances to Obtain Products therefrom, *H. Aitken, Falkirk.—8th June*, 1882. 1*s.* 2*d.*

This relates partly to improvements in treating coal, lignite, shale, wood, peat, or moss, sawdust, and other carbonaceous or bituminous matter, as well as calcareous or cretaceous substances and sandstone, ironstone, and limestone for the production therefrom of gas, oil, tar, coke, resins, sulphur, bitumen and ammoniacal liquor; and it further relates to the treating of coke, spent shale, iron ores, and ores of other metals, for the production of gas, sulphur, arsenic, lead, zinc, and other substances, as well as ammonia.

2684. Ships' Steerage Berths, *A. Nickels, Liverpool.—8th June*, 1882. 6*d.*

This consists in the attachment of means of connecting and supporting the stanchions, foot and head boards, and the side or connecting boards, and the canvas bottom.

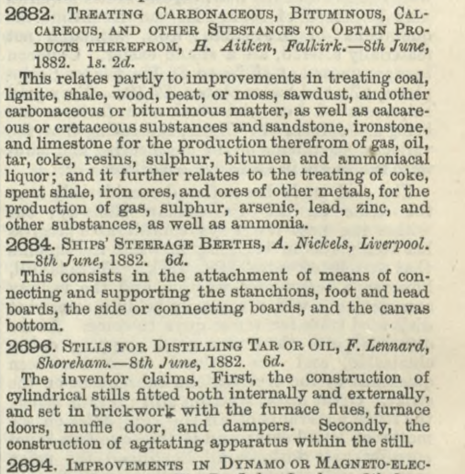
2696. Stills for Distilling Tar or Oil, *F. Lennard, Shoreham.—8th June*, 1882. 6*d.*

The inventor claims, First, the construction of cylindrical stills fitted both internally and externally, and set in brickwork with the furnace flues, furnace doors, muffle door, and dampers. Secondly, the construction of agitating apparatus within the still.

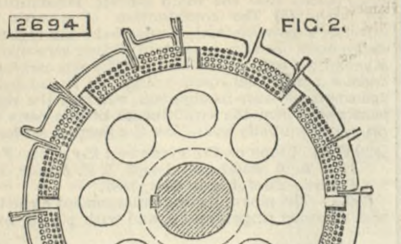
2694. Improvements in Dynamo or Magneto-electric Machines, *W. R. Lake, London.—8th June*, 1882.—(*A communication from E. Weston, Newark, New Jersey, U.S.*) 6*d.*

This relates to the winding of the armatures of the inventor's dynamo machines, and the object is to save time and labour, and, as far as the first part of the

2694 FIG. 1



patent is concerned, to supply currents of high electromotive force. The method of winding is shown in Figs. 1 and 2. The claim is for "an armature wound with two systems of coils in diametrically separate divisions, the divisions of one system being alternately under and over those of the other system, and the said divisions being looped together and connected to the commutator." The other part of the patent


2694 FIG. 2.

relates to an armature wound so as to produce currents of great quantity.

2698. AXLE BEARINGS AND THEIR LUBRICATION, *W. J. Brewer, London.—8th June*, 1882. 6*d*.
This consists in the combination in an axle of lubricating chambers having suitable feeding ducts, with water-tight and dust-tight journal, formed by rings of india-rubber and protecting disc plates and subsidiary parts.

2706. TREATMENT OF ORES, *J. M. Stuart, London, and J. Elliott, Reigate.—9th June*, 1882. 6*d*.
The inventor claims, First, an improved furnace in combination with the ovens and retorts. Secondly, the generation and application of a gas made preferably from sulphate of copper, potassium, salt, iron, and water, together with the heating of the neck of the retort for the purpose of forming a blast.

2708. TREATMENT OF CELESTINE AND SULPHIDE OF STRONTIUM FOR PRODUCTION OF CAUSTIC STRONTIA AND CARBONATE OF STRONTIA, *F. J. Bolton, London. —9th June*, 1882. 4*d*.
This consists essentially in the treating of sulphate of strontia or celestine for the production of caustic strontia and carbonate of strontia, wherein the celestine previously roasted with carbonaceous matter is first subjected to the action of hot water for the extraction of the caustic strontia, after which the residuum is treated first with carbonic acid and then with carbonate of ammonia, or with a mixture of carbonic acid and ammonia gas, in order to convert the remaining sulphides into carbonate of strontia.

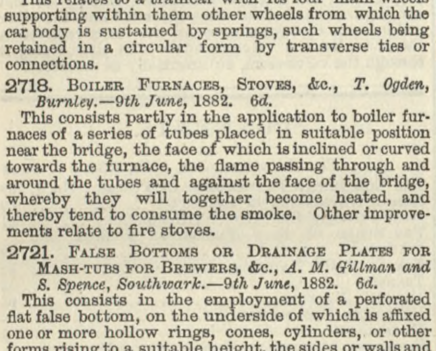
2713. GUNPOWDER, *W. R. Lake, London.—9th June*, 1882.—(*A communication from N. Wiard, Washington, U.S.*)—(*Not proceeded with.*) 2*d*.
This relates to a perforated grain of gunpowder.

2716. TRAMCARS, *T. B. Knightley, London.—9th June*, 1882. 4*d*.
This relates to a tramcar with its four main wheels supporting within them other wheels from which the car body is sustained by springs, such wheels being retained in a circular form by transverse ties or connections.

2718. BOILER FURNACES, STOVES, &c., *T. Ogden, Burnley.—9th June*, 1882. 6*d*.
This consists partly in the application to boiler furnaces of a series of tubes placed in suitable position near the bridge, the face of which is inclined or curved towards the furnace, the flame passing through and around the tubes and against the face of the bridge, whereby they will together become heated, and thereby tend to consume the smoke. Other improvements relate to fire stoves.

2721. FALSE BOTTOMS OR DRAINAGE PLATES FOR MASH-TUBS FOR BREWERS, &c., *A. M. Gillman and S. Spence, Southwark.—9th June*, 1882. 6*d*.
This consists in the employment of a perforated flat false bottom, on the underside of which is affixed one or more hollow rings, cones, cylinders, or other forms rising to a suitable height, the sides or walls and tops of which are perforated.

