SIR CHARLES WILLIAM SIEMENS AS A METALLURGIST.

No. 1.

THE REGENERATIVE FURNACE.

The sudden and much regretted death of Sir Charles William Siemens has left a void which will long be felt in the ranks of British metallurgists, and, indeed, not of British metallurgists only, for there have been but few advances made in metallurgical practice throughout the world during the last twenty-five years that have not benefitted directly or indirectly by the inventions of Messrs. Siemens, and particularly by the regenerative furnace, with the invention, or rather the practical elaboration of which the name of Siemens will always be associated. In justice to Mr. Frederick Siemens it must be remembered that it is to him no less than to his illustrious brother that the perfection of this all-important furnace is due, as is, indeed, clearly shown by the long list of patents for various improvements connected with it which have been taken out sometimes in the name of the one, sometimes in the name of the other, and not a few in the joint names of both brothers. The introduction of this furnace, and its successful application to numerous industrial processes, is undoubtedly the most important contribution of Dr. Siemens to practical metallurgy; whilst, looked at from the theoretical standpoint, it may also be regarded as the outcome and the realisation of one of the most advanced among the modern principles of physical science. The theory which has exercised more influence than any other on our present conceptions of matter and force, which has done for physics what the theory of evolution has done for biology, is the great doctrine of the conservation of energy—the doctrine that a force cannot be created, neither can it be destroyed. In conformity with this theory, it but remains for us to prevent as far as possible its profitless dissipation, and this is the problem which Dr. Siemens has solved, as far as regards one form of molecular energy, namely heat, by restoring to the hearths of furnaces the waste heat which was formerly allowed to escape into the air without doing any useful work.

In order to appreciate fully the value of the regenerative furnace for the economisation of fuel, it will be well to examine rapidly what had been done practically towards the utilisation of waste heat before the Siemens furnace became an established fact. The problem had long attracted the attention of ironmasters, and as far back as 1788 we find that a patent was taken out by Robert Gardiner, ironmaster, in which he proposed to raise steam by means of the waste heat of furnaces, by passing the heated products of combustion under a conveniently situated boiler. The suggestion does not seem to have borne fruit until half a century later, but in the year 1850 it was by no means uncommon to see boilers fired in the way proposed by the waste heat of puddling furnaces, and now-a-days it would be difficult to find a forge of any importance using the old type of reverberatory puddling and heating furnaces that does not thus turn its waste heat to account. The quantity of heat utilised in this manner is, however, but a fraction of the whole amount available. Even under the most favourable conditions there is probably quite as much heat lost as there is advantageously employed. Moreover, there are several practical objections to the utilisation in this manner of the waste heat, though they have with good reason not been able to outweigh its manifest advantages. The step has certainly been a most important one in the right direction. Again, the immense saving of fuel in the blast furnace consequent on the introduction of Neilson's remarkable invention of the hot blast, patented in the year 1829, and widely employed three years later, was well known to all metallurgists. Siemens found in the latter principle, a method that rendered feasible the utilisation of the waste heat of furnaces, and it then remained to carry out the idea practically. This, after a long series of experiments, he succeeded in doing; and the modern regenerative furnace is the result—a brilliant example of the economic application of scientific theories to practical operations. In order to realise fairly the gigantic revolution in metallurgical industries capable of being effected by the employment of the regenerative furnace, it must be remembered that previous to Bessemer's great discovery no one except the chemist in his laboratory had ever seen malleable iron in the molten state, and then only in very small quantities, such as an ounce or two at a time, whereas now we have in the Siemens furnace a means of melting with ease a dozen or more tons of the same metal, and of maintaining the mass for an indefinite time in a state of fusion.

The history of the evolution of the regenerative furnace has been told by Dr. Siemens himself in a most interesting paper, read by him in 1862 before the Institution of Mechanical Engineers. Apart from its historic importance, it affords a valuable lesson to those who think, as many seem to do, that great inventions come into the world in a state of perfection, and well serves to show how much patient thought and labour are required before practical results can be obtained even from a well-matured theory. As far back as the year 1846 Dr. Siemens turned his attention to the practical application of the regenerative principle in order to economise heat in the working of engines. The principle had already been enunciated in the beginning of the present century by the Rev. Robert Stirling, of Dundee, who took out a patent in Scotland in the year 1817, which shows that he clearly understood at any rate the theory of the regenerative principle. He describes a fireplace communicating with two long narrow flues in the middle of a mass of refractory brick or stone-work, and directs that the heated products of combustion and the air for supporting combustion shall be alternately allowed to pass through each of these flues. "The air which supports combustion is alternately introduced by blowing engines, bellows, or any other means, and the gases and vapours, which arise from the fire, pass off in an opposite direction, leaving the greater part of their heat in the flues. This heat is taken up by the air which supports the fire, and is again left in the opposite flue along with the additional quantity produced by combustion. In this manner the heat is accumulated in the furnace and the parts of the flues adjacent to it. . . . . The narrower or longer the flues are, and the more frequently the direction of the air is changed, the greater the saving of fuel and the intensity of the heat produced." This extract shows that Stirling must have appreciated the theoretical value of his invention, but he seems to have been contented to leave the idea undeveloped, and never to have carried it out to any industrial application. In this, as in most similar cases, the real benefactor to humanity is not the man who contents himself with enunciating a barren scientific principle, but rather he who, by persevering and intelligent work, converts it into a fruitful source of practical economy.

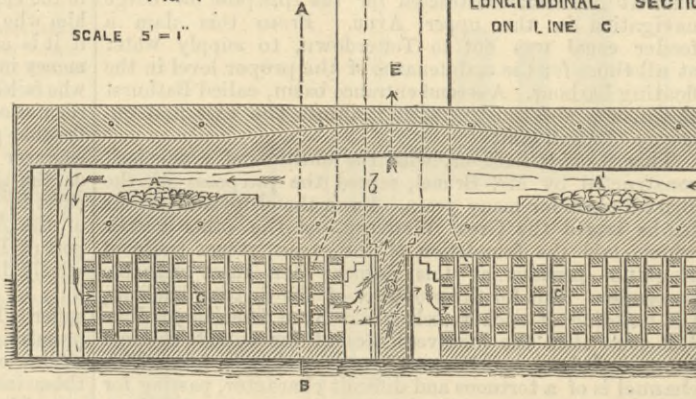
In the year 1856 Mr. Frederick Siemens suggested the application of the regenerative principle to furnaces where a high temperature is essential, and the two brothers worked together at its elaboration and perfection. The result of their labours was a patent, dated December 2nd, 1856, for an "Improved arrangement of furnaces, which improvements are applicable in all cases where great heat is required." The improvements consist, to quote the words of the patent, "in certain arrangements of furnaces, which have for their object to recover the heat which is still contained in the flame or products of combustion on passing away from the fireplace, or heated chambers, or flues, towards the chimney, by causing that heat, or a great portion thereof, to be imparted to the current, or currents, of atmospheric air, gas, or other materials employed to maintain combustion in the same or other fireplaces, by which arrangements heat may be accumulated to an unlimited extent—consistent with the materials employed—and great economy of fuel is effected." The principle claimed is the following:—The products of combustion, on their way from the fireplace to the stack, pass through a chamber loosely filled with refractory materials, so as to present a large surface to the gaseous current. This chamber and its contents are thus strongly heated, and the products of combustion proportionately cooled. When the heating of the chamber has been carried far enough, the escaping gases are compelled, by suitably arranged valves, to pass through a second similar chamber, whilst the air which is intended to maintain combustion in the furnace is compelled to pass *in the reverse direction* through the first intensely heated chamber. On its passage it, of course, abstracts heat from the chamber and its contents, and thus enters the furnace at a very elevated temperature; thus, there is not only a large amount of heat actually returned to the furnace, but owing to the high temperature of the air, combustion takes place much more energetically than it would do with cold air, and as in the case of the hot blast before referred to, a very intense temperature with a corresponding economy of fuel is the result. When the furnace is fired not with solid, but with gaseous fuel, two pairs instead of one pair of these chambers may be employed, and the combustible gases as well as the air intended to support combustion raised to a high temperature before combination is allowed to take place in the body of the furnace. Siemens has given to the above-mentioned chambers containing refractory materials the name of regenerators, which they have since retained, although as Dr. Percy ("Metallurgy," vol. i., Fuel, p. 456) has well pointed out, it is, strictly speaking, an incorrect term; he suggests the word accumulator, as "there is no regeneration of heat, but merely abstraction of some of the heat from the gaseous products of combustion which would otherwise be carried off through the chimney and lost, and the restoration of that heat to the furnace." In spite, however, of the inaccuracy, scientifically speaking, of Siemens' term, it has now become well established and sanctioned by usage, and the furnace will beyond doubt continue to be known by the name which was given to it by its inventor.

Shortly after the publication of the first patent, that is to say, about the year 1857, a couple of furnaces were constructed on the principles embodied in it; they were designed for the heating of iron or steel bars, and erected one at Messrs. Marriott and Atkinson's steelworks, Sheffield, and the other at the Brighton Copper Works, Manchester. The furnace consisted of a single fireplace, in which the fuel, supplied from the top, forms a ridge; the fireplace communicated with two chambers which were alternately used for heating the bars, and between each chamber and the stack was interposed a regenerator. When in operation the end of the regenerator nearest the heated chamber became gradually heated to the temperature of the furnace itself, the stack end remaining all the while comparatively cool. After drawing out the heated bars from the chamber the current was reversed by means of suitable valves, the air necessary for the combustion of the fuel in the closed fireplace passing through the heated regenerator and now empty chamber, thus becoming heated, and the flame and products of combustion were then employed in heating up the other chamber with its change of bars. This furnace worked very well, and was found to economise much fuel; accordingly it remained in operation a great many years, but its application must evidently be limited to a few very special cases where there are two furnace chambers requiring to be heated alternately.

FIG 1

SCALE 5' = 1"

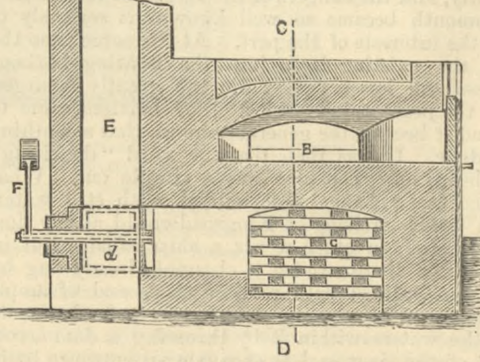
LONGITUDINAL SECTION ON LINE C



SIEMENS DOUBLE FURNACE.

It was felt that much still remained to be done before the regenerative furnace could be considered a practical success; another form, capable of heating a single chamber was, therefore, soon tried. It consisted of a single chamber heated by two fireplaces, which were successively traversed by the heated gaseous current. Its construction, as applied to the heating of iron and steel, is shown in Figs. 1 and 2. Here A A' are the two fireplaces, *b* being the chamber to be heated, and C C' the two regenerators. When the valve D is in the position shown in the figures, the gaseous currents pass as indicated by the arrows; the regenerator C', which is in communication with the outer air, is heating the air in its passage to the fireplace A', whilst the regenerator C is being heated by the products of combustion which pass through it on their way to the stack *e*. It is evident that, when the position of the valve D is reversed by throwing over the lever F, the gaseous current will take the opposite direction; air will be supplied to the fireplace A, passing through the hot regenerator C, and abstracting the heat there stored up, whilst the cooled regenerator C' will in its turn be heated by the products of combustion escaping through it. This furnace was in operation for some considerable time, and appears to have done good service. Mr. Atkinson stated before the Institution of Mechanical Engineers that in the first two months of its operation it economised over three-fourths of the fuel that had been found necessary for a furnace of equal capacity of the old type. On trying, however, to extend its use, numerous practical difficulties were encountered, the chief one being due to the fact that the carbonic acid formed by combustion in the first fireplace was reduced to carbonic oxide by its passage over the heated fuel of the second one, thus consuming fuel without producing any corresponding heating effect. After many attempts to overcome these difficulties, the furnace had finally to be abandoned, and it was clearly seen that the problem to be solved was the construction of a furnace capable of heating a single chamber continuously by means of a single fireplace, in combination with the alternate reversal of the gaseous currents through the regenerators, but without reversing the direction of the flame. This was accomplished by the use of double reversing valves, and was practically carried out in a puddling furnace erected at the works of Messrs. R. and W. Johnson, near Manchester. The furnace consisted of a body similar to that of an ordinary puddling furnace. Beneath it were two regenerators placed longitudinally, with a flue between them, the fireplace being at one end of the puddling chamber, as in the ordinary form. The fireplace was, of course, closed, and the fuel was fed into it from above. The heated air from the first regenerator was brought up at the back of the fireplace, and meeting there with the fuel, produced the required flame in the puddling chamber. Thence the products of combustion passed out at the flue-bridge end of the chamber, down into the flue which carried them to the hot end of the second regenerator, through which they escaped to the stack. For reversing the currents through the regenerators two valves were needed, connected by a lever, one being at the hot end near the fireplace, and the other at the cool or stack end. The heated air was thus made to enter the fireplace by the same passage, whichever regenerator might be employed in heating it, and the direction of the flame inside the puddling chamber remained unchanged. Only a few furnaces were constructed on this plan. They were found capable of producing both a high temperature and a good soft flame without any cutting draughts, whilst using only about half as much fuel as the ordinary puddling furnace. This type was a decided advance on the previous one, but there still remained many serious practical objections, notably the great care necessary to maintain a uni-

FIG.2



TRANSVERSE SECTION ON LINE A.B

form flame, and the liability of the reversing valve at the hot end of the regenerators to get out of order.

It was now found that the use of solid fuel in the furnace would have to be abandoned, and gaseous fuel substituted, the solid fuel being converted into combustible gas in a separate gas producer. This new departure is described in a patent granted on the 22nd January, 1861, to Charles William and Frederick Siemens. In their specification the patentees claim as "an essential part of our invention, that the solid fuel used, such as coal, lignite, peat, &c., should be decomposed in a separate apparatus, so that the introduction of solid fuel into the furnace may be altogether avoided, and the gaseous fuel may be heated to a high degree prior to its entering into combustion." The furnace and producer described in this specification, and shortly afterwards erected, did not differ in principle, in any essential particular from those now in use; many of the details were, however, different. Thus in some puddling furnaces erected about the year 1862, the two pairs of regenerators were arranged longitudinally underneath the body of the furnace, the gas flues and valves being at one end of the furnace body, and occupying the place which in the previous type was occupied by the fireplace, thus indicating how gradual was the development of each form into the succeeding more perfect one. The gas valves were almost identical in construction with those in use to-day; on the other hand, Dr. Siemens, in his paper before referred to, insists that "the gas regenerators require fully as large a capacity as the air regenerators, and sometimes even a greater," a statement that has been contradicted by a more extended experience of the working of these furnaces.

From this date onward the regenerative furnace was an undoubted practical success, and soon received numerous industrial applications. It was used in rolling mills for the reheating of iron and steel bars, and for heating crucibles for steel melting and for glass melting. It was soon found, however, that for the two latter purposes it was more advantageous for most qualities of the product to dispense with the crucibles, and to make the bed of the furnace itself the crucible; thus resulted the open hearth steel furnace and the tank glass melting furnace. These form admirable examples of the economy that results from the application of the regenerative principle when high temperatures are required. Thus at Birmingham in a glass pot furnace on the Siemens principle, 16 to 17 tons of coal were consumed per week as against 35 tons in the old-fashioned furnace; whereas when the tank furnace is employed, only one-third of the fuel previously required is now consumed. Again, in steel melting the old Sheffield pot furnace required 2½ to 3 tons of good coke to melt a ton of steel; in the Siemens crucible furnace one ton of coal suffices to do the same amount of work, and in the open hearth furnace this figure is reduced to 12 cwt. It is evident from the principle of the regenerative furnace that it can only be employed with much advantage when exceedingly high temperatures are required. Siemens himself states that it produces no economy when applied to a boiler fire. Hence its great success in the above-mentioned application, and to these may be added its use in heating gas retorts, in tube welding, and in the extraction of zinc from its ores. A regenerative zinc melting furnace has been working successfully for some time in the neighbourhood of Swansea.

THE DOCKISING OF RIVERS.

No. I.

A REPORT has lately been presented to the Council of the ancient city of Bristol which offers a convenient text for the discussion of a most important matter relating to inland navigation and the cheapening of transport. Our readers are aware that in England a strong reaction has lately set in on behalf of canals, and especially of canals large enough to accommodate the present type of ocean steamers. It is found, on the one hand, that the carriage on such canals is much cheaper than by railway; and on the other hand, that if such a canal can be constructed up to the place where a vessel's cargo is required, the cost of handling and despatching that cargo at the railway station may be mainly or entirely saved. The city of Manchester, spurred on by an ancient rivalry with the port of Liverpool, has taken the lead in this direction; and the gigantic undertaking known as the Manchester Ship Canal has well-nigh obtained the sanction of Parliament. In the case of Manchester the construction of such a canal was a necessity, if ocean-going steamers were to reach the city at all; but in many places there are waterways quite large enough to accommodate such steamers, and reaching many miles inland, which, nevertheless, are seldom or never used for such a purpose. We allude, of course, to tidal rivers. Such rivers, especially where the rise and fall of tide is so great as it is round Great Britain, often give ample depth for the largest vessels during the few hours of high water; on the other hand, at low water their depth is merely a few feet, perhaps even a few inches. The only means at present of utilising such rivers for inland transport is by constructing docks at some distance from the mouth, in which the water is always held at a constant level. Vessels come up the river at flood tide, enter the docks at high water, and are safe there when the tide falls. London is the most conspicuous instance of such a system, but there are many others. It presents, however, manifold inconveniences. Vessels arriving at the mouth of the river are detained there, often in dangerous anchorages, until the tide is suitable for their entering it. They then ascend the river as a single fleet, crowding together, and racing for the entrance to the docks, through which they scramble as best they may. On the ebb tide the reverse happens. A crowd of vessels, large and small, pass through the dock entrance, and jostle each other down the river to reach the deep water at its mouth. Should one of these vessels touch the ground on her passage down the river her fate is well-nigh sealed; the tide ebbs rapidly away from beneath her; she is left stranded, very probably on a steep and rocky bank, and she either rolls over or breaks her back. At the very best, nothing can be done to release her until the tide again rises, and then only a few hours of high water can be utilised for the purpose.

The port of Bristol may be taken as a typical instance of the system here described. Situated at the confluence of two rivers—the Frome and the Avon—about nine miles above the anchorage of Kingroad, where their united stream pours at right angles into the great estuary of the Severn, it has always formed an important centre of trade. In the middle ages it was only second to London. In those days, and long afterwards, the small vessels in which trade was then carried on were content to run up the Avon on the tide, moor themselves to the wharves and jetties of the old city, and lie on the muddy slopes when the water went down. As vessels grew larger, and trade more extensive, the risk and inconvenience of this practice were strongly felt, and the problem of the construction of floating docks was presented to the citizens. At Bristol it was solved by a bold and successful stroke in engineering, such as would do credit to the enterprise of the present day. Its designer—Mr. Jessop—resolved on isolating a considerable length of the river Avon, including the junction of the Frome, from the influences of the tide, and so converting it into a floating harbour. To use a modern phrase, which at Bristol has become classical, he "dockised" a length of about two miles, extending from Totterdown at the upper extremity to Rownham at the lower extremity, the latter being just at the entrance of the well-known and picturesque gorge of Clifton. To do this he threw a dam across the river at Rownham, where he formed an entrance basin, called Cumberland Basin, and another dam across the river at Totterdown; and he excavated a new cut, or canal, for the waters of the Avon, extending in a comparatively straight line from the one point to the other. Up this new cut the tide still passed freely, until it reached a dam at Netham, constructed for the purpose of barge navigation in the upper Avon. From this dam a feeder canal was cut to Totterdown, to supply water at all times for the maintenance of the proper level in the floating harbour. A second entrance basin, called Bathurst Basin, was also constructed to facilitate the exit and entrance of small craft.