2723. IMPROVEMENTS IN ELECTRIC LAMPS, *C. G. Gumpel, Leicester-square.—9th June*, 1882. 6*d*.
This relates to an arc lamp, the arc being regulated by two electro-magnets, one in the main the other in a shunt circuit. The invention will be better understood by the accompanying illustration. The upper carbon is fixed to a guided holder C, attached to a rod A passing through solenoid B, and counterbalanced by a weight connected to it by cords passing over pulleys. When the upper and lower carbons (the lower one being stationary) are in contact and the lamp in


2723

circuit, coil B, of low resistance, becomes energised; core G is then attracted upward, and moving the bell crank E causes roller X to press against rod A, so that the latter is gripped between X and F, and by the continued ascent of the core the arc is struck. When the arc gets too long and its resistance great, the current passes through shunt coil K of high resistance. Its core H is then drawn upwards, and its pawl clamps the rim of wheel W, turning it in the direction of the arrow and causing the upper carbon to descend, so as to adjust the arc.

2726. BILGE WATER ALARMS FOR BARGES, &c., *A. M. Clark, London.—9th June*, 1882.—(*A communication from A. H. L. Oudry, Paris.*)—(*Not proceeded with.*) 2*d*.
This relates to the employment in combination with a suitable mechanical or electrical alarm of a solid substance soluble in water, so applied as to prevent the action of the alarm until, by the rise of the water to its level, the substance is dissolved therein and liberates the mechanism.

2731. REVOLVERS OR POCKET PISTOLS, *E. G. Brewer, London.—10th June*, 1882.—(*A communication from J. E. Turbiaux, Paris.*) 6*d*.
This relates to a revolver which is held in the hand, with nothing exposed to view except the barrel.

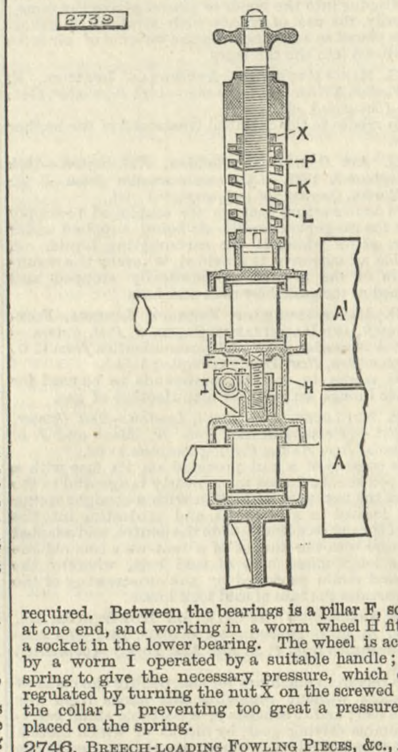
2732. MOVING TARGETS, *R. Morris, Blackheath.—10th June*, 1882. 6*d*.
This consists in the construction of a moving target wherein the speed of the moving object is regulated by more or less throttling the issue of liquid from a cylinder fitted with a piston or plunger connected to the object.

2742. LANTERNS FOR STREET LAMPS, &c., *W. E. Heavens, Pimlico.—10th June*, 1882. 6*d*.
This relates to a lantern composed of sections connected to each other and to a ring or cap, and capable of being detached.

2743. FINISHING TEXTILE FABRICS, *E. Edwards, London.—10th June*, 1882.—(*A communication from C. and J. Chollet, St. Quentin, France.*) 6*d*.
This relates to machinery or apparatus operating continuously upon lengths of textile fabrics passed through it for the purpose of finishing the latter, the material to be treated being carried over endless chains arranged on each side of the apparatus and carrying clips or holders which seize and carry it forward.

2784. AN IMPROVED MODE OF GOVERNING THE FEED OF ELECTRIC ARC LAMPS, *J. Mathieson, Stratford, Essex.—10th June*, 1882. 6*d*.
This relates to an improvement in the mechanism of the gramme arc lamp, whereby sparking at the points of contact, whenever the armature releases the train which feeds the carbon and also breaks the circuit of its own magnet coils, is avoided. It consists in causing the armature, at the moment of attraction, instead of breaking the shunt circuit, to make also an electrical contact, which bridges over or cuts out the magnet.

2739. ADJUSTING THE ROLLERS OF ROLLER MILLS FOR CRUSHING, &c., *J. Higginbottom and O. Stuart, Liverpool.—10th June*, 1882. 6*d*.
In the drawing the rolls A and A^1 are arranged vertically, and the top bearings slide between guides in the frame. The bottom bearings are also placed between the guides, so as to be easily removable when


2739

required. Between the bearings is a pillar F, screwed at one end, and working in a worm wheel H fitted in a socket in the lower bearing. The wheel is actuated by a worm I operated by a suitable handle; K is a spring to give the necessary pressure, which can be regulated by turning the nut X on the screwed rod L, the collar P preventing too great a pressure being placed on the spring.

2746. BREECH-LOADING FOWLING PIECES, &c., *L. Gye, London.—10th June*, 1882. 6*d*.
The inventor claims, First, jointing a movable breech to the body by means of a semicircular-curved bar on its under side; Secondly, a movable stop at the side of the gun; Thirdly, means for giving a backward movement to the extractor when the breech is opened.

2747. RIGGING OF SAILING VESSELS, *W. H. Hall, Kew. —10th June*, 1882. 6*d*.
This relates to the application to the booms of sailing vessels rigged with fore and aft sails of a stay or stays.

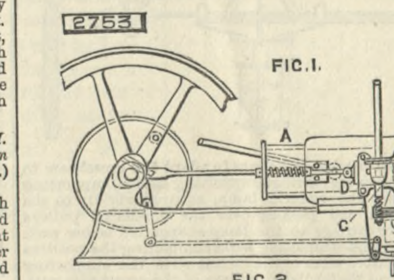
2748. BURNING PYRITES, *E. Bramwell, St. Helens, Lancaster.—12th June*, 1882. 6*d*.
The inventor claims, First, burning pyrites by making the air to support combustion to travel with the products from burner to burner; Secondly, pyrites' burners arranged in series in such manner that the same air shall act on the pyrites in each burner in circulating succession.

2749. CAPSULES FOR BOTTLES, *C. Cheswright, London. —12th June*, 1882. 6*d*.
This invention has partly for its object the production of a capsule of oval form, or having two, three, or more flat sides with rounded corners or edges, such form being better adapted for perforation on the side, whilst the capsule is at the same time capable of assuming the form or contour of the neck of the bottle or other receptacle to which it is applied.

2750. MINERS' SAFETY LAMPS, *W. Morgan, Pontypridd.—12th June*, 1882. 6*d*.
This relates to arrangements for supplying air to the burners and for carrying off the products of combustion.

2752. IMPROVEMENTS IN THE CONSTRUCTION OF ELECTRIC LAMPS, &c., *J. Lane, Fulham.—12th June*, 1882. 6*d*.
This relates to incandescent lamps. Instead of mounting his filament in the usual way the inventor fits them in a special plug, and inserts this into the neck of a glass globe and seals it there. A passage in this plug is utilised to produce a vacuum or to introduce non-combustible gases, and is then closed with sealing material.

2753. GAS MOTOR ENGINES, *C. F. Wordsworth, Leeds, and J. Wolstenholme, Radcliffe, Lancashire.—12th June*, 1882. 8*d*.
This relates to gas engines worked by the explosion of gas and air or vapour, after it has been drawn into a cylinder by a piston on the outward stroke, is


2753 FIG. 1.

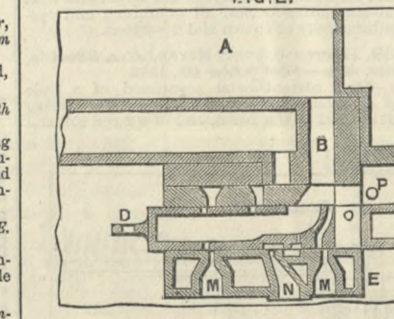


FIG. 2.

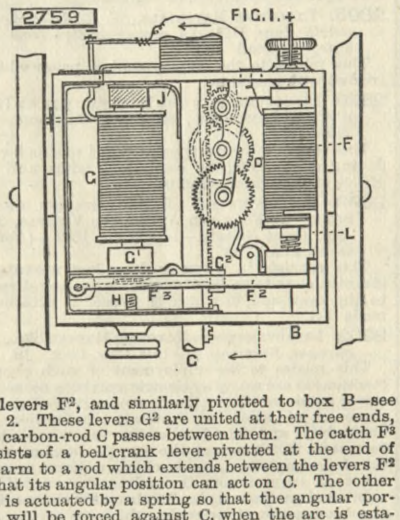
ignited, and exploded in the cylinder until the full travel of the piston has taken place, and on the return stroke the products of combustion are expelled through an exhaust valve. A is the cylinder; B the explosion port; D the slide; E the back plate; G the gas inlet valve; and H the exhaust; M are the air admission ports; N the gas admission port; and P the igniting flame chimney. An annular chamber is formed on the end of cylinder, so that the piston may enter it just before the termination of its outstroke, so that the volume of air displaced may be used for flushing the igniting chamber. The air slots and gas inlet ports are arranged as shown, that a more diluted mixture of gas and air may be exploded, and all chances of wiredrawing at the terminal edges of the slide at the time of ignition are reduced.

2755. IMPROVEMENTS IN ELECTRIC LAMPS, &c., *W. Chadburn, Liverpool.—12th June*, 1882. 8*d*.
This relates, First, to arc lamps. The regulating device consists of three vertical gripping levers pivotted to a ring suspended by adjustable stops from the top plate of the lamp. The lower ends of these levers are made to grip the carbon by the upper ends being expanded by a cone moved by a lever, one end of which is acted on by a solenoid in the main circuit, and the other by a solenoid in a shunt circuit, the fulcrum being attached to the upper plate of the lamp. The Second part of the invention relates to a dynamo machine with vertically arranged field magnets, and an armature consisting of a spiral core of cast iron ribbons coiled at intervals with copper wire coils.

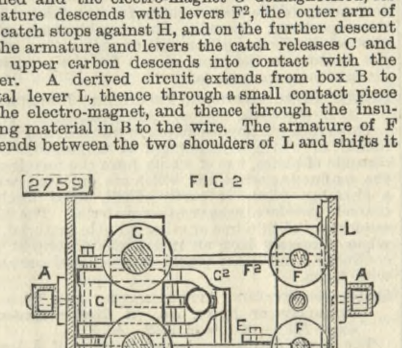
2756. IMPROVEMENTS IN VOLTAIC BATTERIES, &c., *C. G. Gumpel, Leicester-square.—12th June*, 1882. 6*d*.
This relates to the construction of a portable battery. The plates are in the form of circular discs of carbon and metal insulated by vulcanite or other rings. These are placed in a caoutchouc tube of such internal diameter as to prevent fluid communication between the cells.

2757. GAS BURNERS, *J. Imray, London.—12th June*, 1882.—(*A communication from C. Clamond, Paris.*) 6*d*.
This relates to the construction of gas burners in which the heat of the flame or the products of combustion thereof is conveyed downwards by a central metal rod or stem to the gas and air supply, so as to raise the temperature thereof before entering into combustion.

2759. IMPROVEMENTS IN ELECTRIC LAMPS, *H. H. Lake, London.—12th June*, 1882.—(*A communication from R. R. Moffatt, Brooklyn, New York.*) 6*d*.
This relates to the regulation of arc lamps and to a means for cutting the lamps out of circuit. Referring to our illustrations, when electro-magnet G—Fig. 1—attracts its armature G^1, the catch F^3 lifts the carbon supporting rod C so as to establish the arc. G^1 is mounted in two levers G^2, which are arranged between


2759 FIG. 1.

the levers F^2, and similarly pivotted to box B—see Fig. 2. These levers G^2 are united at their free ends, and carbon-rod C passes between them. The catch F^3 consists of a bell-crank lever pivotted at the end of one arm to a rod which extends between the levers F^2 so that its angular position can act on C. The other arm is actuated by a spring so that the angular portion will be forced against C, when the arc is established and the electro-magnet G demagnetised, its armature descends with levers F^2, the outer arm of the catch stops against H, and on the further descent of the armature and levers the catch releases C and the upper carbon descends into contact with the lower. A derived circuit extends from box B to metal lever L, thence through a small contact piece to the electro-magnet, and thence through the insulating material in B to the wire. The armature of F extends between the two shoulders of L and shifts it


2759 FIG. 2

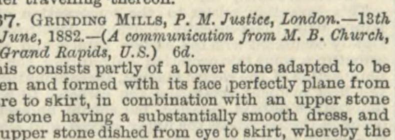
so as to impinge on the before-mentioned contact piece or be removed therefrom. The armature, however, can move sufficiently far to cause pawl E to operate the ratchet wheel and feed the carbon downwards before it shifts L, so as to break the shunt circuit. When this is broken the armature descends and shifts L so as to re-establish the shunt, and if the arc be still too great the operation will be repeated.