This floating harbour, with the addition of a new lock constructed by Mr. Brunel, served the purposes of the Bristol trade for many years. From the shipyards on its banks issued the Great Western, and the other vessels which laid the foundation of the ocean steam trade of England—perhaps at this moment her most valuable possession. But for the provision of the floating harbour, the building of such vessels would have been impossible. But even then the inconveniences of the outside channel between Bristol and Kingroad were seriously felt. This channel is of a tortuous and difficult character, passing for a considerable distance through the narrow gorge of Clifton, where vessels are exposed to sudden gusts of wind, as well as to a violent run of tide. The rise of tide in the Bristol Channel is scarcely surpassed in the world. Even on the outer gates of the Bristol Docks the rise at spring-tides is 33ft., and in the Severn itself, as at Avonmouth, it is from 40ft. to 50ft. The great depth thus given at high water is of course a considerable advantage; but on the other hand, so great a body of water cannot ebb away except at a very high velocity, and when it has ebbed away it exposes long and steep slopes of mud, through which jut up reefs of limestone rock, most dangerous to any vessel which may have to lie upon them. This evil manifested itself at a very early period in the annals of ocean steamers. The Demerara, which was, we believe, the third vessel constructed for the ocean trade, when passing down the river on her first voyage happened to touch the ground. She swung round across the stream, the tide ebbed away from under her, and she was not got off without sustaining severe damage, and without occasioning an immense loss both in time and money to her enterprising owners.

Similar accidents have happened on several occasions subsequently, and the dangers of the river between Bristol and Avonmouth became so well known as seriously to prejudice the interests of the port. At the same time the width of the existing locks into the floating harbour become less and less sufficient for the greatly enlarged vessels of the present day. About 1857 matters came to a crisis, and it became the general opinion that something must be done. It was then that the word "dockising" was first heard of. The idea was a simple one. What was wanted was a channel always filled with still water, by which vessels arriving at Kingroad could at any time ascend to Bristol; in other words, a ship canal. But in the river Avon there existed a channel already dug by nature, securely lined with rock or clay, and of ample dimensions for the purpose. All that remained was to impound the waters within it by throwing a dam across the mouth of the river, and to excavate an entrance basin with upper and lower locks in the corner of land between the Avon and the Severn; and then the whole length from Totterdown to Avonmouth would be at once converted into an immense floating harbour, in which the level could be maintained constant, and along which the whole navy of England might pass and re-pass with perfect safety. It is greatly to the credit of Mr. Thomas Howard, at that time engineer of the Bristol Docks—and still their consulting engineer—that he at once saw the excellence of this idea, considered it in all its bearings, and adopted a definite opinion in its favour, from which he has never wavered. Unfortunately for Bristol, her leading citizens had not the courage or the wisdom to back their engineer's opinion. They talked, they hesitated, and the time went by. In 1859, however, they called in two eminent engineers, Mr. Hawkshaw and Mr. Page, to give a report on the subject. They also consulted the official representatives of the Admiralty. From all three quarters—we regret to say it for the credit of English engineers—they met with unfavourable responses. The bugbears which apparently frightened these gentlemen were mainly two:—First, the difficulty of carrying off the flood waters of the river in times of excessive rain; secondly, the fear lest the exclusion of the tidal waters from the ten miles length of the Avon up to Netham should have the effect of silting up the deep water in the Severn, which forms the anchorage of Kingroad. To appreciate the force of the latter objection, which was strongly urged by the Admiralty, it is sufficient to learn that the quantity of tidal water passing up the Avon is about the 115th part of that which sweeps through Kingroad to fill the upper reaches of the Severn. The objection therefore was about as reasonable, or rather much less reasonable, than if the conservators of a river were to prevent a miller from diverting something less than 1 per cent. of its waters to turn his mill, for fear that the channel below should silt up and destroy the navigation.

Moreover, the objection of course assumes that it is the tidal current which maintains the deep water in an estuary. This question was thoroughly discussed before the Institution of Civil Engineers in 1881; and whilst plenty of opinions were then given in the same sense as that of the Admiralty, it is not too much to say that the facts adduced went to show that the tidal scour is at its best a doubtful and inefficient factor in the maintenance of such estuaries.

The question of the safe carrying away of floods was not, like the last, a mere bugbear unworthy of attention. On the other hand, it was obviously a technical difficulty, which ordinary engineering ability was fully competent to grapple with and overcome. Nevertheless, as we have said, these were the ostensible reasons on which the eminent engineers we have mentioned declined to recommend the dockising of the river Avon. We have said the ostensible reasons; but the real reasons are not far to seek. Any engineer who is called in to report upon the advisability of a scheme which has in it anything novel, or in any way doubtful, is necessarily biassed beforehand towards giving an unfavourable opinion. The reasons are obvious. The scheme will not be carried out by himself; he has therefore no direct personal interest in recommending it. If it is carried out and succeeds, the credit will attach to the engineer who designed and executed it, and not to him who merely gave it his sanction; on the other hand, if it is carried out and fails, those who have spent their money in vain will naturally turn round upon the adviser who failed to tell them that they were going to do so. His reputation will necessarily suffer; and to an engineer, as to other professional men, reputation is money. Hence the engineer called in in such a case is almost certain to err on the side of caution, and this holds with still greater effect in the case of such men as the official representative of the Admiralty. Not merely are the interests of the port of Bristol nothing to him, but he is the servant of a wholly different body, and is specially charged with the duty of seeing that the interests of that body shall not suffer. It is needless to say that any scheme, however promising and important in itself, which offers even the shadow of a semblance of interfering in the future with those interests, is sure to meet with his uncompromising opposition.

However this may be, the fact is certain that the dockising scheme was condemned and for the time abandoned. The Corporation had before them the alternative of constructing docks at Avonmouth, into which a ship could be received as it arrived, and from which the trade could be carried on. This has been the course adopted on the Tyne, the Clyde, and in other places. The Corporation, however, shrank even from this, and resolved instead to improve the entrances into their present floating harbour, and also to remove the worst of the points and corners which hindered the passage of vessels through the Clifton gorge. On these works a large amount of money was spent; but though interesting and important from an engineering point of view, they have done but little towards improving the position of the port. Meantime, private enterprise, amidst many difficulties, financial and otherwise, secured at length the construction of a large dock at Avonmouth. This dock, however, was an unfortunate and ill-planned enterprise from the commencement, and is altogether inadequate to the general purposes of the port. Nor was this all. A second dock was constructed at Portishead, about two miles lower down the Severn, and was connected with Bristol by railway. To this dock the Corporation, by means of some adroit manipulation, were induced to contribute a considerable sum—£100,000. But the moment these two docks were in working order, the evil effects of leaving such matters to competition, and especially to needy competition, became apparent. The Avonmouth and Portishead docks vied with each other in quoting low rates for the docking and unloading of vessels, and for the despatch of goods. In homely language, they proceeded to cut each other's throats; and in doing so they contrived at the same time to throttle the trade of the city of Bristol itself; for it was not likely that ships would pass up the eight miles of difficult tidal navigation to reach the old floating harbour, in order there to pay ordinary port dues, when they could be received and unloaded almost for nothing in either of the basins situated on the banks of the Severn.

The end, therefore, of all the time and all the money which the Corporation of Bristol has spent on the improvement of its port has been that they find themselves in a worse condition than they ever were in before. Such is ever the fate of those who are too timid to take a bold course, or too parsimonious to lay out their own money.

Is it, however, too late? Are there no means of repairing the damage that has been done, and restoring to Bristol the rank she once held amongst the trading cities of the world? This is the problem which at present engages the attention of her citizens. B.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—William M'Dowall, inspector of machinery, to the Hibernia, vice Turner; W. H. White, chief engineer, to the Dryad, when recommissioned; and N. Edward Green, engineer, to the Dryad; Richard H. Trubshaw chief engineer, to the Iris; John Gardner, Charles Underhill, and Horatio F. Walton, engineers, to the Iris; Thomas S. Stanlake, engineer, to the Forward; John T. H. Denny, engineer, to the Goshawk; and William Whittingham, assistant engineer, to the Iris.

THE WORKS OF MESSRS. ESCHER, WYSS, AND CO. AT ZURICH.

No. II.

In the matter of the construction of turbines the system of Messrs. Escher, Wyss, and Co., in a country in which water-power is so valuable and ever-present a motive power, is to make special turbines from special patterns, according to the requirements of each case, the figures being given as to the quantity of water at command and the length of its fall.

They build chiefly two types of turbines, namely:—(1) Jonval turbines. These are of four classes—A, for use when an exactly specified power is wanted from the turbine, and there is always a sufficient supply of water for the same; B, when the quantity of water to be utilised is constant, or nearly so, as in the case of many artificial channels supplied from great rivers; C, when the turbine has always to drive but one machine requiring a constant power, which machine cannot be used when the power varies, as in the case of a rolling mill train; D, when backwater exists in the outlet or lower water channel of the works. (2) Girard turbines—E, for use when the water level in the lower channel does not rise much above its normal position; F, when the whole quantity of water at disposal has to be utilised and is variable; G, when all the water obtainable must be utilised regardless, more or less, of cost; H, for all falls above ten metres.

Both types are constructed and erected to meet the diverse requirements of various cases. The Jonval turbines are the most simple and cheap, and give 75 per cent. or more of the power theoretically obtainable from the fall of the water. Backwater does not diminish the effect of this type of turbine. About 80 per cent. of the power theoretically obtainable is given by the Girard turbines. These are fitted with regulating apparatus which enables them to utilise the water with about 70 per cent. of effect, even when the quantity of water falls to but one-fourth of the normal supply.

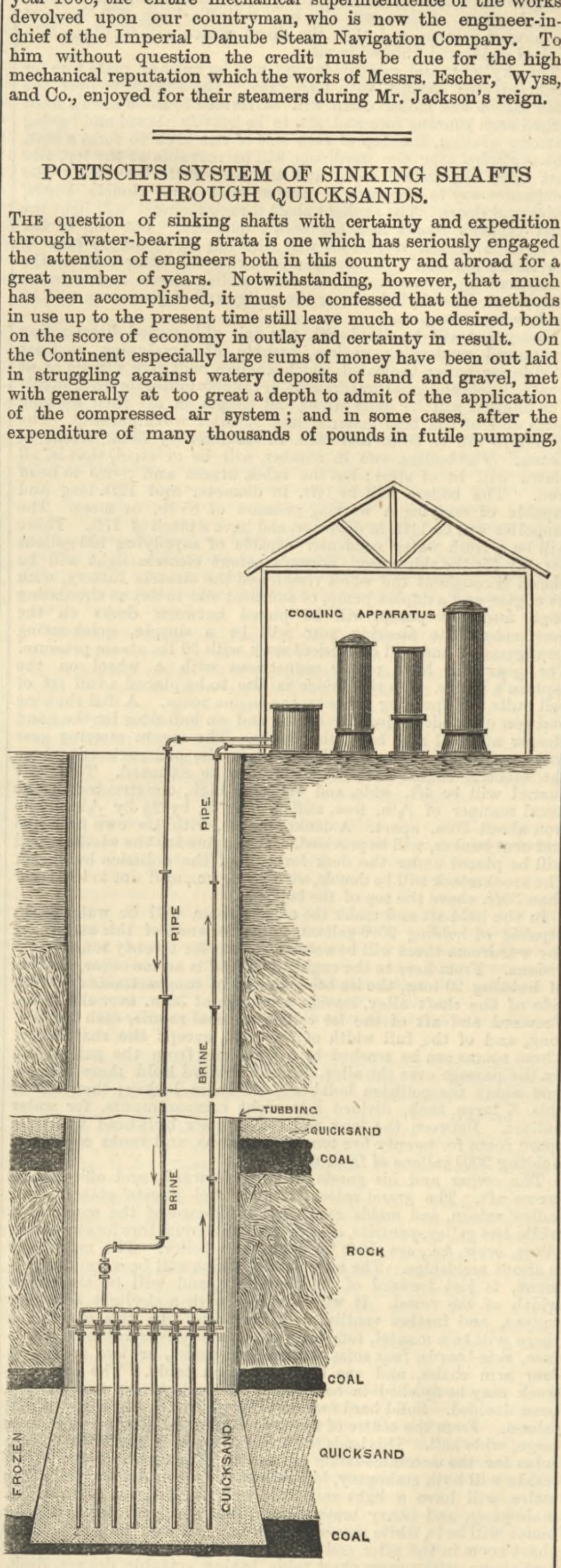
The waterworks of Zurich are one of the sights of the city for strangers, for in them by means of machinery constructed by Messrs. Escher, Wyss, and Co., the river Limmat is made to pump water from itself into the three reservoirs which supply the town and neighbourhood. The water from the Lake of Zurich passes in the first instance through a filter in the bed of the Limmat near the point at which the river issues from the lake, and this filtered water is carried by pipes to the other end of the city, where it is placed in connection with the pumps at waterworks. In these works, which are alongside the Limmat, are eight turbines, coupled in pairs, with a heavy driving wheel 4·32 metres in diameter between each pair, and making from 23 to 25 revolutions per minute. The toothed gearing of these wheels turns a single shaft running the whole length of the building at a little above the level of the solid concrete of the floor. On the other side of the shafts are the pumps. The whole is so constructed that any desired pair of turbines can be made to drive any desired pair of pumps, since both pumps and turbines can be put out of gear at will. The eight turbines are of a little over 100-horse power each. Only a part of the power at command is used for pumping water, some of it by means of wire ropes and skeleton iron towers supporting wheels, conveying the surplus power along the opposite bank of the Limmat, in one case to a distance of more than half a mile, where it is utilised in various works. The first turbines in the waterworks were put in use in 1879. There is room in the building for twelve turbines, and the vacant space was utilised during the time of the late National Exhibition at Zurich by fitting up therein a working model of a wooden turbine and pumps in section, to explain to non-technical observers the whole action. The first reservoir to which these turbines pump water is 50 metres higher than the dam at the works, and will hold 2400 cubic metres of water. The second reservoir, of 2200 cubic metres capacity, is at the altitude of 90 metres; and the third, of 300 metres capacity, at the altitude of 160 metres. Each of the six systems of pumps raises 4500 cubic metres per day, or 3100 litres per minute. The horse-power required for the low-pressure water level is 50, for the middle-pressure 90, and for the high-pressure 140. All the pumps together raise from 2400 to 2600 cubic metres per day. The water from the Limmat, which can be utilised at the waterworks, gives 1200 horse-power, or net 900, of which about 500 are at present used to pump water, and the remainder is utilised at various industrial establishments in the neighbourhood. The total cost of the Zurich waterworks, including cost of land, buildings, pumps, works, river filter and its pipe, turbines, town pipes and fire-plugs, three reservoirs, "exploitation," and varieties of apparatus, was 7,525,000 francs. Automatic electrical apparatus between the works and the reservoirs gives information to the officials in the waterworks as to the level of the water in the reservoirs, so that they may regulate the pumping arrangements accordingly. The gridiron in the river outside the works, to prevent foreign matter being carried into the turbines by the current, at present has the appearance of a bank of dead leaves, these being prevalent in quantity everywhere at this season in such a richly wooded country as Switzerland.

Cotton spinning, as in England, is one of the chief foundations of wealth and industry in Switzerland, the hills and valleys of which are dotted with the works, some of them of the most extensive description. These works, however, in a land of peasant and other proprietors, are less concentrated in great towns than in the United Kingdom. They frequently have vineyards and farms around them, and when the day's labours of the workmen are over, they live beneath their own vine and fig-tree, with all the benefits of pure mountain air and rural life. The general atmosphere also, in consequence of wood being largely used for fuel, is not tainted with coal smoke, although coal is used to some extent in large works, especially where water-power fails. It is not alone in the origination of this great cotton spinning industry in Switzerland that the Eschers have won the gratitude of the Swiss nation. Several of the valleys above the lake of Zurich were once occasionally flooded by the river Linth. The overflow waters of the Lake of Wallenstadt were once joined a little below that lake by the river Linth bringing down the *débris* of rock and vegetation from the higher Alps. This *débris* blocked up the channel from the Lake of Wallenstadt, whilst the waters of the Linth, at the same time, occasionally flooded the valleys, putting the farms under water, and spreading malaria when they subsided. To make matters worse, the Wallenstadt waters afterwards burst through the temporary dams made by the Linth, and produced other floods. During the subsidence of these floods, and for months afterwards, malaria prevailed, and fertile valleys were desolated. Conrad Escher, an uncle of Caspar Escher, in 1807 proposed to the Federal Government a plan to remedy this. He recommended the making of a new channel for the Linth, whereby it should discharge its waters into the Lake of Wallenstadt. He also proposed that a new and sufficient channel should be made, whereby the Lake of Wallenstadt should discharge its waters without lateral overflow into the Lake of Zurich. These plans were carried out completely before the close of 1822, and considerable districts were thereby made profitably and healthily habitable. So great was the appreciation of the inhabitants of the permanent benefit arising from these works, that the projector and constructor acquired the name of Escher von der Linth, despite the objection to titles in a republican nation. The total cost of the undertaking was £60,000. Dr. Escher, another of the same family, was the chief founder of the St. Gothard Railway.

Our notice would be incomplete did we omit to mention the important part which Mr. Murray Jackson played in developing the resources of the firm, especially as regards marine engineering. After the death of Mr. Albert Escher, and until the year 1868, the entire mechanical superintendence of the works devolved upon our countryman, who is now the engineer-in-chief of the Imperial Danube Steam Navigation Company. To him without question the credit must be due for the high mechanical reputation which the works of Messrs. Escher, Wyss, and Co., enjoyed for their steamers during Mr. Jackson's reign.

POETSCH'S SYSTEM OF SINKING SHAFTS THROUGH QUICKSANDS.

The question of sinking shafts with certainty and expedition through water-bearing strata is one which has seriously engaged the attention of engineers both in this country and abroad for a great number of years. Notwithstanding, however, that much has been accomplished, it must be confessed that the methods in use up to the present time still leave much to be desired, both on the score of economy in outlay and certainty in result. On the Continent especially large sums of money have been out laid in struggling against watery deposits of sand and gravel, met with generally at too great a depth to admit of the application of the compressed air system; and in some cases, after the expenditure of many thousands of pounds in futile pumping,



some other special method has ultimately to be resorted to in order to overcome the difficulty. Hitherto, in addition to the "Plenum" process, which is only applicable when the air pressure is not required to exceed some four atmospheres, the system most generally employed has been to sink watertight cylinders of iron, or of masonry shod with iron, by loading them from above and forcing them down with screws or by blows from a falling weight, while the material is removed from the inside by hand or revolving dredgers, length after length being added to the cylinders as the sinking proceeds. Simple as this process appears to be, it is in some cases extremely difficult of application, while, in others, it is not too much to say that it has signally failed.