2764. SINGLE-RAIL RAILWAYS, &c., *A. M. Clark, London.—12th June*, 1882.—(*A communication from C. F. M. T. Lartigue, Olieste, Spain.*) 10*d*.
This consists more particularly in the construction of the single rail post railway, and of the carriage or carrier travelling thereon.

2767. GRINDING MILLS, *P. M. Justice, London.—13th June*, 1882.—(*A communication from M. B. Church, Grand Rapids, U.S.*) 6*d*.
This consists partly of a lower stone adapted to be driven and formed with its face perfectly plane from centre to skirt, in combination with an upper stone said stone having a substantially smooth dress, and the upper stone dished from eye to skirt, whereby the spaces between the stones in zones of a given width on any part from centre to skirt are made of equal capacity. It also consists in means of regulating the feed.

2768. RAILWAY CARS AND COTS FOR USE THEREIN, *P. M. Justice, London.—13th June*, 1882.—(*A communication from M. B. Church, Grand Rapids, U.S.*) 10*d*.
This relates to the berths and seats of sleeping cars, and is in part applicable to the state rooms of steamers and other water craft. It includes also an improved form of cot, which may be used in any situation where an ordinary folding cot is desirable.

2769. IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES, *J. Imray, Chancery-lane.—13th June*, 1882.—(*A communication from P. Jablachkoff, Paris.*) 6*d*.
This relates to the construction of dynamo-electric machines, the leading feature of which is the obliquity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of the axis of rotation to the magnetic field as the axis of the earth is inclined to the plane of the ecliptic. The illustration represents a simple form of the machine. A bobbin A, having cheeks of soft iron and wound with a coil of insulated wire, is fixed obliquely on an axis O, and revolves between the poles of two electro-magnets N and S. In each revolution the edges of the cheeks are presented alternately to N and S, as shown.

2771. IMPROVEMENTS IN DYNAMO-ELECTRICAL MACHINES, *J. Farquharson, Fulham.—13th June*, 1882. 4*d*.
The inventor builds up his magnets of alternate layers of iron and wire, by which means the insulated wires in which the exciting current circulates, is brought nearer to the iron. The armature consists of a narrow ribbon of copper folded backwards and forwards.

2778. APPARATUS FOR COMPRESSING AND MOULDING EXPLOSIVE MATERIAL INTO VARIOUS FORMS FOR BLASTING, *E. Hesketh, Dartford.—13th June*, 1882. 6*d*.
This consists in the method of employing the moulds of the compressed material by withdrawing sliding pieces that close the bottom of the moulds and extruding the contents of the moulds by the advance of compressing punches.

2779. HAYMAKING MACHINES, *J. C. Float, Maldon.—13th June*, 1882. 6*d*.
This consists in an arrangement of gearing for actuating the tine barrels of haymaking machines.

2786. INSTRUMENT FOR MEASURING, INDICATING, AND RECORDING VARIATIONS IN ATMOSPHERIC PRESSURE, *A. M. Clark, London.—13th June*, 1882.—(*A communication from E. Bourdon, Paris.*) 6*d*.
This relates to an instrument for measuring and graphically recording the degrees of pressure (whether higher or lower than that of the atmosphere) produced either by the action of currents of air circulating in the atmosphere, or by the action of ventilating apparatus such as employed in mines, being capable of giving an audible signal to denote when the ventilation of any part of a mine is insufficient.

2791. SIEVES WITH ADJUSTABLE PERFORATIONS, *J. P. Lipps, Dresden.—14th June*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to the use of two perforated cylinders, placed one within the other, and capable of being adjusted so as to shift the position of the holes in relation to each other.

2796. BUOYANT SPEED WHEEL, *W. Teague, jun., Redruth, Cornwall.—14th June*, 1882. 4*d*.
The inventor claims a buoyant speed wheel in which the following are the important and peculiar points—First, the paddles which tend to lift the bow of the vessel out of the water when in motion; secondly, the air chambers in the wheel.

2798. STANDS FOR SPIRIT BOTTLES, &c.. *F. Sibray and J. Hall, Sheffield.—14th June*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to a stand in which the bottles cannot be withdrawn, except from the side that may be open.

2800. CARD-SETTING MACHINES, *H. Yates, Cleckheaton. —14th June*, 1882.—(*A communication from Messrs. Stedman and Fuller, Lawrence, Mass., U.S.*)—(*Not proceeded with.*) 2*d*.
This relates to appliances to be used in combination with the crookers of machines, whereby the motion of the machine will be arrested when the wire for each tooth is absent or not forced through the card-clothing, or is marred.

2801. APPARATUS CONNECTED WITH THE FURNACES OF STEAM BOILERS, *J. Proctor, Burnley.—14th June*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to mechanism for imparting reciprocating motion to the fire-bars of furnaces.

2802. TYPE PRINTING PRESSES, *J. Miller, Springburn. —14th June*, 1882. 8*d*.
This relates to the construction of type printing press with special arrangements of fittings for automatically feeding the paper thereto from the web to be printed, and in mechanism for cutting the paper into lengths to suit any desired size of sheets as they are printed. The machine is mainly designed for printing and cutting off small circulars and sheets by hand power; but, especially in the larger sizes, may also be actuated or worked by motive power.

2805. ORNAMENTING TIN PLATES, &c., *A. M. Hopkins, T. Baker, and T. W. Burt, Birmingham.—14th June*, 1882. 4*d*.
The object is to employ rollers for the purpose of producing designs or patterns upon tin plates, and instead of simply coating the same uniformly.

2807. IMPROVEMENTS IN SECONDARY BATTERIES, *L. Epstein, High Holborn.—14th June*, 1882. 4*d*.
The inventor takes two sheets of lead, places a water cushion between these, and rolls them together into a scroll shape; he then withdraws the water cushion, and inserts the scroll into a convenient cell. This cell is then charged with a saturated solution of permanganate of potash, to which is added at least 10 per cent. of commercial sulphuric acid and 10 per cent. of methylated spirit. The cells are then connected up with a dynamo machine, and formed in the usual way.

2809. ROTARY ENGINES, *J. and F. W. Brierley, Kensal Green.—14th June*, 1882.—(*Not proceeded with.*) 2*d*.
The chief object is to avoid the necessity for using sliding or rocking steam valves.

2812. APPARATUS TO BE ATTACHED TO THE WHEELS OF VEHICLES FOR FACILITATING THEIR TRAVELLING UPON COMMON ROADS, *W. R. Lake, London.—14th June*, 1882.—(*A communication from S. von Heinrich, Doerfel, Hungary.*)—(*Not proceeded with.*) 2*d*.
Each wheel is provided with an endless chain consisting of a number of short lengths of channel iron pivotted together, so that one or two of the channel irons will always be lying on the road.

2814. METALLIC BEDSTEADS, &c., *T. Wilson, Birmingham.—14th June*, 1882. 1*s*.
This consists partly in improvements in the construction of the head and foot rails of metallic bedsteads, so as to dispense with their usual cast iron dovetails and corners. Several other improvements are described.

2815. APPARATUS FOR VENTILATING, COOLING, AND DISTRIBUTING AIR, *A. B. Brown, Edinburgh.—15th June*, 1882. 8*d*.
This consists in the combination in connection with a single rotating shaft of a primary motor, a set of air-compressing cylinders, a set of air-expanding cylinders, and a fan.

2817. BURGLAR ALARMS, *J. Bromerley, Pendlebury. —15th June*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to an alarm apparatus which is sounded when a door or window with which the apparatus is in connection is opened.

2818. IMPROVEMENTS IN SECONDARY BATTERIES, *J. S. Sellon, Hatton-garden.—15th June*, 1882. 4*d*.
This relates to the forming of plates for secondary batteries with perforations, which key, lock, or retain in position the material with which the plates are packed.

2820. MANUFACTURE OF IRON, &c., *J. Beasley, Handsworth.—15th June*, 1882. 4*d*.
The inventor claims, First, the treating the iron in a furnace fettled or lined with oxide of iron and salt saturated with diluted hydrochloric acid and lime or limestone, and with or without the addition of the same substances to a molten bath; Secondly, as a fettling or lining for furnaces or converters, the application and use of oxides of iron, salt, diluted hydrochloric acid, and lime or limestone.

2821. STRAPS FOR RUGS, PARCELS, BOXES, &c., *J. B. Brooks, Birmingham.—15th June*, 1882.—(*Not proceeded with.*) 2*d*.
The straps are provided at a short distance from the buckle end with a metal loop, into which the strap is

passed, and on one end of the strap is fixed a slide buckle, through which the other end is passed, so that the length of strap can be regulated as desired.

2822. PONTOON DECK-HOUSE FOR STEAMSHIPS, &c., *J. Littlejohn, Wallsend-on-Tyne.—15th June,* 1882. —(*Not proceeded with.*) 2*d*.

The object is to form a pontoon embracing all the erections usually found amidships on the upper deck, such pontoon being entirely separate from the vessel, and capable of being detached and floated off in the event of the vessel foundering.

2825. DRESSING LITHOGRAPHIC STONES, &c., *H. J. Haddan, Kensington.—15th June,* 1882.—(*A communication from C. G. Röder, Leipzig.*)—(*Not proceeded with.*) 2*d*.

This relates to dressing lithographic stones by means of revolving discs, to which a cycloidal motion is imparted. Sand and water are automatically supplied to the apparatus.

2831. MUSIC STOOLS, *W. Morgan-Brown, London.—15th June,* 1882.—(*A communication from E. C. Toussaint, Zurich.*)—(*Not proceeded with.*) 2*d*.

This relates to a device for raising or lowering the seat without any turning.

2833. BREECH-LOADING FIRE-ARMS, *J. Robertson, London.—15th June,* 1882. 6*d*.

This relates to the employment of a safety catch mechanism, and also to mechanism for setting the hammers back to full cock at the time when the breech is opened.

2835. PREPARING SOAP FOR TOILET PURPOSES, &c., *W. R. Lake, London.—15th June,* 1882.—(*A communication from J. Bankmann, Vienna.*—(*Not proceeded with.*) 2*d*.

The object is to furnish soap in the form of thin perforated sheets or tablets, so that a single piece may be torn off for each washing of the hands or face.

2836. MANUFACTURE OF NITRIC OR NITRO-COMPOUNDS FOR EXPLOSIVE PURPOSES, &c., *W. R. Lake, London.—15th June,* 1882.—(*A communication from H. Gruson, Buckau-Magdeburg, and A. Hellhoff, Berlin.*) 8*d*.

The inventor claims, First, the manufacture of nitro-compounds by the action of nitric acid upon organic substances or derivatives of organic substances in their crude state; Secondly, the employment of the said nitro-compounds as component parts of explosive compounds, that is to say, for the production of explosive compounds by mixture with substances containing oxygen; Thirdly, the apparatus with two or more compartments for containing the two inexplosive substances, the said compounds being separated by a partition or partitions with or without a valve or valves, which partitions can be broken by a blow or by pressure.

2842. CONSTRUCTION, PROPELLING, AND STEERING OF SHIPS, &c., *R. Aitken, Clapham.—16th June,* 1882. —(*Not proceeded with.*) 2*d*.

This relates partly to the construction of the stern portion of the ship.

2843. APPARATUS FOR HEATING AIR AND GASES, *L. McIntyre, Glasgow.—16th June,* 1882.—(*Not proceeded with.*) 2*d*.

This relates to the construction of the heating apparatus and to blowing machinery.

2844. PANELS, BOARDS, BOBBINS, &c., *J. H. Browne, Salop.—16th June,* 1882. 6*d*.

Chamois or wash leather cuttings are reduced to pulp and bleached, and then made into panels, boards, or bobbins by moulding or otherwise.

2845. IMPROVEMENTS IN INCANDESCENT LAMPS, *A. Pfannkuche, Bedford-row.—16th June,* 1882.—(*Not proceeded with.*) 2*d*.

This relates to the attachment of the filaments to the conducting wires in incandescent lamps.

2847. PRINTING MACHINES, *J. H. Johnson, London.*—(*A communication from E. Anthony, New York.*) —(*Complete.*) 10*d*.

This consists, First, in printing on two rolls of paper by means of three forme-bearing cylinders, a portion of the formes being necessarily duplicated and a portion of them not necessarily so; and, Secondly, in placing the formes on the forme-bearing cylinder or cylinders in several portions.