To ensure success in cases where other means have failed various special plans have been devised, among which we may mention the Kind-Chaudron system, which has been fully described in the "Transactions" of the Institution of Civil Engineers, and the plan adopted by M. Chavatte, which is detailed at length in the "Bulletin de la Société de l'Industrie Minérale," besides one or two other arrangements which have not been applied beyond the one special case for which they were designed. Granting, however, that with one or other of the systems we have enumerated, a shaft can be successfully carried through a water-bearing stratum, it is often only accomplished after an enormous expenditure of time and money, the proprietors of the mine being handicapped with this extra amount of capital, as compared with their more lucky neighbours, who have perhaps done their sinking under less unfavourable circumstances. Any process therefore, which is both certain in its results and comparatively cheap in application, is certain to be received with great satisfaction by all those concerned in the sinking of shafts, and we therefore give the following description of a new method recently invented by Herr Poetsch, mining engineer, Aschersleben, which is now being introduced into this country by Messrs. A. and E. Cohen, of Basinghall-street, E.C., and which seems to us likely to be of great practical value. It consists in actually freezing the quicksand or running ground to a hard solid mass, through which the shaft can then be sunk in the ordinary way without pumping, the external circular wall of ice left outside the excavation giving sufficient protection against influx of water, sand, or gravel, until the permanent masonry or iron lining is got into position. To accomplish this, after the shaft has been brought down to the level of the quicksand, a number of bore-holes are carried down to the solid ground by means of a sand pump. These holes are spaced about a yard apart, and are placed in circles, the outer one approaching as nearly as possible to the circumferential line of the shaft when finished. The bore-holes are then lined with iron tubes closed at the bottom, within each of which is a smaller concentric tube of copper open at the bottom and connected at top to a main pipe communicating with all the other copper tubes and extending to the top of the shaft. The upper ends of the outer iron tubes are also connected to one main pipe, which, like the other, extends to the surface of the ground. Through these pipes brine, consisting of a solution of the chlorides of calcium and magnesium in water—which has a freezing point of about 36 deg. below zero Fah.—is caused to circulate by a small force pump driven by an engine, its course being down one of the mains and the internal copper pipes, and back through the surrounding annular spaces and the other main to the top of the shaft. At the surface is placed a cooling apparatus, preferably of the ammonia type, the refrigerator being inserted between the two lines of mains, so that the brine in its flow is continuously cooled to a temperature of about 15 deg. below zero Fah., before its passage down the shaft into the bore-holes. In this manner heat is rapidly abstracted from the quicksand or other running ground, which is thereby frozen into a hard solid mass after a period, it is stated, varying from fifteen to twenty days, according to the size of the shaft and the conditions under which the apparatus is worked, the freezing being continued till the solid block extends well beyond the space to be occupied by the shaft and its lining. The excavation is then carried on as through solid ground, the masonry or iron lining being introduced as the cutting proceeds, in order to prevent the surrounding ice wall from breaking in from the external fluid pressure.

The annexed engraving will show without further explanation the manner in which the process is applied, the arrangement being that recently adopted in the successful sinking of the Archibald shaft of the Douglas coal mines at Schneidlingen. In this, the first practical application of Herr Poetsch's system, a bed of running sand about four metres thick had to be pierced. Twenty-three bore holes were employed, and the freezing process was completed on the 10th of August last, on which date the sand had become a mass of such hardness that it was with considerable difficulty that pieces could be broken off. The shaft was then completed in the usual way without stays and without pumping. To expedite the work it is proposed that when admissible, the shaft shall be sunk down to the natural level of the water of larger dimensions than actually required for the working, in order to permit of an outer ring of bore holes being made in the ground outside the lining of the shaft, in which case it is estimated that the freezing may be accomplished in from ten to fourteen days.

In the present stage of the process it is, of course, impossible to ascertain with any great degree of accuracy the cost at which the freezing of such a large open mass can be accomplished, though some idea can, perhaps, be formed by comparison with the work actually done by refrigerating apparatus in the manufacture of ice. Assuming that what is called a 10-ton machine be employed, this would be capable when applied in the usual way for ice-making, of forming 10 tons of ice in twenty-four hours at a cost of about 8s. per ton, exclusive of interest on capital, and with coal at about 12s. a ton. Probably in freezing a quicksand only a third of this quantity of ice could be calculated upon, or, say, 3⅓ tons per twenty-four hours. Taking the block to be formed at 22ft. diameter and 13ft. thick, and assuming one half of the quicksand to be water and the other half solid matter, the quantity of ice may be roughly taken at 70 tons. This, at 3⅓ tons per day, would take twenty days in its formation, the working expenses per ton being three times that in ice-making, or say a total of £84. To add to this there would be the rent of the installation and the cost of the special pipes and appliances, which would have to be made to suit the circumstances of each case, as well as a sum for patent rights and charges; but allowing handsomely for these, it will be seen that the total cost in such a case as we have taken must be comparatively insignificant compared with that of the usual methods in which enormous sums have been spent in pumping alone, and this will be true even if the time occupied in freezing is very much greater than is now stated to be the case.

It is, of course, a matter of speculation at the present time to what extent Herr Poetsch's plan can be applied in this country, but it must be obvious that there are many instances in which it is likely to prove of the greatest value, and we have therefore not hesitated to bring it before our readers. The principal points in favour of the system appear to be not only in the cheap and expeditious method of making shafts and cuttings through quicksand or running ground, but in the fact that it seems to give an almost absolute certainty of result, at a cost which is not only comparatively small, but which can be very closely ascertained beforehand. In this way the risks attending the sinking of new pits should be minimised.

REVERSING MILL ENGINES.

The engraving—page 424—represents a pair of engines specially designed for rolling small sections of rails, designed and manufactured by Messrs. Davy Brothers, Sheffield, and intended to run at a high speed. The maximum speed will be about 150 revolutions, and the piston speed about 1200ft. per minute. With this object all the bearings have large wearing surfaces, and the momentum of the working parts is carefully counterpoised by balance weights secured by straps to the webs of the cranks. The cylinders are 36in. diameter, and have a stroke of 4ft.; they are fitted with slide valves having the pressure partially removed from the back by a balance piston, and are worked by excentrics in connection with a link of the Allan type. The reversing is effected by moving by hand the valve of a small auxiliary cylinder, so arranged that the piston cannot overrun, but follows exactly the movement of the hand lever. As will be seen from the engraving, the reversing lever, the steam valve lever, and the screw for opening the drain cocks are all arranged on a platform elevated to a convenient height to allow the driver good sight of the rolls. These engines have recently been erected at the Blaenavon Steel Works, near Pontypool, Monmouthshire. Messrs. Davy Brothers have done a good deal to promote the adoption of high speed engines in rolling mills by the excellence of their workmanship, design, and material, and the engine we illustrate is a fair example of the excellent work turned out by this firm.

MR. WILLIAM ASTOR'S NEW STEAM YACHT.

We learn from the *Nautical Gazette* that the Harlan and Hollingsworth Company, of New York, have laid down the keel of the largest steam yacht ever constructed, and the first to be built of steel in America. This vessel is for Mr. William Astor, of New York, and in addition to her size, great strength and speed and fairness of model, the essential requirement of her construction is that she shall be capable of any sea service either under steam or canvas. To this end it has been made binding with the builders that the new yacht must be constructed under the rules of the English Lloyd's Register relating to steel vessels, and also to fully meet the requirements of the United States steamship inspection laws; and in the several surveys necessary from the laying of the keel to her completion everything must come up fully to the highest grade, not only in the matter of hull and machinery, but in the full equipment required for a transatlantic passage. The general design and description, as well as the plans in detail of the new yacht, were furnished to Mr. Astor by Mr. G. Hillmann, of City Island, N.Y., who will be the superintending engineer. The model of this specimen of yacht naval architecture will present no strange and startling innovation, but there is reason to believe that she will be strikingly fair, of yacht-like contour throughout, and as capable of ocean service as any steamship afloat. The general dimensions of this vessel, which places her at the head of the list of steam yachts of the world, will be as follows:—Length of deck from foreside of rudder post to afterside of stem, or its rade line, 227ft. 5in.; breadth, extreme, 30ft.; depth of hold from top of floors to underside of deck amidships, 18ft. 7½in.; depth, moulded, from top of keel to top of beams at side and amidships, 20ft. The proportion of length to depth as calculated is 11·03, and of length to the breadth, 7·58. The latest improvements in every particular of construction, finish and appointments will, it is understood, be brought into requisition, and the workmanship throughout of every description and in every department of a character to thoroughly equip and complete the vessel in every respect ready for sea, except in the minor matters of upholstery, linen, silver, glass and crockery ware. The view of the yacht from her upper deck, when finished, will charm the nautical eye, as the plan indicates by its large area, comfort at sea, and ample exercise in port. There will be a trunk over the boilers, engines and galley 70ft. long and about 2ft. 6in. high, and a house of moderate length from just forward of the foremast and extending aft over the hull, while the captain's bridge will be laid across the forward end of the house, from rail to rail. The wheelsman will stand at the forward end of the bridge, from which full control of the steam steering gear will be had. The yacht will be barque rigged, and will carry over 7000 square feet of canvas, and, in the matter of boats, nothing afloat will be more liberally provided.

Special attention will be given to the construction of the watertight bulkheads and compartments, particularly as this vessel is intended for cruising or sea service. The collision bulkheads will be about 13ft. aft the stem at water line, and from this to the forward boiler bulkhead will be the main saloon and staterooms, occupying 82ft. 3in. From the forward boiler bulkhead to to the engine-room bulkhead it will be about 40ft. The engine-room will be about 19ft. 3in., and another bulkhead 35ft. aft of the engine-room will divide the officers' quarters from those of the crew and extend to a point 26ft. forward of the sternpost. All these bulkheads will run from the bottom of the vessel to the main deck and be built in the most approved manner. Besides those mentioned there will be a bulkhead under the cabins at forward end of the coal bunkers and running up only to between decks, and there will also be the usual water-tight compartments around the stern bearing. Two longitudinal bulkheads will enclose the engines and boiler room, which will extend from the skin to the top of the upper deck, beams 16ft. 6in. apart, forming coal bunkers on each side. These bulkheads will be carefully constructed, and all connecting doors in them, as well as the athwartships bulkheads, will shut watertight. The keel of the new yacht is to be a centre-wrought plate keel and keelson combined, 32in. deep by $\frac{18}{16}$in. thick, and will run as far forward and aft as practicable, the ends to be solid with butts and scarphs as required. The side plates of the keel will be 8in. deep by $\frac{14}{16}$in. in thickness. The stem will be moulded 8in. by 2¼in., rabbeted to receive the plating, rounded on forward edge and well finished, the upper end raking out, forming a head and tapering in thickness to 2in. at the outer end. The sternpost will be moulded 8in. by 4½in. thick. At the propeller eye it will mould 12in. by 3½in., and below the keel 5in. thick.

The frames, 4in. by 3in. by $\frac{7}{16}$in., will be spaced 21in., and in one piece from the keel to the underside of the rail. Angle rims 4ft. long, also 4in. by 3in. by $\frac{7}{16}$in., will be placed back to back of frames, bent up 18in. through centreplate, which will firmly hold and connect the frames. The floor plates will be 24in. deep at centre, running up to the bilge to a line of double their height. Under the boilers and engines they will be $\frac{9}{16}$in. thick and $\frac{8}{16}$in. forward and aft of that point. The reverse angle irons on the frames will be in one length, 3in. by 3in. by $\frac{6}{16}$in., and extend from the keelson to the upper edge of the stringer angle of the upper deck on alternate frames, and 12in. above the lower deck otherwise. In the boiler and engine rooms they will be double as far as the lower turn of the bilge, or 12in. above the fore and aft bulkheads. Doubling pieces will be worked at all keelsons and stronger angle irons. A keelson will be placed on top of the centre-through plate, and two angle irons 4in. by 4in. by $\frac{8}{16}$in. will be worked continuously as far forward and aft as possible, thoroughly rivetted to a plate 30in. wide by $\frac{10}{16}$in. thick laid on the floor plates and held to them by double reverse angle irons. The bilge keelson will be worked to rule. The beams will be of bulb T iron 7in. by $\frac{7}{16}$in. for the upper deck and 8in. by $\frac{7}{16}$in. for the lower deck. Between the boilers on the lower deck and fore and aft of the smokestack on the upper deck the beams will consist of a plate 10in. wide by $\frac{9}{16}$in. thick, with angle irons 3½in. by 3½in. by $\frac{8}{16}$in. at top and bottom, heavily kneed to side. The pillars for the hold will be 3in. by 2¾in. by 2½in. by 46in. wide. A continuous angle iron will be worked on top of this and the reverse angle irons, 5in. by 3½in. by $\frac{8}{16}$in. For the lower deck there will be the same size plate, but the angle irons here will be 4in. by 3in by $\frac{8}{16}$in. In the plating of the outer skin the three upper strakes will be worked flush, with inside bands 9in. wide, to be double rivetted and the butt straps treble rivetted. The plates to be $\frac{10}{16}$in. thick, at least 36in. wide, except at the shear strake, where they will be from 40in. to 45in. wide. The shear strake will be doubled at the upper edge by an inside plate 21in. wide and $\frac{10}{16}$in. thick. The plates from the flush strakes to the garboard will be $\frac{9}{16}$in. thick and lap as usual, being double rivetted and butt strapped.

The decks will be of iron plates $\frac{5}{16}$in. thick, inside of bands 4½in. by $\frac{5}{16}$in. between the beams and single rivetted, though the butt straps will be double rivetted. Over the upper deck will be laid a course of white pine 3½in. by 3½in. wide, which will be held by galvanised lag screws. The lower deck will be covered with Georgia pine 2½in. by 5in. wide, the material to be selected, which will also be held by galvanised lag screws. The trunk over the boilers and engine will be of $\frac{5}{16}$in. steel plate, and well secured to the deck by angle irons and to the beam. The earlings for the trunk will be of angle iron 3in. by 3in. by $\frac{7}{16}$in., and kneed to stiffening angles of the same size, 30in. apart. In the wake of the smokestack and engine skylight bulb "T" beams 6in. by $\frac{6}{16}$in. will be placed. The outside of the trunk will be covered with cherry. The coamings for the sky-lights, companionways, &c., will be of light steel or plate iron, secured to the deck frame in the same manner as the trunk, and all finished outside with cherry, and the same or other hard wood on the inside. The frame of the house on deck will be of steel angles 2½in. by 2½in. by $\frac{5}{16}$in., forming ceilings and side frame in one piece. The sides will be of steel plates as high as the sashes, and well secured to the iron deck. The waterways will be of teak 9in. by 10in., and well fastened to the stringer plates. The rail will be of teak 15in. by 4½in., and the pin rails also of teak 3½in. thick. There will be six gun ports fitted in the bulwarks. The deck fittings will be complete to the minutest detail. The side lights will be of the most approved pattern, fitted flush with the outside plating, and the glass to be 10in. in diameter and 1in. thick. The rudder will be made in the most approved manner, the stock to be 5½in. in diameter, pintles 3in. in diameter, and to be capped with brass. Of anchors to be supplied there will be one 18 cwt., another 16¾ cwt., one of 8 cwt. for the stream and a kedge of 400 lb. The new yacht will be supplied with a steam launch of steel, 35ft. long. This will have a compound engine and coil boiler and be fitted with air tanks and finished in mahogany. The owner's gig will also be 35ft. long and row six oars. This will be of cedar, lap streaked, and be finished in mahogany. There will also be a metallic boat, 28ft. long, of the newest pattern, and then the dingy, which will be of smooth-worked cedar and finished in ash.

The skylights and companionways will be built of plate iron or steel, covered outside with mahogany. The skylights over the main saloon and ladies' cabin will be formed so as to have a fixed arched sash running fore and aft, to be heavily glazed and having a strong grating, the top of each side of the arch to form a seat. The skylights over the wardroom will be movable at the top, also that over the ladies' cabin and the one next forward. The companionway to the crew's quarters will have double hoods, slides and doors. The skylight abaft the mizzenmast will light the chief officer's rooms and the crew's quarters. The top of the skylight over the wardroom will lift off, in order to take in provisions and ice. The companionway in the after end of the trunk leading to wardroom will have sliding doors and stairs on each side. The skylights over the galley and engine room will be made very strong.

The yacht will be fitted with one pair of inverted direct-acting compound condensing engines, capable of developing at least 1400-horse power indicated, which engines will give a speed of at least 12 knots under natural draught, or 14 knots under forced draught. The engines will be built strong and simple in all their working parts and of the best material and superior workmanship. The cylinders will be 30in. and 60in. in diameter by 36in. stroke of piston. The boilers, two in number, will be of steel, that is, all plates will be of steel; but the tubes, braces and rivets to be of iron. The boilers will be 14ft. in diameter and 12ft. long and capable of carrying a working pressure of 85 lb. or more. The propeller will be 11ft. in diameter, and have a pitch of 17ft. There will be a fresh water condenser capable of supplying 100 gallons per day for the ship's use. Edison's patent electric light will be placed throughout the whole vessel, and the electric battery, with its engine and a duplex pump, of sufficient size to act as circulating bilge and fire pump, will be placed between decks on the port side. The steering gear will be a simple, quick-acting arrangement, and will do efficient work with 50 lb. steam pressure. The gear will have proper connections with a wheel on the captain's bridge. On the bridge is also to be placed a full set of bell pulls and speaking tubes to the engine room. A dial showing position of rudder, also the course and an indicator for the hand steerer aft, will also be on the bridge. The steam steering gear will be placed over the after boiler or in the compartment where the electric engine and battery are to be situated. The shaft tunnel will be 4ft. wide, and 5ft. 6in. high, constructed in the usual manner of $\frac{4}{16}$in. iron, stiffened by 2½ by 2½ by $\frac{4}{16}$in. angle iron about 36in. apart. A donkey boiler, with its own fire room and coal bunker, will be provided. The engine for the windlass will will be placed under the deck forward of the collision bulkhead. The smokestack will be double, with hood, &c., and not to be higher than 30ft. above the top of the boilers.

In the hold aft and under the officers' room will be water tanks capable of holding 2500 gallons. Just forward of this and under the wardroom there will be a stowing room for twenty tons of provisions. From here to the engine bulkhead is an ice cellar, capable of holdlng 20 tons, the ice being stowed in compartments on each side of the shaft alley, leaving a passage of 30in. over the same. Forward and aft of the ice cellars are coal rooms, each 3ft. 9in. long, and of the full width of the hold, except the shaft alley. These rooms can be reached by a trap door from the galley, and by the passage over the alley. In the forward hold there will be, just abaft the collision bulkhead, the chain locker; then aft of this a large tank, divided into eight compartments, for water ballast. Between the tank and coal bunker bulkhead will be a spare room for twenty-five tons of provisions, and tanks capable of holding 2000 gallons of fresh water.

The owner and his guests will live forward, and officers and crews aft. The grand saloon, owner's and guests' state rooms, ladies' saloon, and maids' rooms are all forward of the machinery, while the galley, pantries, officers' rooms and quarters for engineers, oilers, crew, &c., are abaft the engine and boiler. The machinery is about amidships. The main saloon, which will be a grand apartment, is just forward of the machinery, and will be the entire width of the vessel. It will be lighted with a skylight 6ft. 9in. square, and further ventilated by air ports. In this apartment there will be a mantel, four cases to serve as silver cabinets, bookcase, side-boards, four sofas and two arm chairs, or two sofas and four arm chairs, and one large extension table. The overhead work may be finished in hard wood panels, but this has not yet been decided. Solid hard finish will be given to the sides of the saloon. From the centre of the main saloon, leading forward, is a large, wide hall. This leads to the house on deck, the latter having sofas for the accommodation of guests. The finish of the house inside will be in mahogany, in Eastlake or Queen Anne style. The stairs will have a light rail, balusters, and newel posts all in mahogany, and heavy brass steps. The overhead panels of the house will be in white pine or poplar, and painted in fresco. The chart room in the after end of the house will be finished in the mahogany, with proper chart table, having suitable drawer, desk, and sofa.