2851. FURNACES FOR BURNING PYRITES, *J. Mason, near Witney.—16th June.* 1882. 6*d*.

This consists, First, in forming the cylinders or rollers in the furnace with projections, studs, or serrated ribs or rings or their equivalents; Secondly, the use of a spirally-constructed fireplace; Thirdly, arranging the bed of the furnace in parts in different planes, the cylinders or rollers of each part being driven by a separate shaft or separate shafts.

2853. PIPE JOINTS, *J. H. Moore, Bournemouth.—16th June,* 1882.—(*Not proceeded with.*) 2*d*.

This relates to the construction of pipes with tapered sockets and spigots, a compressible ring or tube of gutta-percha or other material being sprung into a groove in a flange at the front end of the socket.

2854. AMBULANCES, *J. U. Burt, King's-cross.—16th June,* 1882.—(*Not proceeded with.*) 2*d*.

This relates to improvements in the general construction of the vehicles or ambulances, appliances being fitted in said vehicles for removal by hand.

2859. SASH WEIGHT ATTACHMENTS FOR SASH WINDOWS, *H. C. Tucker, Peterborough.—17th June,* 1882.—(*Not proceeded with.*) 2*d*.

This consists in an appliance for locking the sash weights when desired.

2860. TRICYCLES, &c., *R. Neal, New Benwell, Northumberland.—17th June,* 1882.—(*Not proceeded with.*) 2*d*.

This relates to the employment of hydraulic cylinders fitted with rams.

2861. APPARATUS FOR STORING, TRANSPORTING, AND PRESERVING FOOD, &c., *E. Edwards, London.—17th June,* 1882.—(*A communication from S. Schreiber, Hanover.*)—(*Not proceeded with.*) 2*d*.

This relates to improvements in the general construction of the apparatus.

2862. HYDRO-EXTRACTORS FOR DRYING FULLED CLOTHS, *E. Edwards, London.—17th June,* 1882.—(*A communication from C. Brecheissen, Elbœuf, France.*)—(*Not proceeded with.*) 2*d*.

This relates to methods for rolling fulled cloths from which the moisture is removed by hydro-extractors, so that such cloths are free from folds or creases.

2864. BLEACHING COTTON CLOTH, &c., *E. de Pass, London.—17th June,* 1882.—(*A communication from G. D. Davis, Boston, U.S.*) 4*d*.

The process consists in boiling cotton cloth or other fabrics a reasonable time in a kier in a solution made by dissolving a compound composed of certain proportions of any of the products of petroleum—by preference paraffine—the expressed oil of mustard seed, and an alkali, forming a kind of soap or saponaceous matter.

2866. APPARATUS FOR TAKING UP SLACK CHAINS OF HOISTS, &c., *G. Allix, Poplar.—17th June,* 1882.—(*Not proceeded with.*) 2*d*.

This relates to the employment of a block or weight serving as a drum or barrel, on which the chain or rope can be wound as the block descends upon an upright, the block rotating in its descent.

2869. SHIPS' RUDDERS, *M. Cotter, Glasgow.—17th June,* 1882.—(*Not proceeded with.*) 2*d*.

This has reference to improvements connected with the pintles and gudgeons or journals and bearings of rudders.

2872. DISTILLATION OF SPIRIT, *J. T. Board, Bristol.—17th June,* 1882. 2*d*.

This relates to the means and apparatus for the distillation of spirit by which the hot spent wash from a Coffey or other continuous still can be employed in heating the pot still, and by which the weak residual spirit from the pot still can be carried directly back to the continuous still.

2873 PRODUCING PRESSED COKE AND COKE BRICKS IN COKE FURNACES, *G. E. Vaughan, London.—17th June,* 1882.—(*A communication from F. Lürmann, Germany.*) 4*d*.

This consists in the application of mechanical pressure to the coke in the expelling chambers of coke furnaces, so as to produce pressed coke or coke bricks.

2880. SEWING MACHINES, *W. Fairweather, Manchester.—19th June,* 1882. 6*d*.

This consists in arranging eyes upon the needle slide bar, through which eyes the thread passes, and in causing the thread as it is thus moved up and down by the needle slide to come and rub against a bent piece of wire or metal secured to the "head" for the needle slide.

2882. SELF-ACTING WINDOW-BLIND APPARATUS, *W. S. Laycock, Sheffield.—19th June,* 1882.—(*Not proceeded with.*) 2*d*.

This relates to a blind roller caused to rotate by a spring or weight.

2886. PRINTING MACHINES, *J. H. Johnson, London.—19th June,* 1882.—(*A communication from E. Anthony and J. E. Harvey, New York.*)—(*Complete.*) 8*d*.

This consists of a means of printing two or more rolls of paper from type, stereotype, or a mixture of both; and also of a method of reversing the sides of a travelling web or sheets in tapes in such a way that the web after passing through the apparatus is opposite its former position, and its plane parallel or at an angle to the plane of its former position, and the lines drawn across it perpendicular to its edges are parallel to their former positions.

2888. CAPSTANS, WINDLASSES, &c., *S. Baxter, London.—19th June,* 1882. 2*d*.

The inventor claims the manufacture of capstans, windlasses, chain and wire cable holders, and riding bits, by casting them in steel and annealing the same.

2891. MATERIALS USED IN MAKING CORSETS, CRINOLINES, &c., *S. Dixon, Petersfield.—19th June,* 1882.—(*Not proceeded with.*) 2*d*.

This consists in covering with or embedding the stiffening materials in fine cork.

2892. SCRAPERS FOR FUEL ECONOMISERS OR WATER HEATERS, *J. G. Perkin and G. Scott, near Wakefield.—19th June,* 1882.—(*Not proceeded with.*) 2*d*.

This relates to the employment of levers for carrying the upper and lower scraper segments.

2895. EXPLOSIVE MATERIALS, *W. R. Lake, London.—19th June,* 1882.—(*A communication from F. J. Petry, Vienna.*) 4*d*.

This relates to the employment of paper which is treated with a mixture.

2898. IMPROVEMENTS IN THE MANUFACTURE OF INCANDESCENT LAMPS, &c., *A. Swan, Gateshead.—19th June,* 1882. 6*d*.

This relates to special apparatus and means for producing and forming the conducting wires and glass globes of incandescent lamps.

2899. APPARATUS FOR EASING STRAINS ON THE SHEETS OF FORE AND AFT-RIGGED VESSELS, *R. A. Ray, Great Grimsby.—19th June,* 1882.—(*Not proceeded with.*) 2*d*.

This consists in a spring draw box mounted in gimbals, so as to be free to oscillate in any direction to the draw rod, to which the sheet is attached or made fast.

2902. IMPROVEMENTS IN ELECTRIC METERS, &c., *J. T. Sprague, Birmingham.—19th June,* 1882. 4*d*.

This relates to the employment of such chemical reactions as are set up by electric currents as set free gas or gases, usually by the decomposition of water in presence of acids, to facilitate conduction and electrolysis, and the objects of the improvements are to restore to the current the energy absorbed in the act of decomposition, and to obtain uniform measurement of current notwithstanding the variation of volume of gas generated. The inventor claims, First, the construction of meters in which gas arising from decomposition is caused to re-enter combination, so as to regenerate the electro-motive force expended in the decomposition; Secondly, the combination of an electrolytic decomposition cell or voltametre with a gas battery in the same circuit for the purpose of electric measurement, &c.

3008. IMPROVEMENTS IN TELEPHONIC INSTRUMENTS *J. D. Husbands, London.—24th June,* 1882. 1*s*.

This relates to improvements in transmitting instruments in which a diaphragm is employed, which consists of plates, two of which form the terminals of the conducting wires, and which are enclosed within a chamber filled, or partly filled, with finely or coarsely powdered coke or other material. The plates are formed of thin iron or other suitable material, and when necessary have an intermediate strip of non-conducting substance placed between and connected with them.

3016. ASCERTAINING APPROXIMATELY THE TRIM AND STABILITY OF SHIPS, &c., *A. Taylor, Newcastle-upon-Tyne.—26th June,* 1882. 4*d*.

The inventor claims the application of a known weight acting with a known leverage to "heel" over a vessel, the angle of the heel or inclination and the metacentric height being recorded upon an index graduated in divisions calculated for the known displacement of the vessel.

3029. GLASS FURNACES, &c., *E. de Pass, London.—27th June,* 1882.—(*A communication from H. Quennec, Paris.*) 6*d*.

The invention relates to a system of furnace with quick combustion hearth, for continuously working and melting glass in a single tank, bath, or pot, the air being heated by the sides of the furnace, and to the use of floating cuvettes, bowls, or pots of special construction.

3070. IMPROVEMENTS IN ELECTRIC ARC LAMPS, *E. de Pass, London.—29th June,* 1882.—(*A communication from C. R. and B. Abdank, commonly called Abakanowicz, Paris.*) 6*d*.

This invention relates to the construction of arc lamps with independently movable armatures not rigidly connected with the carbon holder, and which armatures come into operation only during the magnetic action of the electro-magnet, these armatures at the first moment separating the carbons to a predetermined normal distance, but should an accident occur in the arc release the upper carbon and allow it to advance until it touches the other.

3137. SPORTING CARTRIDGE CASES, *C. D. Abel, London.—3rd July,* 1882.—(*A communication from W. Lorenz, Carlsruhe.*) 6*d*.

This consists in making sporting cartridge cases of an outer removable metal jacket in combination with a metal case as a substitute for paste-board cartridge cases.

3614. ILLUMINATING GRATING, *T. Hyatt, Kensington.—31st July,* 1882. 4*d*.

The glasses are supported at points along the edges, instead of enclosing them in continuous bearing rebates, by which means a greater amount of light will be transmitted through a given area of grating. The sides of the channels formed in the glasses, and their junction edges, are roughened by sand blast or other process, so as to give the hydraulic cement employed a firmer grip on the glass.

4014. HYDROCARBON FURNACES, *J. Mundell and W. J. Gordon, Philadelphia.—22nd August,* 1882.—(*Complete.*) 6*d*.

This relates to means for injecting the hydrocarbon spray into the furnace, and comprises an opening in the furnace wall provided with top and bottom adjustable spray plates projecting within the furnace, and an ejector; means for spreading and distributing the flame of the injected vapour in the combustion chamber; means for preventing the flame from backing against the ejector, and regulating the quantity of flame, and the construction of the furnace whereby it may be adapted for the use of ordinary carbonaceous fuel.

4054. GAS FURNACES, *C. D. Abel, London.—24th August,* 1882.—(*A communication from the Stettinger Chamotte-Fabric Actien-Gesellschaft vormals Didier, Stettin, Germany.*) 6*d*.

This consists partly in the mode of producing and employing a mixture of hot air and steam for converting the fuel into combustible gases, whereby the formation of slag is prevented, and the earthy constituents left in the form of ashes.

4179. VENTILATORS FOR RAILWAY CARRIAGES, &c., *R. H. Brandon, Paris.—1st September,* 1882.—(*A communication from Prince J. Pagnatelli d'Aragon, Paris.*) 6*d*.

The inventor claims, First, the use of water or other suitable liquid introduced into a box or case for purifying and removing the air inside railway carriages or other vehicles by a pipe issuing into the box or case and dipping into the water or placed above the same; Secondly, the use of wheels with straight or helical wings placed so as to increase the volume of air to be introduced into the carriages.

4428. MANUFACTURE OF ARTIFICIAL LEATHER, *E. Fischer, Kaltwasser, Germany.—18th September,* 1882. —(*Complete.*) 2*d*.

This relates to the chemical treatment of the leather waste.

4442. AIR GAS, *H. J. Haddan, Kensington.—19th September,* 1882.—(*A communication from D. H. Martin, Queensland.*)—(*Complete.*) 6*d*.

Two double-acting bellows are employed to supply air to the gas generator, the air being supplied under water, above which is the carburetting liquid. A suitable arrangement is provided, whereby the manufacture of the gas is automatically stopped and resumed as the gasholder rises and falls.

4569. MANUFACTURE OF FURNACE LININGS, FIRE-BRICK, AND ILLUMINATING GASES, *S. Pitt, Sutton.—26th September,* 1882.—(*A communication from C. G. Francklyn, New York.*—(*Complete.*) 4*d*.

This relates to various compounds to be used for furnace linings, &c., and for manufacture of gas.

4688. NUT LOCKS, *A. J. Boult, London.—2nd October,* 1882.—(*A communication from W. Mack and J. B. Deeds, Terre Haute, U.S.*)—(*Complete.*) 6*d*.