From the hall which opens into the main saloon, there is a passage leading forward. On the starboard side, and next the saloon, is the owner's state room, which will be handsomely fitted in hard wood. Bath and retiring rooms open into this room. Forward of the owner's room on the same side will be another state room, with bath and all conveniences. Then on the port side of the passage are three large state rooms, while at the end of the passage is the ladies' saloon, extending across the ship, with a connecting private bath room. Forward of the ladies' cabin, on the starboard side, there will be another state room, and still further forward a room for the waiting maids. All these rooms will be finished in hard woods, and will be upholstered in costly and attractive style.

On the starboard side, just abaft the machinery, is a large galley, which will be thoroughly appointed and fitted. Opposite the galley is a room for two cooks, then still going forward on the same side, a pantry, a room for two stewards, a spare room, then rooms for the chief engineer and second engineer. On the starboard side, next after the galley, is a bath room, then a room for two quartermasters, next the second mate's quarters, then the captain's room, and still further aft, quarters for the first mate. Then there is the ward room, which will be a cheery-looking apartment, and then extreme aft comes the quarters for ten seamen and ten firemen. Electric bells will be fitted from all rooms forward, also from the house on deck to the pantry and steward's room aft. Electroliers or chandeliers, brackets, lights, &c., will be fitted throughout the vessel, the style to be according to place, while those for the main saloon, ladies' cabin, and owner's room will be of artistic value.

The standing rigging will be of the best charcoal galvanised wire. All the shrouds will be parcelled and served their entire length. There will be four shrouds for the fore and main masts and three for the mizzenmast. The running rigging will be of the best manilla bolt rope. The foremast is 71ft. and topmast 38ft.; the mainmast 73ft. and topmast 38ft.; the mizzenmast 61ft. and topmast 36ft. The bowsprit is 21ft. outboard. It will require until next May or June to finish this magnificent yacht.

THE AMERICAN CRUISERS.

The *New York Sun* of November 15th contains the following:—"Washington, November 14th.—The Naval Advisory Board has received a very black eye from The Engineer, a London periodical, which ranks as an authority on engineering subjects. Copies of The Engineer of October 26th, containing a criticism of the Chicago, the new steel cruiser, have arrived here, and have caused such a stir that telegrams have been sent to New York for more copies of the paper. The animus of the article is not hostility to American ideas, for the writer says that 'no engineers and shipbuilders on earth can compare with the Americans in the design and construction of river steamers.' He adds that the decline of American shipbuilding cannot be laid to the tariff, for if there had been any great interests involved the tariff would have been lowered. The article continues as follows:—'After all the fuss and turmoil which have attended the proceedings of the Naval Advisory Board, it was to have been expected that something much more important would have been produced. In the design of the Chicago the English engineer and naval architect will find at every turn something defective. It is not quite easy to see for what she is intended. Against ironclads she would be helpless. It is difficult to understand what purpose the inch and a-half steel deck is to serve. It is too thick for a deck and too thin for a defence. There is no manner of protection provided for the men save the trumpery shields on the guns, and any vessel fitted with a sufficient number of Hodgkiss or Nordenfelt guns could prevent 8in. guns from being fired. We find good reason for doubting if the Chicago can ever be a fast vessel. Her engines are revivals of devices long since obsolete in this country, and all the vices of American marine engineering manifest themselves. No English engineer in his senses would dream of putting in compound beam engines to drive twin screws. We can hardly realise the mental condition of any man who can argue that, because beam engines go well with cylinders with a stroke of from 12ft. to 15ft., and with paddle wheels 40ft. in diameter, making fifteen revolutions or so per minute, they must also suit compound twin screw engines running at eighty revolutions per minute. Defective as the engines are, they are admirable when compared to the boilers. To go to sea with such boilers is simply to court destruction. The Chicago will have fourteen boilers. If the fires are ever urged, such boilers will prime furiously. If from any cause the plates over the furnaces become overheated they will crack, and the result may be anticipated. Nothing could be more injudicious than the use of furnaces made up with plates of fire-brick in a sea-going man-of-war.' These are the principal points of criticism, which are much elaborated in the article. The Naval Advisory Board is much chagrined at the attack, which will have great weight with scientific men on account of the character of The Engineer." The *Engineering and Mining Journal* says:—"Despatches from Washington to the New York daily papers unfriendly to the Administration represent naval circles in that capital to be considerably excited over a criticism, published in The Engineer, of the design of engine and boilers of the new steel cruiser Chicago. It may be well to warn Americans, before they attach too much importance to what The Engineer says, to state that the pages of that journal have for years maintained an attitude of hostility to everything that is American." It may be well to warn Americans before they attach too much importance to what the *Engineering and Mining Journal* says, that it is quite untrue that we have maintained an attitude of hostility to everything that is American. As to the Chicago, we have endeavoured, in criticising her, to explain why we regard her as defective. Americans versed in naval matters can tell for themselves whether our comments are justifiable or not. Marine engineers, too, can easily say whether it is or is not advisable to adopt a type of engines long since tried and abandoned in this country, and a type of boiler concerning which it is enough to say that in this country brick furnaces have been well tested at sea with the worst results, and that unless absolutely pure distilled water, entirely free from grease, is used in the boilers of the Chicago, they will not last twelve months. Even the most hostile of our contemporaries must admit that the machinery and boilers of the Chicago are strictly experimental, in the sense that nothing like them has ever before been sent to sea in a man-of-war. We hold this policy to be wrong, and we believe that far better results would have been obtained had Americans been content to profit by the dearly-bought experiences which we have had in this country, and the results of which have been placed at their disposal by their own engineer—Mr. King—who has nothing to learn concerning English naval practice.

Marine Engineering.—When the present year is completed, it will be found that it has been the year of probably the largest output in regard to marine engineering, except probably on the river Wear, where a strike has limited work. But at all the other centres, especially in the great shipbuilding ports, there has been full work, and there are orders still in hand that will carry the works well into the next year. There are also very great extensions and additional works either in progress or completed on the Tyne, at West Hartlepool, and at other of the east coast ports. Nor can it be said that the prospects are gloomy. It is probable that next year will witness a slight decline in the number of new vessels to be engined; but on the other, hand those that are built are of increased size, and there is a demand for more powerful engines. And as our mercantile navy is from time to time changed from the sailing vessel to the steamer, every year will witness an increase of the amount of engineering work that will be needed for renewals and repairs, so that there should be a constant increase in the demand for marine engineering, and it is worthy of notice that there is a widening of the area of use of marine engines, for whilst our great builders are busy with engines for the finest passenger vessels, and on the east coast the demand for cargo carrying steamers keep them busy, there is also an entrance of steamers into new trades, and a probability of the building of others to meet the special requirements that show themselves. As the old sailing vessels die off they are not replaced, and not only are their successors more and more steamships, but on board the latter there is an increasing desire to employ steam power for some of the work that has been done hitherto by manual labour; so that the position of the marine engineering trade must be looked upon as satisfactory.

Death of Mr. J. Stewart.—Information has been received of the death of Mr. James Stewart C.E., a member of the Livingstonia Mission. Deceased was trained as a civil engineer, and went to India to serve in the Public Works Department. When the time of his furlough came, instead of going to Scotland, he visited the Livingstonia Mission, and became so interested in its operations that he threw up his lucrative pay and hopes of preferment in India to become the engineer of the mission in 1878. He explored the east and west shores of Lake Nyassa and the country to the north-west between Nyassa and Tanganyika, and settled its latitude and longitude, which had been only approximately fixed by Dr. Livingstone. Returning to England at the close of 1880, he read a paper upon his discoveries before the Royal Geographical Society. Mr. James Stevenson, of Glasgow. having provided a sum of £4000 for the opening of the road which Mr. Stewart had surveyed between the two lakes, deceased returned to Africa in 1881, at the head of a staff of artisans. He got to work, but nineteen of his assistants were massacred in cold blood by a neighbouring chief. Yet, nothing daunted' he began the construction of the road at the head of Lake Nyassa. He completed this difficult portion at the heights of Maliwanda, built a mission-house in the country of the Choongoos, and reported to the Livingstonia and London Missionary Societies that the way was opened for their mission stations on the new road. While proceeding with the navigation of the Ilala Mr. Stewart caught fever in the lower reaches of the river, and succumbed to malaria, at the age of forty years.

RAILWAY MATTERS.

THE Government of Victoria have appointed Mr. Richard Speight, of Derby, assistant general manager of the Midland Railway Company, to the office of Chairman of the Commissioners of the Victorian State Railways, at a salary of £3000 per annum. The appointment is for seven years.

THE Tasmanian Government proposes to obtain a loan which is to be devoted, according to a statement by the Minister of Lands, as follows:—Railways, £719,000; railway surveys, £300; main roads, £27,000; main bridges, £12,200; branch roads, £58,420; branch bridges, £4700; jetties, £2800; telegraphs, £4060; tracks, £1000; buildings, £59,100; miscellaneous, £4300; in all, £892,880.

WE, says the *Liverpool Journal of Commerce*, understand that the Wirral Railway, of which Mr. James Harrison and Mr. Harold Littledale are directors, have become the purchasers of the Seacombe, Hoylake, and Deeside Railway, and that it is intended to form a junction with the Mersey Tunnel Railway, near to the Birkenhead Park entrance, and to push on with vigour the Seacombe extensions.

A RATHER unusual accident occurred to the engine of the Midland Scotch express a few days ago. While running at full speed, the wood lagging round the boiler of the engine, took fire. The train was stopped at Wellingborough, and the fire extinguished. Afterwards, when the engine was proceeding at a great speed, the fire burst out again, and became so serious that the train was again stopped at Rushton, the engine detached, and the fire extinguished. A goods engine was secured, and took the express to Leicester.

THE widening of the more crowded parts of the railways to three and four, or even more, lines, so as to separate the fast from the slow traffic, is proceeding rapidly; and there are now over 400 miles of railway in England and Wales, upon which three, and more frequently four, lines are laid. The *Railway News* says the London and North-Western Company has 110 miles of four lines, and 29 miles with three lines. The Midland 66 of four and 21 of three lines. The Great Northern 24 of four and 30 of three lines. The Great Western 19 miles laid with four lines.

AFTER several postponements, two passenger trains daily will now run between Pesth and Semlin. This will give Belgrade two posts per day, and will reduce the time occupied in the journey to Pesth by over 50 per cent. Semlin is on the Austrian bank of the Danube, opposite Belgrade. The Belgrade correspondent of the *Times* says the bridge over the Save will not be completed until next summer. The duration of the journey between Belgrade and Vienna will eventually be reduced to twelve hours instead of thirty, as heretofore. The Servian Railway will reach Alexinatz in a few days, and the work is being pressed forward between Alexinatz and the Macedonian frontier, near Vranja.

AN important change is to be made during November in the standard railroad time of the United States and Canada. Hitherto there have been no less than fifty standards of time, and to remove the inconvenience arising from this state of things the whole of North America has been divided for time purposes into five broad belts, running north and south, each extending over 15 deg. of longitude. In each belt, the *Colonies and India* says, only one standard of time will be maintained, one hour's difference existing between each standard. The principal cities in Eastern Canada will probably follow the example of the chief cities of the United States in making civic time uniform with railway time.

REFERRING to the accident on the North-Western Railway at Watford, a correspondent, writing to the *Times*, says:—"As a passenger by the express which met with the terrible accident at Watford on the 31st ult., I have followed with much interest the evidence given before the coroner and the magistrates, and have read with amazement some of the disclosures that have been made as to the work imposed on the unfortunate signalman. The condition of things revealed is most startling, and deeply concerns not only the company's servants, but the whole of the travelling public. That one man should be shut up in his box without assistance with fifty-six levers to work, and in 33 minutes have to conduct nineteen shunting operations, besides attending to the telegraph instruments and making entries in the signal book, and that life and limb, to say nothing of property, should be dependent many times during a journey, like that from Liverpool to London, upon such work being faultlessly performed, is a state of affairs of a most suggestive and alarming character, and one to which public attention should be urgently called."

THE reduction of the price of steel rails to 35 dols. at mill has created a good deal of comment. "To our minds," the American *Engineering and Mining Journal* says, "the most serious feature in connection with it is that it throws an unfavourable light on the future, rather than the present, condition of the iron trade. Rails, more than any other speciality in the iron and steel trades, are ordered generally many months ahead, and the rail business therefore may be said to reflect, more accurately than any other, what will be the requirements of the most important consumer, the railroads. People are apt to point with satisfaction to the fact that, in the first ten months of the year, the mileage of our railroads increased 5000 miles. Unfortunately, the great bulk of all the ironwork needed for such new roads has probably long left the mills and foundries. The business they are doing at present confirms the conclusions one cannot help drawing from the condition of affairs in the financial centres of the country, that the iron and steel trades cannot look for much relief to the railroads and the many allied industries dependent upon them."

A DIVISION of the accidents and casualties on American railways in September, according to classes of trains, is given by the *Railroad Gazette* as follows:—

Accidents.	Collisions.	Derailments.	Other.	Total.
To passenger trains	11	18	3	32
To a passenger and a freight	17	—	—	17
To freight trains	50	55	4	109
Total	78	73	7	158
Casualties.				
Killed by	21	22	1	44
Injured by	125	56	2	183
Total	146	78	3	427

This shows accidents to a total of 236 trains, of which sixty or 25·4 per cent. were passenger trains, while 176, or 74·6 per cent., were freight trains. This is a low proportion of freight train accidents, when the proportion of freight to passenger traffic on most roads and the extra precautions taken to secure the safety of passenger trains are well considered. Thus 50 per cent. of all the killed owe their death to derailment.

THE American *Railroad Gazette* gives a despatch from Easton, Pa., November 4th, which says: "This morning, while workmen were engaged in repairing the Lehigh Valley Bridge over the Delaware river, the fast freight came along, and before it could be stopped ran along the track to the spot where the repairs were being made. The rails had been removed and heavy wooden timbers spanned the 10ft. or more between the pier and the end of an iron span. Some of these timbers had been removed and the locomotive crashed through the remaining ones and lodged against the pier, turning half over. The rear driving wheel caught against the heavy girder of the span and there the engine hangs. To remove it will be no easy task. All day long a force of men have been working over the wreck; but so peculiar was the accident and so difficult the task of getting a purchase on the locomotive that it will require considerable time to remove it. The engine weighs over 70 tons, and as the bridge is over 70ft. high at the point in question, the magnitude of the work may be imagined. The bridge span is also injured and the damage will be heavy. The accident was occasioned by the engineer of the train being unable to stop after getting the signal, as a pushing engine on the rear of the train, which extended around a curve, could not be notified, and pushed the front of the train upon the railless span."

NOTES AND MEMORANDA.

THE gas companies at Newport, R. I. U.S. have decided to reduce the price of gas after December 1st, from 2·00 dols. to 1·00 dols. per 1000 cubic feet. There is nothing like making a change that is observable when it is made.

AT the beginning of 1882, Sweden possessed a mercantile navy of 4151 vessels, measuring 530,000 tons, of which 3397 were sailers, with 450,000 tons, and 754 steamers, with 80,000 tons. The number of sailing vessels had during the year decreased with 184 ships.

POWDERED asbestos mixed with soluble salts, such as silicate of potash, and mineral or other colours which combine with the silicic acid, is used by Mr. Erichsen, Copenhagen, so as to form a product which resists the action of oxygen, heat, cold, and moisture.

FOR a home-made fountain pen, the *Scientific American* says, take two ordinary steel pens of the same pattern and insert them in the common holder. The inner pen will be the writing pen. Between this and the outer pen will be held a supply of ink, when they are once dipped into the inkstand, that will last to write several pages of manuscript. It is not necessary that the points of the two pens should be very near together, but if the flow of ink is not rapid enough the points may be brought nearer by a bit of thread or a minute rubber band.

THE use of an aluminium process for the decoration of iron and steel, as well as for their protection against rust, is spoken of in the German technical press. This process is intended to take the place of nickeling, tinning, and coppering. The coating of aluminium is said to leave the sharpness of outline unimpaired, and to adhere very closely, being applicable to both cast and wrought work. Decoration with gold, silver, or vitrifiable pigments is said to be facilitated by this method. It is considered that the high price of aluminium—caused by the expensive processes by which it is made—will not seriously affect the success of this process.

THE Japanese are seriously considering the utilisation of the hot springs near Tokio, as a means of producing heat and power. The subject has been discussed in the Japanese Seismologic Society. In a country where the presence of hot springs and the frequency of earthquakes indicate a rapid increase of subterranean temperature, the thing may be quite practicable. In the "Proceedings" of the Paris Society of Civil Engineers it has even been questioned whether the extraction of the heat would not diminish in some degree the frequency and intensity of earthquakes; but if any considerable heat extraction could be effected, exactly the contrary would be the result.

A SURVEY of the coal lands of the Canadian North-West has just been made under the directions of the Dominion Geological Survey. Approximate estimates of the quantity of coal underlying a square mile of land in Bow and Belly rivers district give in one case 4,900,000 tons, in two cases 5,000,000, and in another 9,000,000 tons. The coal is in general exposed on the surface, and there is consequently little labour necessary to the working of the mines. Though no Government surveys have been made in the surrounding districts, coal-bearing strata are known to extend to the north and west of the parts from which coal is now being taken.

THE United States Government caused an official inquiry to be made as to the efficacy of pouring oil upon the sea to reduce its violence in storms. The conclusion arrived at from the experiments is that "when a vessel is lying in the open ocean, exposed to a dangerous sea, and drifts directly before the wind, the pouring of oil upon the water is an effective means of safety, but when lying under 'ranging sail,' the oil is useless." Mr. Sparrow, who conducted the experiments, "does not think that any of the appliances invented for distributing the oil in the latter case can be successfully used, and he thinks, therefore, that the instances will not be numerous in which the discovery will prove of practical value. He adds that it is only in deep water that the oil has a calming effect."

FROM statistics obtained in Feb., 1881, it appears that the number of British-born subjects in India, excluding those not born within the United Kingdom, was 76,456 males, and 12,088 females—total, 88,544. The British soldiers of the Indian army who are British-born subjects are distributed thus:—North-Western Provinces, 20,184; Punjaub, 18,688; Bombay, 12,608; Bengal, 10,583; Madras, 5883; Burmah, 5155; Assam, 785; a further number being scattered among the minor provinces. Five towns have each a population of over 200,000—namely Bombay City and Island, 773,196; Calcutta, including the suburbs, 766,298: Madras, 405,848; Hyderabad, including Secunderabad, 354,962; and Lucknow, 261,303. The following seven, arranged in a descending scale of population, have between 150,000 and 200,000—namely, Benares, Delhi, Patna, Agra, Bangalore, Umritsir and Cawnpore. Ten are returned as containing between 100,000 and 150,000—namely, Lahore, Allahabad, Jeypore, Rangoon, Poona, Ahmedabad, Bareilly, Surat, Howra, and Baroda. Meerut heads a list of 40 towns with populations ranging from 50,000 to 100.000.

DURING the week ending October 20th, in 32 cities of the United States, having an aggregate population of 7,305,300, there died 2722 persons, which according to the official returns published in the American *Sanitary Engineer*, is equivalent to an annual death rate of 19·4 per 1000, a slight diminution from that of the preceding week. In the North Atlantic cities the rate was 19·9; in the Eastern cities 20·1; in the Lake cities 16·2; in the River cities 19·0: and in the Southern cities, for the whites 16·9, and for the coloured 31·9, per 1000; 35·6 per cent. of all the deaths were of children under five years of age. During the week ending October 27th, in 30 cities of the United States having an aggregate population of 6,863,600, there died 2493 persons, which is equivalent to an annual death rate of 18·9 per 1000, a slight diminution from that of the preceding week. In the North Atlantic cities the rate was 18·8; in the Eastern cities 19·6; in the Lake cities 14·9; in the River cities, 15·6; and in the Southern cities for the whites 21·4, and for the coloured 32·7 per 1000. 36 per cent. of all the deaths were of children under five years of age.

WILL electricity enable us to transmit power in large quantities more efficiently than other means? Will it enable us to transmit small quantities? These questions were put to the Society of Arts, and answered by Professor Osborne Reynolds in his Cantor lectures as follows:—Thanks to the experiments of M. Deprez, we can say that a current of electricity, equivalent to 5-horse power, may be sent along a telegraph wire $\frac{1}{6}$in. in diameter, some ten miles long —there and back—with an expenditure of 29 per cent. of the power, because this has already been done. Compared with wire rope, this means falls short in actual efficiency, as Messrs. Hems send 500-horse power along a $\frac{3}{4}$in. rope. To carry this amount, as in the experiment of Deprez, 100 telegraph wires would be required; these wound into a rope would make it more than 1·4in. in diameter, four times the weight of Mr. Hems's rope. With the moving rope the loss per mile is only 1·4 per cent., while with the electricity it was nearly 6 per cent.; so that, as regards weight of conductor and efficiency, the electric transmission is far inferior to the flying rope. Nor is this all. With the flying belt, Mr. Hems found the loss at the ends, in getting the power into and out of the rope, $2\frac{1}{2}$ per cent.; whereas, in M. Deprez's experiments, 30 per cent. was lost in the electric machinery alone, which is very small as such machinery goes. But this is not all. No account is here taken of the loss of power in transmission to and from the electric machinery. Taking the whole result, it does not appear that more than 15 or 20 per cent. of the work done by the steam engine could have been applied to any mechanical operation at the other end of the line, as against 90 per cent. which might have been realised with wire rope transmission. To set off against this, electricity has the enormous advantage in the conductor being fixed, and in the fact that it is likely to be, if anything, less costly and more efficient for small quantities of power than for large.

MISCELLANEA.

THE Calcutta Exhibition opening ceremony will take place on December 4th.

MESSRS. ROBERT DAGLISH AND CO., of St. Helens, have obtained an honourable mention at Madrid for the photographs and drawings of gold reducing machinery manufactured by the firm.

ON the 17th inst. Messrs. Oswald, Mordaunt, and Co., Southampton, launched a fine iron sailing ship of 2180 tons register, built to the order of John Coupland, Esq., Goscote Hall, Leicester, of the following dimensions:—Length, extreme, 286ft.; breadth, extreme, 40ft. 3in.; depth of hold, 24ft. 3in.

IN Tasmania there are about 1600 persons employed in gold mining, who in 1882 produced 49,122 oz. of gold, of the value of £187,338. The dividends paid by gold and tin mining companies amounted to £241,915, a falling off as compared with 1881 of £29,159. The decrease is accounted for chiefly by a decline in the price of tin.

SPEAKING of the opening of the railway to Colesberg, which is only a few miles from the border of the Orange Free State, the *Colonies and India* says:—"From a commercial point of view, the completion of this portion of the system is of great importance, as it will greatly facilitate the receipts of produce from the more distant wool-growing districts and the forwarding of merchandise from Port Elizabeth."

THE Royal Commission on Metropolitan Sewage Discharge has again met at 8, Richmond-terrace, Whitehall. There were present —Lord Bramwell, F.R.S., in the chair, Sir P. Benson Maxwell, Sir John Coode, Colonel C. B. Ewart, C.B., R.E., Professor A. W. Williamson, F.R.S., Dr. De Chaumont, F.R.S., Dr. Stevenson, and Dr. W. Pole, F.R.S., secretary. The evidence on this public question should be public.

A CENTRAL NEWS telegram from Hamburg says:—"The idea of constructing a canal between the Baltic and the North Sea, through Holstein, has now assumed definite shape. Prince Bismarck has re-considered his former objections, and a Bill for powers to execute the necessary works will be laid before the Reichstag during the coming session. The cost is estimated at between six and a-half and seven and a-half million pounds sterling."

THE Victorian Chamber of Manufactures have passed a resolution requesting the Premier to take the necessary steps for securing the more expeditious transmission from London to Melbourne of the specifications of patents registered in Great Britain. Unless the new law necessitates very considerable changes in the time occupied in publication, extra speed in transmission will not make much difference between the date of a patent and of the receipt of the specification in Victoria.

THE Northwich Town Hall is in such a dangerous condition, in consequence of subsidences caused by continued extracts of brine at the large salt works near at hand, that the local magistrates recently issued an order to the lessees to take it down or to repair or otherwise secure the building. The lessees decline to move in the matter. The only alternative is to temporarily secure the building by what is popularly known throughout the salt district as propping, and this will probably be attempted immediately.

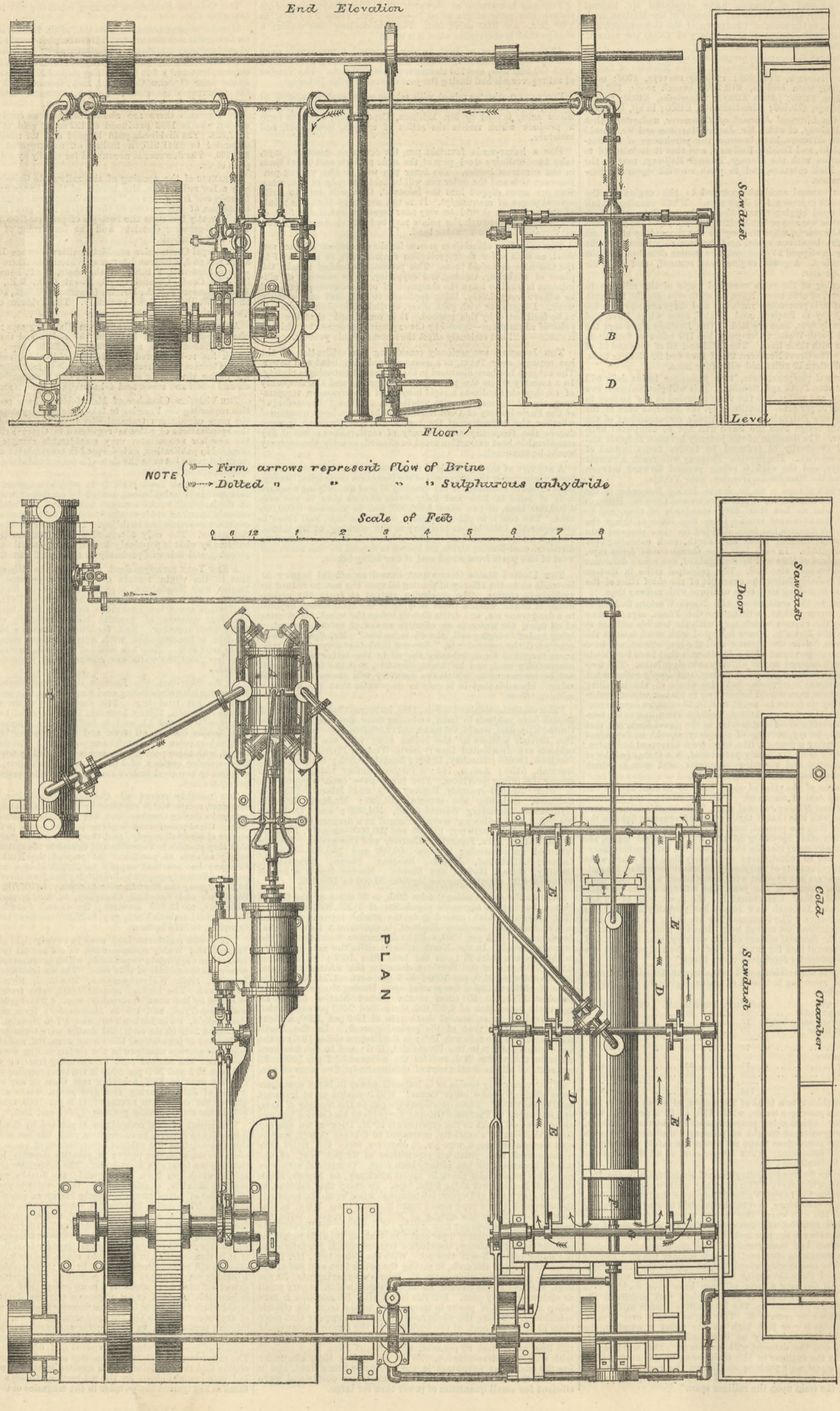
A NEW YORK correspondent reports in the *Allgemeine Zeitung* that in the virgin forests of Sonora, a province of Western Mexico, near Magdalena, a pyramid has been found measuring 4350ft. at its base, and rising to the height of 750ft. A carriage road winds about this enormous structure from base to summit. The face consists of granite blocks carefully cut and perfectly fitted together. Not far distant stands a hill which, we are told, is honeycombed with cells of various sizes, all cut out of the solid rock. They are without windows, several are on the same level, and the walls are adorned with fantastic shapes and symbols.

ON the 24th inst. the Rosario steel screw steamer, built by Messrs. Earle's Shipbuilding and Engineering Company, Hull, was taken on her trial trip. The dimensions of the vessel are as follows:—Length, 275ft.; breadth, 34ft.; depth of hold, 19ft. 3in. The vessel is classed A1, and is built on the longitudinal system with double bottom all fore and aft for water ballast, and is divided into seven water-tight compartments. The ship is schooner rigged, with three pole masts, and is propelled by triple compound three-cylinder engines of 140 nominal horse-power, steam being supplied by two steel boilers made for a working pressure of 150 lb. per square inch.

THE monthly report of Colonel Frank Bolton, the official examiner, on the water supplied by the several metropolitan water companies during October last has again been issued in the new form. Great prominence is given in this report to the important matter of constant supply, and the public will be gratified to learn that they promise to expedite and complete the system of constant supply as soon as possible. At present the Kent Waterworks Company has constant supply to 23,259 houses, mostly in the poorer and densely-populated districts; the New River Company, to 19,803 houses; the East London Company, to 106,043 services; the Southwark and Vauxhall Company, to 3387 services; the West Middlesex, to 13,885 services; the Grand Junction, to 24,637 houses; the Lambeth Company, to 25,936 services; and the Chelsea Company, to 3413 houses.

THE deaths registered last week in twenty-eight great towns of England and Wales corresponded to an annual rate of 23·2 per 1000 of their aggregate population, which is estimated at 8,620,975 persons in the middle of this year. The six healthiest towns were Leicester, Hull, Wolverhampton, Bradford, Birmingham, and Sunderland. The highest annual death rates from scarlet fever, measured by last week's mortality, were 4·9 in Leeds, 1·7 in Newcastle-upon-Tyne, and 1·5 in Manchester; from measles, 3·1 in Huddersfield, 1·8 in Birkenhead, and 1·7 in Newcastle-upon-Tyne. In London 2633 births and 1681 deaths were registered. Allowing for increase of population, the births were 102, and the deaths 77, below the average numbers in the corresponding weeks of the last ten years. The annual rate of mortality from all causes, which had been 19·0 and 20·5 per 1000 in the two preceding weeks, further rose last week to 22·2, a higher rate than in any week since the middle of July. During the first seven weeks of the current quarter the death-rate averaged 19·3 per 1000, against 20·8 and 20·0 in the corresponding periods of 1881 and 1882.

THE report of the committee appointed by the Lords of the Admiralty to inquire, in connection with the loss of her Majesty's ship Doterel, into the subject of explosions of gas in coal bunkers, and as to the explosive power of xerotine siccative, has been published in the form of a Blue-book. The committee report that the solvent which has been employed in the liquid dryers, known as xerotine siccative, consists of the more volatile products of the distillation of petroleum, commonly known as petroleum spirit or kerosine. This liquid product is composed of a mixture of light petroleum oils, the most volatile of which evaporate freely at temperatures varying between 50 deg. and 80 deg. Fah. If, therefore, this liquid be exposed to air at ordinary temperatures inflammable vapour will escape readily and rapidly from its surface, and if it be thus exposed in a confined space, the air which the latter encloses will become impregnated by the inflammable vapour with a rapidity proportionate to the prevailing temperature, and to an extent sufficient to produce in a more or less brief period a rapidly inflammable mixture or an explosive mixture if the quantity of liquid which evaporates bears the necessary relation to the volume of oxygen contained in the enclosed atmospheric air. The explosive mixture produced is, in fact, quite analogous in its nature and behaviour to a mixture of coal gas or of fire-damp and air, and is capable of producing similarly violent and destructive explosions. The experiments which the committee made led them to the conclusion that the explosion which resulted in the loss of the Doterel had been brought about by the production of such a large body of flame as had ignited the powder in the magazine of the ship.



PICTET'S ICE MACHINE.

MESSRS. EMMERSON, MURGATROYD, AND CO., ENGINEERS, STOCKPORT.

(For description see page 428.)

CEMENT MILL PLANT.

THE PULSOMETER ENGINEERING COMPANY, LONDON, ENGINEERS.

Fig. 2

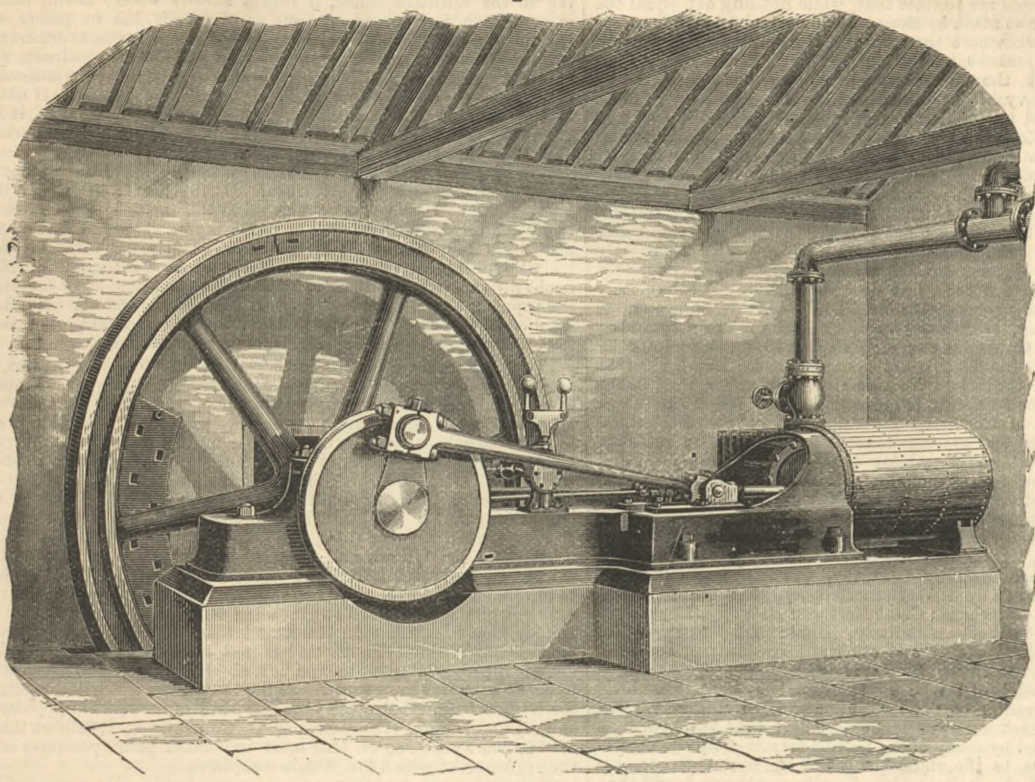


Fig. 3

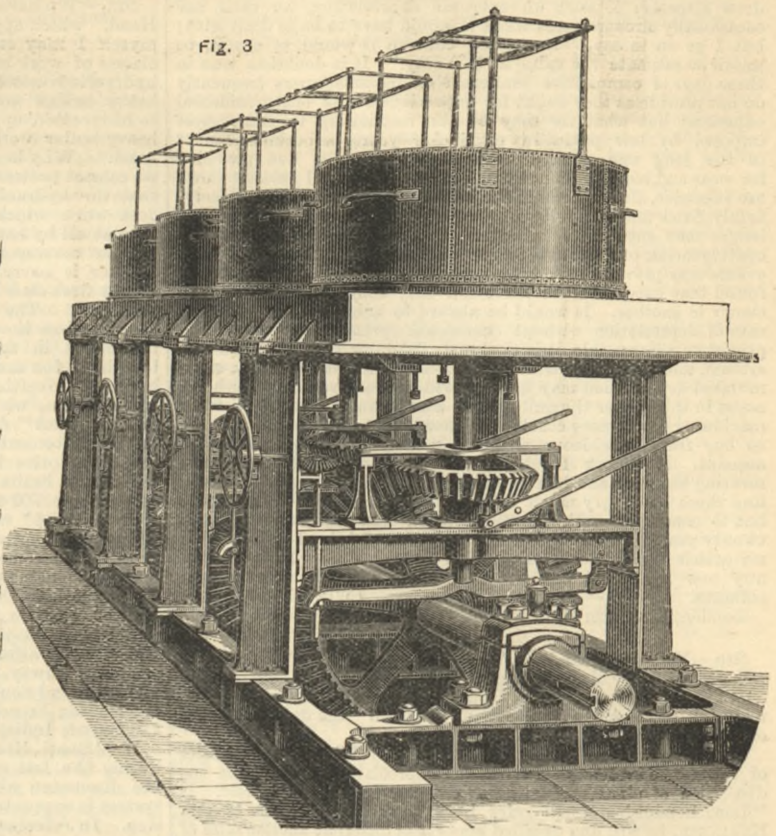


FIG. 4

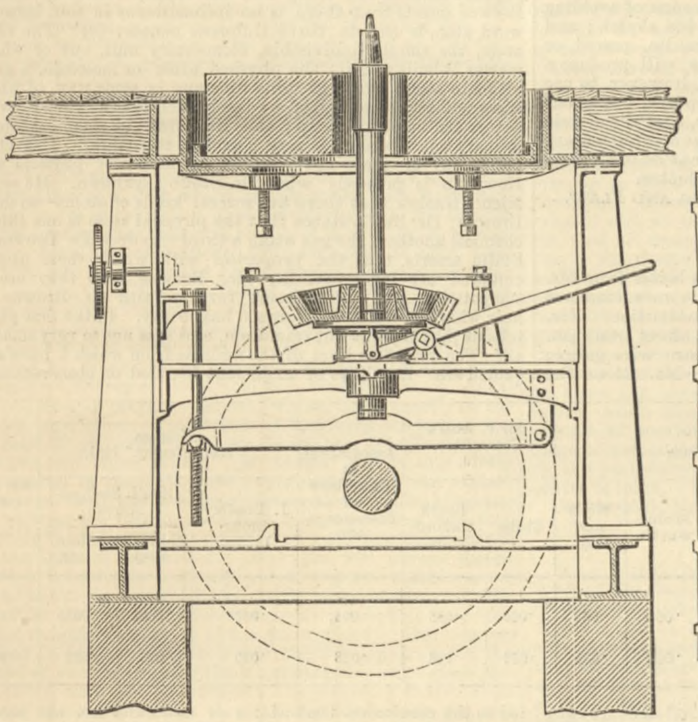


FIG. 5

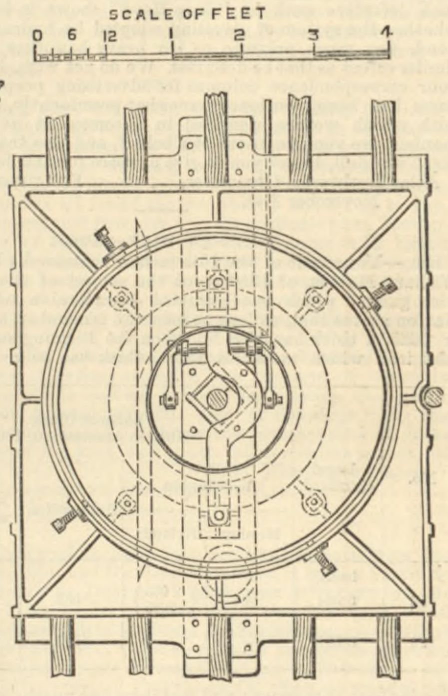
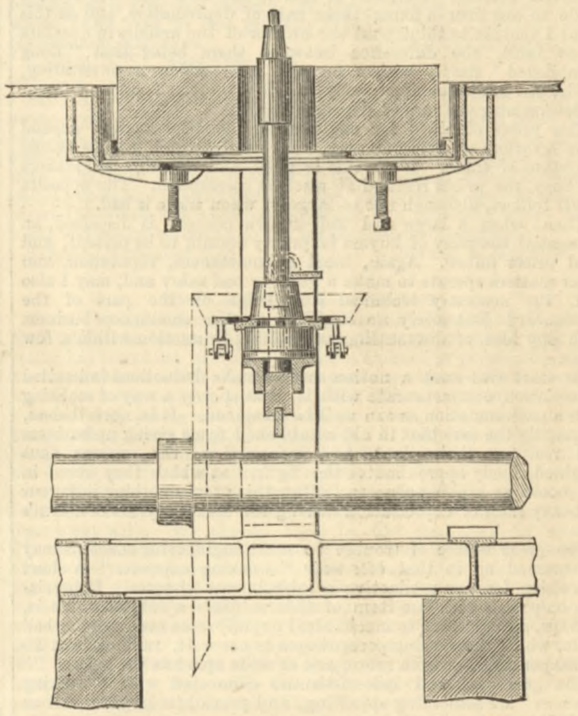