This consists of a nut provided on its face with a V-shaped angular recess made nearly tangential to the bore of the nut, in combination with a straight spring brace located in said recess, and projecting into the bore of the nut on a line outside the centre, and adapted to engage with the thread of a bolt on a line oblique to the longitudinal axis of said bolt, whereby the increased strain produced by the unscrewing of the nut increases the bite of said lock brace.

4728. SHARPENING THE CALKS ON HORSESHOES, &c., *W. R. Lake, London.—4th October,* 1882.—(*A communication from F. A. Roe, New York.*)—(*Complete.*) 4*d*.

This relates to machines for sharpening the calks of horseshoes without removing the shoes from the horse's feet; and it consists of a portable stand carrying suitable driving gear, by means of which motion can be transmitted to an emery wheel mounted at the end of a flexible shaft, whereby the same may be placed in any desired position to act on the calks. The apparatus may also be employed for grooming horses by replacing the emery wheel by a brush.

4804. PROPELLERS FOR NAVIGABLE VESSELS, *R. Smith, Canada.—9th October,* 1882.—(*Complete.*) 10*d*.

This relates to improvements in propellers with folding blades expanding when driven in one direction and creating resistance upon the water to propel the vessel, and folding on the return to offer no resistance to the progress of the vessel, and it consists in obviating the backward draft which occurs as the propeller reaches the end of its stroke, by cutting off the steam from the main cylinder (the piston-rod of which carries the hinged blades) before the piston of the second cylinder (to the piston-rod of which the edges of the blades are pivotted by suitable connecting links) has reached the end of its stroke, and admitting steam to the second cylinder as the stroke of the main piston is completed. The invention further relates to means for avoiding the shocks due to the "pounding" of the propeller.

4930. A NEW ELECTRIC ARC LAMP, *C. S. Snell, Saltash, Cornwall.—17th October,* 1882. 6*d*.

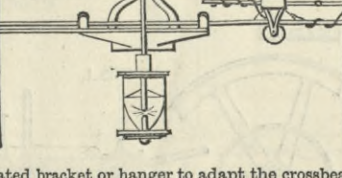
This refers to an arc lamp in which the upper carbon is regulated by a brake acting on the soft iron core of a solenoid, and he claims the "elastic feeding" of the carbons by the combination of these and a spring.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

269,526. APPARATUS FOR SUSPENDING, RAISING, AND LOWERING ELECTRIC LAMPS, *Charles C. Jennings, Buffalo, N.Y.—Filed May 4th,* 1882.

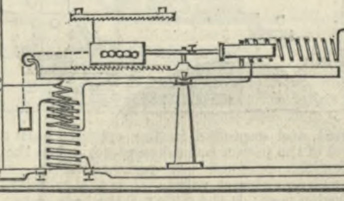
Claim.—An apparatus for suspending, raising, and lowering electric lamps, consisting substantially of supporting cables secured at their ends to the walls of a building or room, a carriage having arms provided with pulleys adapted to travel upon the supporting cables, and insulated brackets or hangers secured thereto, also provided with pulleys for the reception of the lamp-supporting cables, a cross-arm having at each end thereof a grooved pulley, pivotted to an



insulated bracket or hanger to adapt the crossbeam to travel upon the carriage-supporting cables, supporting cables for the electric lamp, secured rigidly to the crossbeam and passing over the insulated pulleys upon the carriage to the lamp suspended below such carriage, and conducting wires connecting the positive and negative wires of the circuit with the supporting cables and the insulated pulleys of the crossbeam with the lamp-suspending cables, all combined and operating substantially as shown and described.

269,559. ELECTRIC-CURRENT METER, *Alex. Bernstein, Boston, Mass.—Filed October 4th,* 1882.

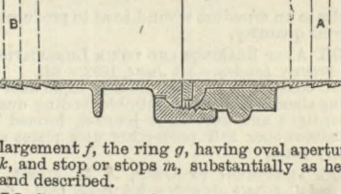
Claim.—(1) A current-meter composed of a scale beam, of a movable and counterbalanced registering device at one end of the beam, and of a fixed coil and



a sliding iron core connected to the registering device at the other end of the beam, of a coil suspended below the end of the beam, carrying the register and placed in an auxiliary circuit with the coil at the other end of the beam, and of a fixed coil of larger diameter and surrounding the suspended coil, and being placed into the main circuit, substantially as set forth. (2) The combination of a scale beam carrying a movable and counterbalanced registering device upon one arm, a coil and sliding core upon the other arm, a coil suspended from the arm carrying the register, a fixed coil surrounding the suspended coil, and a suitable stop mechanism, whereby the register is stopped when the equilibrium of the parts takes place, substantially as and for the purpose set forth.

269,626. UNION OR COUPLING FOR PIPES AND TUBES, *Jules L. B. Bodel and Joseph L. F. Brauer, Paris, France.—Filed August 24th,* 1882.

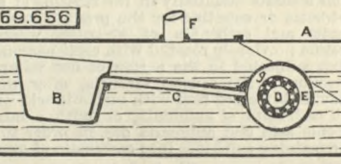
Claim.—The pipe *a*, having enlargement *c*, combined with threaded rings *d* and *g*, and with pipe *b*, having



oval enlargement *f*, the ring *g*, having oval aperture *h*, recess *k*, and stop or stops *m*, substantially as herein shown and described.

269,656. STEAM-TRAP, *Arthur L. Fish, San Francisco, Cal.—Filed October 19th,* 1882.

Claim.—(1) In a steam-trap, the combination of the trap-body A, having an inlet pipe F, the float B having an open mouth at its top for receiving the water in the trap-body when it rises above a proper level, a hollow valve-stem having ports, and a hollow valve-chamber having ports, and connected with the open-mouthed float for receiving the surplus water from the float and discharging it through the valve-stem,



substantially as described. (2) In a steam-trap, the combination, with the trap-body A, having an inlet pipe F, of the fixed hollow valve-stem D, having ports g^1, the hollow valve-chamber E, having ports *g*, the float B having an open mouth at its top to receive the water from the trap-body when it rises above the proper level, and a hollow float arm C having one end opening into the hollow valve-chamber and the other end into the float for conveying the water received in the latter to the valve-chamber and discharging it through the valve-stem, substantially as described.

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