FIG 6



In our impression of the 19th ult. was published a plan and sectional elevation of a Portland cement mill, erected by the Pulsometer Engineering Company, for an output of fifty tons of cement per day. The engravings showed the arrangement of the millstones and clinker breaker and elevator therefrom, the engine-house with two engines and condenser, one engine being coupled direct to the mill shaft, and the other employed in working a shaft for driving wash mills. The elevator from the clinker breaker lifts the broken stuff up to a hopper common to the four pairs of stones, while the ground cement from the stones is carried away by a belt and delivered to an elevator, which raises it to a suitable elevation for storage.

The engine for driving the cement mill is illustrated more clearly by the accompanying perspective, Fig. 2. It is of the horizontal type, with a steam cylinder 21in. diameter by 36in. stroke, making sixty revolutions per minute. The slide valves are placed one at each end of the cylinder, and separate expansion valves on the back of the main valves. The range of expansion is controlled by means of the governor, which acts upon a rod carrying a block sliding in a slotted link. This link is pivotted upon a pin, and is driven by an excentric on the crank shaft. The expansion may also be controlled by hand independently of the governor. The crank shaft bearing is in four pieces, having means of adjustment for end wear as well as top and bottom wear. The bearing is 8·5in. diameter by 17in. long, and is unusually large. The fly-wheel is 14ft. diameter, and the connecting, piston, and valve rods are of steel.

The cement mills consist of four pairs 4ft. 6in. stones, illustrated by the perspective and detail engravings, Figs. 3 to 6. The mill shaft for the first two mills is 8·5 diameter. This shaft is made large enough to drive four more pairs of stones. The gearing is extra strong, being made of cast steel, and is in the ratio of 2 25 to 1; the teeth are 2·75in. pitch by 6·5in. broad on the face; the vertical millstone spindle is 3·5in. body. An important improvement is the arrangement of stone spindle. This has been adopted at the suggestion of Mr. Shadbolt, of the firm of Coles, Shadbolt, and Co., who devised this improvement and had it at work on his own mills since 1866 with the most satisfactory results, the same bearing being still in use with no detrimental wear. It will be seen that the spindle passes through brass bushes held and made adjustable in a cast iron box, and rests on the movable footstep supported by the lightering bar; the wear of the footstep so troublesome in the usual arrangement is thus avoided, and ample provision made for taking the wear from the side thrust of the spindle. The clinker elevator, which is driven from the mill shaft by means of bevel gearing and vertical spindle, takes the material from the crusher by means of band and buckets, passing over pulleys at the top and bottom. The clinker is raised and falls into the hopper or bin placed on the top floor of the mill; from this bin the four spouts are led which distribute the clinker to each pair of millstones.

The engine for driving the wash mills is similar in every respect to that already described for driving the cement mills, except that it is smaller, having a steam cylinder 15in. diameter by 30in. stroke. The crank shaft bearing is 5·5in in diameter by 11in. long; the fly-wheel is 12ft. in diameter. It will be noticed that the wash mill shaft—see the engraving in The Engineer, page 303—is above the engine shaft, to which it is geared, and passes over the top of the boilers and on to the wash mills. The wash mill shaft is 5·5in. diameter, and is geared to the vertical spindle by bevel gearing in the proportion of 4 to 1; teeth, 2·5in. pitch by 6in. on face; vertical spindles, 6in. square. In consequence of these mills being erected near the mouth of a tidal river, it was found necessary to use a surface condenser for the condensation of the steam from each engine. It is shown on the general plan—p. 303—placed under the floor level, the condenser apparatus requiring to be placed low down to suit the lowest level of the tide. The condenser consists of a cast iron cylinder, having covers and the usual tube plates at each end, and contains 604 brass tubes, 0·75in. diameter and 7ft. in length between plates. The tubes are packed by wood ferrules as in an ordinary marine engine condenser.

The pumps consist of a 6in. centrifugal for circulating the water through the condenser, through the tubes of which it passes twice; and of a vertical air pump. Both pumps are driven by straps from pulleys on the crank shaft of an inverted cylinder engine of 10in. diameter and 18in. stroke. It will be seen thus that the arrangement has many advantages over separate condensers for each engine, a vacuum being obtained in the cylinder of each engine before starting, which is advantageous when starting engines with the heavy machinery employed in cement-making. In the space for the condensing apparatus are also fixed two donkey pumps for feeding either hot or cold water, the feed passing through an economiser on its way to the boiler. The boilers are two in number and are of the usual double-flued or Lancashire type, 7ft. 3in. diameter by 30ft. long; flues, 3ft. diameter, each flue having Galloway tubes. The boilers are worked to a pressure of 60 lb. per square inch.

The mill is altogther very completely fitted up, and with the machinery and engines described it will be seen that less power is used than is usual for works of the capacity of 50 tons per day.

LETTERS TO THE EDITOR.

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

CONTINUOUS BRAKES—VACUUM GAUGES.

Sir,—When the automatic vacuum brake was introduced upon the Midland line by Mr. R. D. Sanders, vacuum gauges were placed in the guards' vans, but these were afterwards removed by the railway company with a view to obtain fewer parts, and so-called "simplicity," the result being that efficiency has been sacrificed. Major Marindin, when reporting upon the collision between a passenger train and the buffer stops at Northampton, April 3rd, 1883, remarked that the case furnished "a strong argument for the necessity of placing gauges in the guards' vans, so that they may see at all times what is the condition of this continuous brake which is particularly liable to become useless when running, in the event of a driver disregarding the rules." The directors, in accordance with this report, have ordered gauges to be placed in the vans without delay. These gauges are duplex; the left-hand side shows the vacuum maintained in the main brake pipe, and the right-hand side indicates the vacuum in the reservoir and above the one piston under the van itself. Any person riding in a van cannot now fail to remember the words of Colonel Rich in his report upon the Portskewet accident, "that the efficiency of this class of brake is materially interfered with by the leakage hole in the piston head."

The new gauges show clearly that the moment this vacuum brake be applied the power begins to leak away, and that in less than two minutes it is all gone, and then that a considerable time must elapse before the driver can obtain another vacuum. The recent fogs in the Midland district have again directed attention to the necessity which exists for the driver of the leading engine having control over the continuous brake in cases where two engines are employed to draw a train. On the Midland Railway there is a very large amount of "double-engine running"—indeed, it is stated more than upon any other line—yet not any of the express engines are fitted with brake pipes at the leading end.

The absurdity, therefore, continues that the leading driver, who has the best view, is powerless, as the control over the continuous brake is placed in the hands of the second man, who from his position has not so good a view. We cannot wonder that engine-drivers complain of this arrangement, especially during foggy weather.

Clement E. Stretton.

40, Saxe-Coburg-street, Leicester, November 17th.

DEPRECIATION IN FACTORIES.

Sir,—The letters of your correspondents, "M.I.M.E." and "Long Established," in The Engineer of last week are satisfactory, as showing the interest felt in this important subject, which is one that can only be elucidated by discussing it from different points of view. It is to be regretted, however, that they have both selected the same part of my article—p. 365 in THE ENGINEER of November 9th—for criticism, and have quoted me wrongly. They write as if I would depreciate machinery while it is yet new down to the second-hand value it would have if re-sold. It is true I drew attention to such an extreme depreciation, for there are occasionally circumstances when it would have to be so dealt with; but I go on to say, "In a going concern it would, of course, be unfair to estimate the value in this way." It is doubtless true in these days of competitive tenders that manufacturers frequently do not provide as they ought for depreciation and other incidental expenses; but whatever may be the restrictions in this respect imposed by low prices in particular years, a business cannot in the long run succeed that does not make due provision for wear and tear. I do not think that the rates I have set down are excessive, although there are often cases where good machinery, firmly fixed and carefully worked for moderate hours, will last longer than such rates indicate. But, in providing for doubtful contingencies, one cannot adopt the minimum rates that after events may prove to have been sufficient, and generally it will be found that excess in one direction only compensates for insufficiency in another. It would be absurd to adhere to any arbitrary rate of depreciation without occasional revision; but as an exact provision is impossible, it is obviously desirable to start with a safe system, and then when trade is depressed and prices are low, accumulated depreciation may have provided a reserve fund, which will assist in tiding over the dull time. Such a fund also serves, when machinery has become obsolete or insufficient, before it is worn out to buy fresh machinery without unduly swelling the capital account. If "Long Established" will work out his system of meeting the wear and tear of boilers with that I describe, he will find there is not very much difference at the end of fifteen years; but to commence with the assumption that the boiler will last twenty years is, in my opinion, unsafe. As I intend re-publishing my article in a somewhat extended form, I shall gladly welcome any new light that can be thrown upon the subject in your columns. EWING MATHESON.

London, November 19th.

SIR,—Your correspondent, "Long Established," in course of his remarks upon the above article in your valued paper, does my firm —Wheatley Kirk, Price, and Goulty—the honour of appealing to us for an expresssion of our experience as to "the deductions that ought to be made for depreciation."

As in the same sentence "Long Established" alludes to "Sales of Plant," he evidently refers to the depreciation arising from the dispersion of plant by auction as compared with original cost. If "Long Established" will refer back to various numbers of THE ENGINEER, he will find detailed reports of different auction sales of engineering plant, with the prices obtained and comments of your reporters thereon. But, Sir, I fail to see how this will form a guide to any firm in fixing their rate of depreciation, and on this point I venture to think that the author of the articles in question is at fault, the difference between them being that "Long Established" simply wishes for the information as interesting, whilst Mr. Matheson apparently insists upon it as forming a factor in determining the rate of depreciation.

The prices obtained for engineering plant by auction depend upon a variety of circumstances, first among which may be named the state of trade. When this is good, and machine tool makers are busy, the prices realised at auction correspond. The opposite result follows, although not so largely, when trade is bad.

Then, when a large and well-known concern is dispersed, an influential company of buyers is pretty certain to be present, and good prices follow. Again, local circumstances, reputation, and other matters operate to make a good or bad sale; and, may I also add, the necessary technical knowledge on the part of the auctioneer? But surely no engineer or firm commences business with any idea of dismantling and selling by auction within a few years.

To start with such a notion and to make deductions (miscalled depreciation) commensurate with it, is as speedy a way of realising such a consummation as can well be imagined. It is, nevertheless, frequently the case that in old-established firms giving up business and realising their plant, &c., by auction, the amount thus obtained closely approximates the figures at which they stand in the books as a going concern. But this proves nothing in favour of heavy rates of depreciation during the first few years of a firm's life.

The great source of trouble to most engineering concerns may be summed up in that *bête noir* "working expenses"—a short expression for non-productive establishment charges. Depreciation only deals with one item of this subject—a subject which is, perhaps, as important to mechanical engineers as even good or bad trade, whilst the varying percentages to cover it, ranging from 25 to 300 per cent., or even more, are as wide apart as the poles.

The guesswork and rule-of-thumb connected with "working expenses" are something appalling, and prevail in large as well as small firms to an alarming extent.

Prime cost systems we have in abundance, but I have not yet seen one which could tell the true cost of work done, including all establishment charges.

How correctly to measure the total "working (non-productive) expenses" so as to apportion charges on work done is, I submit, the great desideratum requiring elucidation.

London, November 21st. HENRY SHIRLEY PRICE.

DESIGNS, SPECIFICATION, AND INSPECTION OF IRONWORK.

SIR,—If Mr. Pendred has so little time for letter writing, it is a pity he does not confine himself to giving a few sober facts in support of his own statements, or in refutation of mine, instead of wasting time by attempting to correct my logic. Again, he has been rather premature in tendering his thanks, for an expression of regret at his misunderstanding me can hardly be termed an apology. About the square-backed angle iron cover, I still maintain that it is not the custom of the profession to use them, and Mr. Pendred has not yet given any proof of his assertion to the contrary.

Mr. Pendred has now corrected the expression "tensile or lateral" strain, by substituting "bending or buckling" for lateral; but this was for him to do, and not for me, as he suggests. He is still indignant about my doubting the quality of the iron as it comes from the maker; and I repeat that, if he can put such implicit confidence in the quality of the iron as turned out, inspection is unnecessary. About spoiling a large plate for testing, I say again that it is unnecessary. In the first place, why choose a large plate for your test pieces when there are so many smaller ones for covers, &c.? The better plan, however, is to instruct the contractor to order a certain number of plates 6in. larger than the required size, and you have then your strips without any difficulty, and without spoiling a large plate. I would remind Mr. Pendred that hammering the corner of a plate down is a far different test from that of bending the plate to a given angle, so often specified; and I would ask him if he can, out of his bundle of specifications, give a single instance where an engineer of eminence has specified the former test?

I have withdrawn nothing relating to my remarks about heating rivets, and the necessity of having the holes larger than the rivets was mentioned in my first letter. I mentioned a possible objection to the practice, and Mr. Pendred and Mr. Dornton both ridiculed the idea, and the former now offers some negative evidence—like an Irishman in court, who said he could bring fifty witnesses to prove that they didn't see him commit the theft; but I have given positive evidence by what Mr. Pendred describes as "trying a practical experiment."

"Snap Head" appears on the scene with some startling remarks about machine rivetting, which possibly will be replied to by some one more directly interested in the matter than I am; but it can be of no possible interest to anyone his speculating upon what I may say, or in attributing to me statements which I have not made. Unless a new element enters into this discussion, I shall take no further part in it. JOHN J. WEBSTER.

Stephenson-chambers, Liverpool,
November 21st.

SIR,—We have read with some surprise the letter signed "Snap Head," which appeared in your last issue. The writer says, "For myself I may state that a somewhat extended experience in all classes of work leads me to state that, while nothing can equal the hydraulic rivetter as made by Messrs. Fielding and Platt for coarse heavy bridge work where three or more thicknesses of plates are to be rivetted up, machine rivetting is quite unsuitable for all but heavy boiler work, the most of which really cannot be closed by hand." Why heavy bridge work should necessarily be "coarse" we cannot pretend to say, but so far, "Snap Head" has to admit that the hydraulic system of rivetting invented by Mr. Tweddell does work which cannot be so well done by any other means, or even at all by hand.

Your correspondent then goes on to say that "The hydraulic rivetter is never used in the best locomotive boilers, nor, indeed, in any first-class boiler works, but it is the mainstay of slop boiler makers." The delightful *abandon* which so frequently characterises the statements of anonymous writers is very forcibly illustrated in the sentence just quoted. Having been closely identified for many years with Mr. R. H. Tweddell's system of hydraulic rivetting, both as sole makers of the machinery and as co-patentees, we think the sweeping charges brought forward by "Snap Head" demand some notice on our part. First, then, as to his statement that the hydraulic rivetter is never used in the best locomotive boilers. It is quite impossible for us to name within the limits of this letter more than a very few of the shops where some 700 to 800 of these machines are at work; but even "Snap Head" will, perhaps, allow that the following firms and railway locomotive departments turn out what may be considered first-class locomotive boilers, if not, perhaps he will be good enough to name some of the works where they do make good ones. Among others, Messrs. Beyer, Peacock, and Co, Dübs and Co., Neilson and Co., Kitson and Co., R. and W. Hawthorn, London and North-Western Railway Company, Crewe; Great Eastern Railway, Stratford; Great Western Railway, Swindon; North-Eastern Railway, Gateshead; Great Northern Railway, Doncaster; Glasgow and South-Western Railway, Kilmarnock; and most of the leading French, Austrian, and other railway companies on the Continent, India, the United States, and Canada.

If "Snap Head" will read a paper read by Mr. Tweddell during the last session of the Institution of Civil Engineers, and the discussion which followed it, he will find that the hydraulic system is supported by many of the leading members of our profession. In reference to the statement that "the hydraulic rivetter is the mainstay of slop boiler makers," we have always found that the cost of such installations as we supply has the effect of keeping such makers out of our books. There are many means of avoiding such defective work as "Snap Head" shows in his sketch; and whether the system of rivetting adopted be hydraulic, geared, or hand, too much pressure or too heavy hammers will produce a similar effect as that he describes. We do not wish, however, to use your correspondence columns for advertising purposes, but as our name has been mentioned somewhat prominently, and the system with which we are identified in a somewhat uncomplimentary manner, we venture in our own behalf, and also that of our friend Mr. Tweddell, to ask you to give us space for this letter.

Atlas Ironworks, Gloucester, FIELDING AND PLATT.
November 21st.

THE NEW WIRE GAUGE.

SIR,—Your issue of the 16th instant contained a letter from Mr. William Hatton, of Bilston, on the subject of the new standard wire gauge, which has attracted considerable attention. Mr. Hatton states that, as long as men can remember, sheet iron $\frac{1}{16}$in. or ·0625in. thick has been No. 16 on the Birmingham wire gauge; that iron which measures ·025in. thick has been No. 24 on the Birmingham wire gauge; and that these two numbered sizes are both old-established points on the sheet iron gauge. From the annexed table, however, from some other authorities on this question it would hardly appear that these numbers are generally recognised as having the particular equivalent sizes given by Mr. Hatton, but rather that they are local and customary.

November 24th. INQUIRER.

No.	Legal standard.	Latimer Clark. British Association, 1869.					Sir F. Abel's Committee, 1879.		Association of Chambers of Commerce, 1879.	Hughes. "Ironmonger," 1881.			Mr. Hatton, 1880.
		Warrington.		Holtzapffel.	Molesworth.	Wells and Hall.	Stubs.	South Staffordshire.		J. Bradley, Stourbridge.	South Staffordshires.		
		Henley.	Rylands.								Robinson, 1880.	Rose, 1858.	
	inch.												
16	0·064	·065	{ ·065 / ·0625 }	·065	·065	·062	·065	·065	·064	·0625	·0605	·0625	·0625
24	0·022	—	—	·022	·022	·025	·022	·023	·028	·025	·023	·025	·025

MODERN PHYSICS.

SIR,—Although Mr. Browne's long letter published in THE ENGINEER of the 23rd inst. is specially devoted to criticising your critique on Dr. Stallo, the subject is one of general interest, and I may, perhaps, be permitted without impertinence to say something on the subject. I will premise that I do not intend to defend Dr. Stallo's teaching as a whole, nor to express any opinion concerning the merits of your review of his book. To do either would open up far too wide a a field of controversy. My purpose is to examine one or two of Mr. Browne's statements, and ascertain how far they are consistent with fact.

Taken as a whole, Mr. Browne's letter is intended to be a refutation of Dr. Stallo's main argument, which is that modern physics are badly taught now, the theories advanced by the teachers being extremely inconsistent with each other and with the truth. I shall leave the last proposition on one side, and confine myself to the first, namely, that the teachers of modern physics are not agreed as to what ought to be taught. If we are to believe Mr. Browne this is not the case, and the teaching of physics is thoroughly consistent, the inconsistencies being only apparent, and really due to misconception on the part of those taught. "Having made my protest," says Mr. Browne, "I may be allowed for a moment to inquire whether there is really any ground for the sweeping charges we are considering. I venture to assert that there is not. That confusion exists I admit freely, but it is a confusion as to words, not as to things."

As I have already said, it is not my purpose to follow Mr. Browne through all his argument. It will suffice if I lay down a thesis concerning a small portion of it, and prove that Mr. Browne is wrong, and for this purpose I select two of his statements: the first referring to elasticity; the second to the atom.

For the same reason it is outside my purpose to deal with the conflicting statements of a great number of authorities; but I think Mr. Browne will not object if I compare his teaching with that of Sir William Thomson. Mr. Browne has taught physics on more occasions than one. He teaches them in the letter I am dealing with. It will not be disputed that Sir William Thomson is one of the greatest living teachers of physics. If, now, I show that the teachings of Mr. Browne and Sir W. Thomson are opposed to each other, or inconsistent with each other, then I think it may be admitted that Dr. Stallo is, at all events, partially right, and that he does not quite deserve all the hard things your correspondent has said concerning him.

To return then to elasticity. The elementary units of mass, Dr. Stallo tells us, we are taught—by one school at all events—to regard as absolutely hard and inelastic; whilst as soon as we come to the kinetic theory of gases, we are taught that they are perfectly elastic. Both statements cannot be true. Mr. Browne, however, tells us there is no inconsistency; all depends on what is meant by elasticity. "According to the popular sense, an inelastic body is one which does not alter its shape or size when exposed to any force"—I will return to this statement in a moment—but "according to the scientific sense, it means a body which, having been exposed to a force accruing from another body, has no power of exerting a counter force in the opposite direction, so as to separate the two again." I gather from this, and I think it is legitimate to do so, that scientific teachers do not mix up these two definitions, but are always careful to use the term in the proper sense. If not, then so far Dr. Stallo is right. According to Mr. Browne, it is only "popular," half-taught teachers, men of no account, who accept the popular view.

Now let me ask Mr. Browne, is he quite sure that his statement of the popular view is quite correct? If he reflects a little he will see that it is not. To the popular mind the inelastic body is one easily deformed and incapable of regaining its shape. I never yet met with any one who did not regard putty and soft clay as inelastic substances; but they certainly admit of deformation. No doubt my experience is that of most of our readers. But leaving the populace alone, let us see how Sir William Thomson uses the word elasticity, and whether it is or is not consistent with the "scientific sense" on which Mr. Browne sets such weight.

I have before me a copy of a paper, on "The Size of Atoms," read before the Royal Institution on the 3rd of February, 1883, and in it I find the following passage, page 4, "The rods themselves let us suppose to be invisible, and merely their ends visible to represent the particles acting on one another mutually with *elastic force, as if of india-rubber bands, or steel spiral springs, or jelly, or elastic material of some kind.*" Here we have india-rubber, steel, and jelly all spoken of by an eminent science teacher as elastic. It is quite clear that Sir William Thomson draws no such definition of elasticity as Mr. Browne does, and it seems to be probable that the elasticity of Sir William and of your correspondent are not quite the same. Perhaps Mr. Browne can tell us what Sir William ought to have said. To reply that Sir William used loose definitions is to condemn him at once, and to grant one of Dr. Stallo's contentions, namely, that scientific men think and teach loosely. It seems to me that Sir William Thomson has not adhered to the scientific definition here at all events, and be it observed that the "particles" to which he refers are atoms. To me it appears indisputable that Sir William has used elasticity in what Mr. Browne calls the popular, and, by implication, erroneous sense. Consequently it follows that Sir William's teaching on this most important point possesses all the vagueness of which Dr. Stallo complains.

Now let us turn to the atoms. Dr. Stallo contends that the physical atom is one thing and the chemical atom another. Mr. Browne asserts that there is no inconsistency in this, because the word atom is used in three different senses: (*a*) "The ultimate atom, the simple, indivisible, elementary unit, out of which all matter is built up; (*b*) the physical atom or molecule, a group of ultimate atoms which at some time and in some way, of which we know nothing, were united by bonds such that no known process of nature can break them up; and, lastly (*c*), the chemical atom, the primary constitutent of any chemical substance.' This chemical atom may or may not contain a number of physical atoms." Now this is precisely what Dr. Stallo lays down. He says that science teaches that there are several kinds of atoms—so does Mr. Browne; Dr. Stallo states that the physical atom is one thing, the chemical another, the gas atom a third—so does Mr. Browne. Dr. Stallo asserts that the properties with which these atoms are endowed are incompatible; Mr. Browne says they are quite compatible. But before going further with Mr. Browne let us hear what Sir William Thomson has to say. In the first place, he tells us that there is but one atom, and it is not so very small after all. The very first lines of the address from which I have already quoted are "four lines of argument founded on observations have led to the conclusion that atoms or molecules are not inconceivably small." Further on we have the words "atoms or molecules of ordinary matter." Thus it appears that the molecule and the atom are identical. According to Mr. Browne this is not the case; the molecule and the atom are two different things. Why, then, if true scientific teaching is always consistent, has Sir William mixed them up? Which of the three kinds of atoms did he speak of? Are Sir William's atoms elastic or not? Sir William, it seems to me, is determined that the physical atom or molecule is to be *the* atom, and he tells us "the chemists do not know what is to be the atom; for instance, whether hydrogen gas is to consist of two pieces of matter in union constituting one molecule, and these molecules flying about, or whether simple molecules each indivisible, or, at all events, undivided in chemical action, constitute the structure." This seems to me to be just what Dr. Stallo says.

Let me now return for a moment to Mr. Browne's own definitions. He admits that when men teach that the atom is hard and inelastic they mean the ultimate atom. So far so good. When they teach the kinetic theory of gases, the elastic atom then spoken of is not the ultimate atom, but a molecule built up of several atoms. Will Mr. Browne kindly say how a molecule built up of absolutely inelastic units acquires perfect elasticity? Let us take hydrogen. The chemists do not know, according to Sir W. Thomson, whether the hydrogen molecule is the ultimate indivisible atom, or whether it consists of two atoms. If it consists of one atom—the ultimate physical atom—then it must be inelastic, and ruin falls on the kinetic theory. If it is composed of two atoms, then we have the union of two absolutely inelastic parts producing one elastic whole, which is a *reductio ad absurdam*. Perhaps Mr. Browne will state that this union introduces a new element, namely, a force of some kind; but the ultimate atom as defined possesses no force of any kind, consequently Mr. Browne's ultimate atom is not the atom of which Sir William Thomson speaks, and of which we have all been taught. It is nothing to the point to say that Mr. Browne's atom is the true atom. For the sake of argument I will concede this, with the result that we find a doctrine taught concerning atoms which is inconsistent with other teaching concerning atoms; and therefore Dr. Stallo is again right.

Finally, let me say one word about the outburst of righteous indignation with which Mr. Browne opens his letter. He denounces working hypotheses. If they are not true let them perish. So be it, let them go. What will Mr. Browne give us in their place? For example, I will tell Mr. Browne, if he does not know, that among the very highest chemical thinkers the greatest uncertainty exists as to whether the chemical atomic theory is true or not. Some of the very best men are disposed to regard all matter as composed of the simple atom, the difference between various substances consisting of the varieties in their motions. Thus a group of atoms with one class of motions is hydrogen, with another oxygen; the resultant of these motions caused by contact is water, and so on. Are we, because of such speculations, to reject the

Daltonian theory? No competent chemist asserts for a moment that the atomic theory is demonstrably true; are we, therefore, to abandon it? If Mr. Browne retains nothing in science save what is demonstrably true, he will have very little left. The working hypothesis is essential to the progress of science. Let us retain it; but let us tell the student that it is a working hypothesis—the best we can do for him.

I have hitherto coupled Mr. Browne's teaching only with that of Sir William Thomson. I find, however, that he speaks in very high terms of Newton. But Mr. Browne has taught that action can take place at a distance—a doctrine repudiated by Newton in the strongest possible terms. Most modern physicists teach us that matter exists. But if I have not misunderstood Mr. Browne's writings, he holds that matter in the normal sense has no existence; it is replaced by "force centres." Thus the atom after all disappears. Again, Professor Oliver Lodge tells us that the ether is a continuous elastic fluid, and that electricity can be got by shearing this fluid. Mr. Browne teaches that continuity is simply impossible. Dr. Lodge holds that the cause of all motion is motion. Mr. Browne holds that the cause of motion is force; but what force is he cannot tell us. Mr. Browne is entirely unable to explain how a horse can draw a cart unless there is a greater pull at one end of the trace than the other, in which view he stands tolerably isolated. Mr. Browne has for years past taught doctrines which have been repudiated by college professors, in proof of which I would refer your readers to the pages of the *Philosophical Magazine*. He is the very last man indeed who ought to assert that physics are taught uniformly in the same way. His own practice, as compared with that of other college men, is a standing proof to the contrary.

I think then I have made out my case, and shown that Mr. Browne is blind to facts when he asserts that science as taught has no real inconsistencies. I have, of course, had only space to cite a very few examples to show that he is wrong, but *ex uno disce omnes*. Perhaps, however, Mr. Browne will refuse to accept either Sir William Thomson or Professor Oliver Lodge as teachers of true science.

Π. Φ,

London, November 26th.

THE EFFICIENCY OF FANS.

Sir,—In your article last week on fans you speak of the calculations made at Dudley as my own. You were mistaken. The formula used was that used by every mining institute in Great Britain, and by M. Guibal, the inventor of the Guibal fan, and the School of Mines in Belgium. So if I have gone astray, I have done so in good company. I am very far from satisfied with the explanations given, because I find these simple rules have been adopted by the mining institutes of England and School of Mines in Belgium:—(1) The water-gauge increases as the square of the revolutions; (2) the volume increases in direct proportion to revolutions; (3) the power of the engine increases as the cube of the volume of air passed, which in the new fan is not the case.

The mechanical removal of a cubic foot of air by a cubic foot of steam, say, at 1 lb. pressure, is followed by the atmosphere pressing down the piston at 15 lb. on the inch. Surely we don't draw a parallel between the removal, say, of a cubic foot of air weighing $\frac{1}{13}$ lb. and the effect produced by the vacuum which follows? If we take the effect of the fan, and suppose the absurdity of a tube 6000ft. long, with a piston of 312in. area, and a vacuum = $\frac{1}{8}$ lb. on the square inch, *i.e.*, $3\frac{1}{2}$ w.g., we will get a result very different to that which relates to the mere mechanical removal of so many cubic feet of air weighing 1 lb. for 13 cubic feet. This relates to the following result of a trial on November 3rd:—35in. open fan; revolutions, 699; air speed in open 20in. tube, 6158ft. per minute; water gauge in open 20in. tube, $3\frac{1}{2}$ cubic feet per minute, 13,371ft.; indicated horse-power, 3·14. The density of the air at 6158 speed will be as 32·2 to 102. And in working out the matter on this basis the water gauge enters largely into the calculation of useful work in a fan, *i.e.*, fan efficiency. In a paper read for M. Guibal by Professor Herschel in April, 1873, comparing the efficiency of the Guibal and Waddle fans, M. Guibal makes the following pregnant remark, which bears exactly on the case we are considering:—"A statement had been made that the Guibal gave 22 per cent. more air than the Waddle fan, but took 79 per cent. more power." M. Guibal replies thus: "He has not noticed in comparing the experiments that the utilised horse-power of the Waddle is only represented by 1817 kilogrammetres, whereas the Guibal gave 3655 kilogrammetres, and that consequently the indicated horse-power of each apparatus cannot be used as a basis of comparison. He asks will anyone accept a comparison between the motive power of any two machines, one of which would raise a weight of 1817 kilogrammes, and the other of 3655 kilogrammes, without inquiring whether they both raise these weights respectively at the same speed? This is nevertheless what is done when we compare the two apparatus at the same speed of 60 revolutions without noticing the water gauge produced. If we were able to transport the Staveley fan to High Park I am sure when we saw the Guibal produce more w.g. and displace more air than the Waddle at the same speed, we would not pretend to take the indicated horse-power of the first and compare it with the indicated horse-power of the second in order to prove their respective merits." Working out the test of November 3rd:—Air velocity, 6158ft. per minute; water gauge, $3\frac{1}{2}$in.; indicated horse-power, 3·14; volume of air, 13,371 cubic feet by formula $\frac{M V^2}{3{\cdot}16\, g}$. I think we find the work done by the engine is just about = power in air. When we take into consideration that a heavy rain was falling and a man had to keep a cloth on the strap close to the fan pulley which acted somewhat as a friction brake, I think there is enough to show that horse-power given in and horse-power given out are so near, that the whole question is far from settled. Add to this the fact that the fan running empty with closed inlet takes more power than when passing 8000 cubic feet per minute at 2in. w.g., and a new factor is introduced which still further adds to the complication.

In conclusion, I wish to say the new fan does not lose water gauge at higher speed, it increases exactly as square of the revolutions, and the volume of air increases in direct proportion to the revolutions.

G. M. Capell.

Passenham Rectory, Stony Stratford, Nov. 20th.

Sir,—We have read with interest your able article on Capell's patent double-power fan, and can fully bear out the correctness of your statements. We, in common with many others, have heard of its wonderful capabilities, and many of his statements have been, as you rightly term it, "what no fellow can understand." We have, in consequence, several times been told that not only we but other makers would cease to sell any of the existing type of fans. On October 2nd and 3rd, through the courtesy of Mr. Capell, we have had one of his 20in. double-power fans at our works, and invited him and other gentlemen to inspect the testing of his and our ordinary make of fan, from a special countershaft we have for running all sizes of fans, and the experiments were superintended by Mr. Capell on two different occasions. We were much surprised to find that Mr. Capell knew so little about the actual results and capabilities of his double-power fan; and when put to the practical tests, it was at once apparent that the bulk of his calculations were what he thought they ought to be, instead of the actual results; and we gave him a challenge to prove his advertised and guaranteed statements at the speeds mentioned. When Mr. Capell saw the actual results of tests, he informed us that the figures and guarantee should be withdrawn from print, and this promise was carried out in the next issue.

Mr. Capell has, with the exception of having port holes between the blades of his fan, gone back to the old-fashioned bumble-bee, or broad-paddled type of fan, which is well known, takes considerably more power to drive than any of the modern type of fans. The name "double-power" is therefore very applicable. We think your suggestion of a public trial a good one, and should like to test alongside of his or any other maker both our ordinary make, and our new "patent duplex" blowing fan and exhauster, as we are convinced from actual tests that the pressure on the water gauge will be much greater in either blowing or exhausting than with any other fan in the market, and will take considerably less power to drive.

William Allday and Sons.

Branston-street Works, Birmingham, November 21st.

Sir,—Having read your article on the "Efficiency of Fans" in your last number, and being a member of the South Staffordshire Institute, I should like to reply to some of your statements, which, whoever your informant may be, are incorrect. If the statement "that the power exhibited by the fan was as nearly as possible twice that of the engine," is intended to apply to the test made in Birmingham on the 1st inst., the remark is altogether absurd; and with regard to your calculations showing 6·5-horse power nearly, which you obtained, I presume, through an incorrect surmise of the water pressure, instead of one-sixth of a pound it never exceeded $1\frac{5}{16}$in.

At the meeting it was the general impression that the experiments made were not satisfactory either to the patentee or to the Institute; yet taking the mean of two tests, as stated at the meeting, the actual power given out by the fan was 1·83, and the indicated power of the engine, minus the power shown by friction diagram, was 2·11.

Your correspondent is singularly expressive about the closing of the meeting and the remark immediately following; but is he not alone responsible for the same? At the first meeting, and also at the meeting for discussion, favourable opinions were expressed of the fan; at the same time several members contended it was impossible to get such results as the patentee claimed in his paper, and at the conclusion it was decided to conduct further trials before a definite opinion could be given of its real merits or otherwise, a course which the patentee fully concurred in.

2, St. John's-place, Wretham-road, Chas. H. Treglown.
Handsworth, Birmingham, November 21st.

Sir,—I have been too closely engaged upon important professional work to be able to answer your article upon the above subject fully this week. Permit me, however, to say in reference to the remarks, "It is not to the credit of the South Staffordshire engineers that they should allow his (Mr. Capell's) mistake to pass uncorrected on the spot;" and, "The meeting finally broke up without being able to come to any conclusion," that when you have a full statement of facts you will see the engineers in question not only recognised the discrepancies you point out, but considered the results so far from satisfactory that they appointed a committee to further test the Capell fan and others of different types under similar conditions, so as to arrive at a just comparison. It is fair to Mr. Capell to acknowledge that in the most important trials of mine fans that have taken place, the hitherto acknowledged formula for ascertaining the horse-power of the air—and the one he adopts—was used, but with results eminently in his favour.

Priory-street, Dudley, Alexander Smith.
November 22nd.

Sir,—I have had some experience with the working and construction of fans, but I fail to see anything whatever in the Capell double power fan to convince me that it is of double power, or even up to the standard of efficiency to a well constructed single power fan. The so-called double power Capell fan is an open fan exhaust with an outlet all round the periphery; and I beg to say, Sir, that all open exhaust fans give a great suction—your description in Engineer of February 16th gave the pressure with closed suction. I need not say that a lifetime would be passed away and not one single cubic foot of air in volume would pass through the fan with such a test. Has Mr. Capell been mixing up volume tests with pressure tests? I shall be glad if the following questions are answered in your next issue:—Firstly, taking a Capell double power fan, 3ft. diameter of revolving disc, I would be glad to know the size of inlets; secondly, the pressure of water in inches when the whole suction is open and passing the whole volume of suction through the 9ft. area of discharge into the common atmosphere; and also to know the pressure suction close to the periphery of the inlet, and at one-half the radius and at the centre of inlet.

C. P. Hendy, Engineer.

Cook's-yard, Nelson-street, Commercial-road, E.,
November 22nd.

Sir,—In your issue of the 16th inst. you have an article on the trials of the Capel fan, and the discussion upon it by the Institute of Mining Engineers at Dudley. I think your criticisms on the discussion do an injustice to the members of that Institute. You say, "It is not to the credit of the South Staffordshire engineers that they should allow his—Mr. Capel's—mistake to pass uncorrected on the spot, as they have not corrected it," &c. Allow me to say as one of the members present that the useful effect, as worked out by several of the members, was 72 to 73 per cent., which is not much different from your more leisurely calculation, and which I think is good duty for a fan.

C. F. T.

Factory-road, Tipton, November 27th.

THE DEFINITION OF FORCE.

Sir,—Allow me to offer a few more remarks on this rather important question. I do not think it is right a discussion should end without arriving at some conclusion. It was not fair of "Φ. Π." to refer one to his correspondence, as I am not the only one interested in the controversy. His last letter was not to the point. I admitted there were certain forces which are manifestly nothing but motion. It is of no use demonstrating that which every one is bound to admit. "Φ. Π.'s" example of the plate should have served the purpose, if he had gone a little further, turned the tap and explained why the water which would then be at rest on the plate did still press on the hand with a certain force.

After a careful perusal of "Φ. Π.'s" letters I feel doubtful about his theories. I will not encroach upon your valuable space at any great length, it has evidently been discussed before; but I do not quite understand your correspondent's account of the combination of oxygen and hydrogen to form water. If the motion is already in the gases, why should there be any necessity to apply a flame to cause the explosion? And by combination I understand a particular motion which has to be generated by a force.

"Φ. Π.'s" explanation of the force of gravitation was disappointing, nothing more than an "ether theory," which looked very similar to that of Le Sage. I venture to think there are three difficulties in the way, first, the supply and disposal of the ether; secondly, its direction, if in lines radiating from the centre of the earth, it will account for the weight of terrestrial bodies; but the earth tends to approach the sun, therefore the latter must have its own system of ether, and so on with all the other celestial bodies; thirdly, a person on entering a house ought to be lighter, because he would shelter himself to a certain extent from the ether rain. It will be a grand stride in the progress of science when all forces are resolved into motion; it may be eventually. I joined in the controversy hoping to learn.

Without doubt the common definition of force is defective; but it is the best we have, and it will do for all practical purposes. To define force as motion a teacher would have to introduce his students to a chaos of doubtful theories. Let us take as an example the term heat. It may be defined as the cause of certain common effects or as the molecular motion of bodies; but the latter definition is justified in this case, because the evidence in favour of the one "theory of heat" is enormous; but can the same be said of the theories of force? I may believe all force to be motion, for the simple reason that I cannot conceive action at a distance; yet such an action may exist although the mind may not be able to conceive it. Can the intellect form any conception of its own nature? Who can conceive an atom so small as to be indivisible, or infinity of space, or a score of other mysteries which seem to point a limit to the human conception? But a simple belief is very different to a bold assertion, the latter should always be qualified by proof.

I feel more than ever convinced, after a study of Dr. Stallo's remarkable work, that modern science consists of two distinct parts—the certain and the uncertain, or the fact and the theory.

14, Warstone-terrace, Alfred-road, Stephen Eddy.
Handsworth, November 20th.

INSIDE CYLINDER ENGINES.

Sir,—It is to be feared that some of your correspondents will miss the true points at issue in discussing the diameters of inside cylinders for locomotives. As you have very properly pointed out, the question is not how large a cylinder can be got in, but what is the largest cylinder that gives a good result.

In this connection I may refer to the practice of Mr. W. Adams, when locomotive superintendent of the North London Railway. He found himself called upon to design engines which would pull very heavy trains at high speeds, and he found that $17\frac{1}{2}$in. was the largest cylinder he could use inside. As a result, he abandoned inside cylinders, and put them outside instead, and with the best results.

It is useless to make the exhaust port wide. The throttling takes place in the slide valve. I have seen engines in which the bridge is less than 1in. deep, and I have known instances in which the valves have been made so thin, in order to get a little more depth of bridge, that they have collapsed under a heavy pressure of steam. Everyone knows, too, that these shallow valves are not readily kept tight; they spring under the pressure. The bridge of a slide valve has to carry in such engines as we are speaking of a load of about $3\frac{1}{2}$ tons, and it is easy to see that unless the metal is thick enough to be stiff the valve will leak.

But, in addition to all this, the cranks have got to be thought of; and if we compare the number of broken crank shafts in engines of the Glasgow and South-Western Railway type with those of the Gladstone type, much will be found in favour of the latter. The true way to settle the point is to let the repair accounts of engines of both types be produced, and the figures would be found startling.

Crewe, November 21st. J. D. R.

Sir,—I noticed with interest a letter from Mr. Joy a week or two ago, giving a few facts about his valve gear that is about to be placed on engines with large cylinders, and should like to hear with what results it has worked on those engines already fitted up with it. I believe the Midland Railway Company has some of its engines working with this valve gear; would some of your kind readers give us a little information about this interesting matter, as it bids fair to be the valve gear of the future? I noticed a photograph a few months ago in one of your numbers of a colonial engine for 3ft. 6in. gauge, built by Neilson and Co., of Glasgow. I think it was for the Cape Railways. Would Mr. Joy kindly let us know how his valve gear has worked on these engines, as I believe you stated there were to be a number fitted up with it for the Cape Government Railways.

Locomotive Engineer.

London, S.W., November 25th.

Sir,—In the letter on the above subject from Mr. F. A. Field in your paper of 23rd inst., he says he believes that valves below the cylinders are a comparatively recent adaptation. Such is, however, not the case, as the old Sphynx, and other engines of the same type, built by Sharp and Co. for the Manchester, Sheffield, and Lincolnshire Railway more than thirty years ago—I believe about 1849—had the slide valves under the cylinders, which Mr. Field will see by referring to "Clark's Railway Machinery."

Lincoln, November 27th. Joseph J. Tyrrell.

THE DISPOSAL OF SEWAGE.

Sir,—I had intended to have made a few remarks upon Mr. Howard Kidd's letter on the subject of sewage, but the town in which I reside has been busy getting the Town Council in proper order for another twelvemonth. Now, what your correspondent Dr. Forrest says is perfectly correct, but at present this system is very little known. As I take great interest in the town, and have lived in it many years, I am very anxious to get it adopted in our town, which has a population of about 18,000 old and young. I find the sewers are becoming very offensive, and the river is getting a very bad name. Now, I feel perfectly satisfied if this system was fully at work in our town these two great evils would be entirely done away with. We should then be like the people in Japan. The only manure they have there is produced by the inhabitants; that is why they have such abundant crops. Dr. Liebig used to say that if the people in this country made a proper use of the human excreta they would not waste so much money on bone dust and artificial manures. The next point is how to manufacture this undiluted manure into a proper state for the farmer, and what will be the outcome in regard to profit. This system does not interfere in any way with the convenience or comfort of the present water-closets, but saves a great amount of water.

Being anxious to know what amount of undiluted manure our 18,000 inhabitants would produce in the year, I wrote to the inventor if he would kindly give me the information. His answer is: "If you wish to make the manure profitable you must have a proper workshop that your people can work in all weathers. Then, when every house is on this system, your town will produce 4400 tons. This, mixed with dry ashes or other disinfecting material, will, at £2 per ton = £8800 annually." Surely that is worth attending to. He also states that as there is no patent right to prevent any town from adopting this great boon, and it costs so little to do it, he hopes every town will adopt it for their own benefit.

Bailie Mure.

Dalglish House, Stirling, November 24th.

THE STRENGTH OF LEAD PIPES.

Sir,—I notice in The Engineer of the 23rd inst. a letter from Messrs. W. Pope and Son, which seems to infer that we prefer purchasing our lead pipe from foreign manufacturers. This is not the case. We simply buy in the best and cheapest market, and give our customers the benefit of the best articles at the lowest possible prices.

W. B. Rickman, Managing Director.

Pintsch's Patent Lighting Company, Limited,
Metropolitan-chambers, New Broad-street,
London, E.C., Nov. 24th.

KIDD AND BARFF'S GAS.

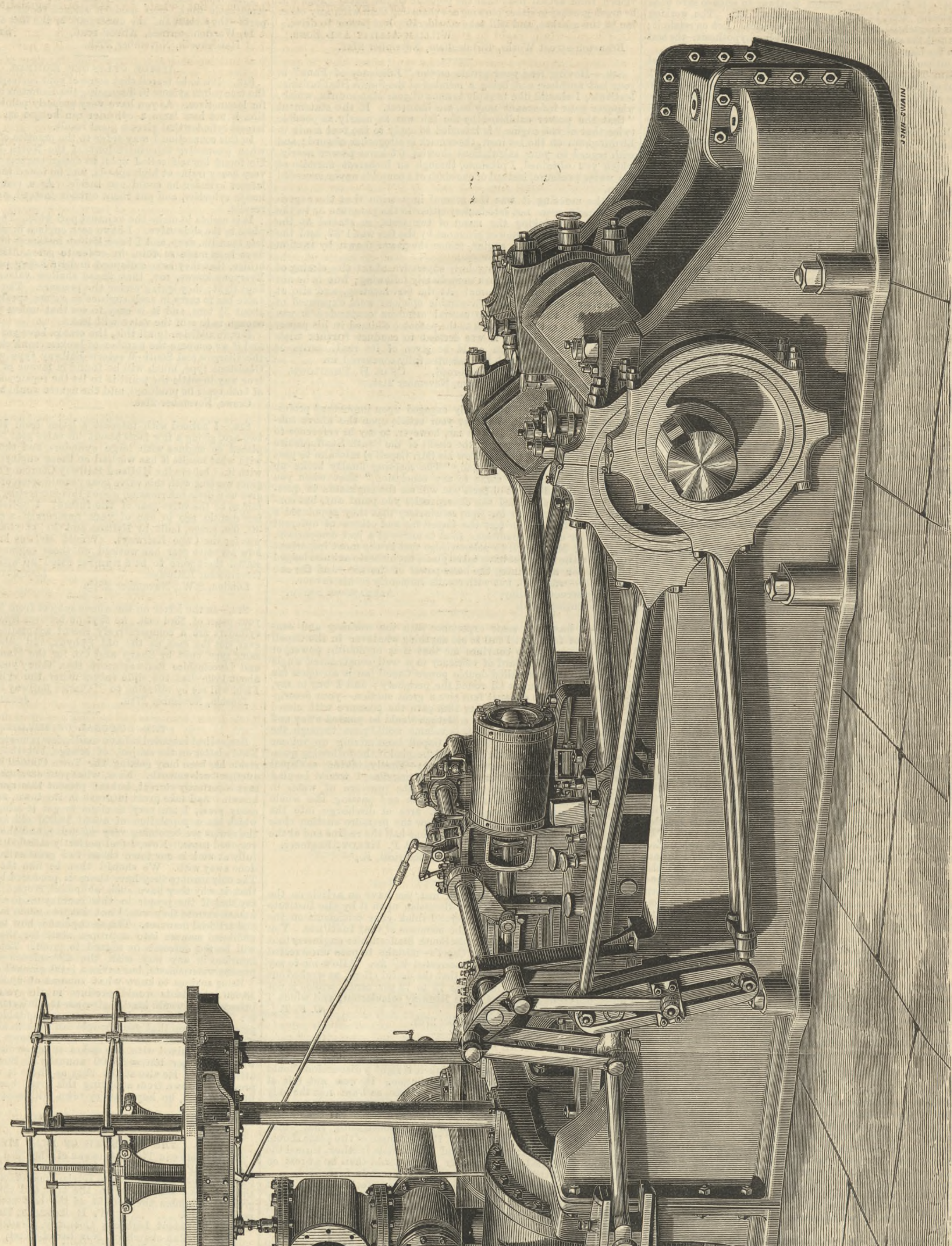
Sir,—I should be glad if Mr. Dowson would inform me in what way the so-called "Dowson" gas differs from that made by the Kidd and Barff producer, which anybody who pleases can use? Beyond an alteration in the steam generator and superheater, I see nothing whatever to entitle the gas produced to its new name. There is not the slightest doubt that this gas requires a larger gas engine cylinder for the same power, whatever Mr. Dowson may say to the contrary. The fact that theoretically it requires only 1·1 time its volume of air for combustion is quite sufficient proof of this.

Verax.

November 25th.

The Patent-office.—We are requested to state that the Civil Service Commissioners are about to hold an examination for six additional assistant-examiners to the staff of the Patent-office, at a salary commencing at £250, and rising by £37 10s. triennially to a maximum of £400 per annum.

The International Exhibition at the Crystal Palace.—Great progress has been made in the arrangements for this exhibition, which promises, it is said, to be of considerable importance. Official agents have been appointed in Austria, Hungary, Belgium, Brazil, China, France, Germany, Greece, Holland, Ireland, Italy, Japan, Norway, Persia, Russia, Sweden, Switzerland, Spain, and the United States, and a large number of exhibits have been promised from all these countries.



REVERSING RAIL MILL ENGINES—BLAENAVON STEEL WORKS.

MESSRS. DAVY BROTHERS, PARK IRONWORKS, SHEFFIELD, ENGINEERS.

(For description see page 417.)

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.*

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

E. B. D.—*No drawing of the windmill in question has been published in* The Engineer.

Tractus.—*We hardly understand your question. You will find in "Youatt on the Horse," a good deal of information about the resistance of common road vehicles, such as mail coaches. If you will state precisely what you want to know, we will endeavour to aid you.*

A. G. H.—*The specification is prepared by a competent authority, and then the firms most likely to build a ship of the kind specified satisfactorily are requested to tender. The number of shipbuilding firms is comparatively small, and there is no occasion to advertise. Indeed, it is very soon known that a firm or company want a ship, and if business is slack the builders ask for the order.*

WIRE NAILS.

(*To the Editor of The Engineer.*)

Sir,—We want to know the name and address of a maker of good machines for making wire nails. Wire Nails.

Lincoln, November 27th.

ÆRATING WATER.

(*To the Editor of The Engineer.*)

Sir,—Can any of your readers inform me what is the best method of ærating a quantity of liquid, say 25,000 gallons at a time? Is it better to force air into the liquid, or to pump up the liquid and let it fall in a shower through the air? Does any firm make special machinery for this purpose? J. B.

London, November 28th.

MEETINGS NEXT WEEK.

The Institution of Civil Engineers.—Tuesday, Dec. 4th, at 8 p.m.: Ordinary meeting. Paper to be discussed, "The New Eddystone Lighthouse," by Mr. W. T. Douglass, Assoc. M. Inst. C.E. Paper to be read with a view to discussion, "On Electrical Conductors," by Mr. William Henry Preece, F.R.S., M. Inst. C.E. Thursday, Dec. 6th, at 8 p.m.: Special meeting. Second lecture "On Heat in its Mechanical Applications"—"The Generation of Steam, and the Thermodynamic Problems Involved," by Mr. William Anderson, M. Inst. C.E.

Society of Engineers.—On Monday, Dec. 3rd, at the Westminster Town Hall, Caxton-street, Westminster, at 7.30 p.m., a paper will be read "On Roller Milling Machinery," by Mr. J. Harrison Carter, the leading features of which are as follows:—(1) The extensive character of the British milling industry. (2) The importance of excelling in the quality of our own flour in order to secure the benefits of its manufacture for our own country. (3) The merits of pure flour. (4) The formation of the wheat berry the miller's difficulty. (5) Millstone milling and its defects. (6) The manufacture of pure flour by the roller milling system. (7) The roller milling system described.

Society of Arts.—Monday, Dec. 3rd, at 8 p.m.: Cantor Lectures, "The Scientific Basis of Cookery," by Mr. W. Mattieu Williams, F.C.S. Lecture I.—The kitchen a chemical laboratory. Modes of applying heat. Radiation, conduction, and convection. Roasting, grilling, baking, boiling, and stewing. Wednesday, Dec. 5th, at 8 p.m.: Third ordinary meeting "The Manufacture of Mineral Waters," by Mr. Thomas T. P. Bruce Warren.

Chemical Society.—Thursday, Dec. 6th, at 8 p.m.: Ballot for the election of Fellows. "On the Constitution of the Fulminates," by Dr. Divers and Mr. M. Kawakita, M.E. "On Liebig's Production of Fulminating Silver without the use of Nitric Acid," by Dr. Divers and Mr. M. Kawakita, M.E. "Note on the Constitution of the Fulminates," by Dr. H. E. Armstrong. "Experimental Investigations on the Value of Iron Sulphate as a Manure for Certain Crops," by Mr. A. B. Griffiths.

THE ENGINEER.

NOVEMBER 30, 1883.

THE BOARD OF TRADE ON MERCHANT SHIPPING.

We recently published a circular issued by Mr. Chamberlain, as President of the Board of Trade, calling upon shipowners to tell them how they were to be made honest, and suggesting the establishment of certain naval marine courts. The circular in question has been sharply criticised in our columns and elsewhere, and Mr. Chamberlain has found it expedient to issue a second paper, in which he justifies the action of the Board and paves the way for fresh legislation. The memorandum is very well written; Mr. Chamberlain, indeed, takes the part of an enthusiast, and plays it admirably. It is open to question, however, if enthusiasts make good legislators; and there is reason to believe that Mr. Chamberlain has suffered himself to be carried somewhat further than is advisable. He cannot quite dismiss the notion that shipowners are, as a whole, a bad lot; and this is much to be regretted, for any legislation based on this theory is certain to be unsatisfactory. Mr. Chamberlain ought to attack a system, and not men, and he will find no journal in England more ready to lend him cordial support than this, if he will select the proper mark for his attack, the proper place for changes. But we must, on the other hand, refuse to believe that the shipowners of England are a reckless body, who care nothing for anything but making money. "We want," writes the President of the Board of Trade, "the shipowner to bring his ship safe to port. We may tell him what he must do in order to effect this, and set somebody to watch him to see that he does it. Or we may make it his interest to bring his ship safe to port, and leave it to him to find the best means of doing so. What we are attempting at present is a half-hearted way of trying the former course, and it has failed. But how about the other? If it can be shown that our law as it at present stands not only does not make it the shipowner's interest to bring his ship back safe, but tempts him so to conduct his business as to make it his interest that she shall be unsafe, and protects him when he has done so, it will follow that we have hitherto neglected by far the most powerful means which the State can use to make ships safe; and that the law, while nibbling at preventive measures, is really promoting and encouraging loss of property and of life." The Memorandum is not a little precise in its charges:—"From a return moved for by Mr. W. H. Smith (Parliamentary paper 143, 1883), it appears that the loss of life has, on the whole, increased since 1875-76, when it was 2031, and that it was 3372 in 1881-82. It also appears that the loss of life in 1881-2 was greater than in any year since 1867, except in one year, 1873-74, when it was swollen by the loss of nearly 1200 coolies in two emigrant ships." Mr. Chamberlain classifies the principal losses:—"The losses in British timber-laden ships since 1875 have been as follows:—1876-7, 1877-8, 1878-9—83 ships, 105 lives; 1879-80, 1880-1, 1881-2—103 ships, 185 lives. The losses in the last year recorded are:—1881-2—98 ships, 280 lives. From the returns presented to Parliament, it appears that the losses in ships loaded wholly or chiefly with grain have been as follows, taking the averages for periods of three years:—1876-7, 1877-8, 1878-9—82 ships, 406 lives; 1879-80, 1880-1, 1881-2—74 ships, 386 lives. The losses in the last year of which we have a record are:—1881-2—68 ships, 551 lives. The loss of coal-laden British ships, taking averages for periods of three years, is as follows:—1876-7, 1877-8, 1878-9—ships, 196; lives, 447; 1879-80, 1880-1, 1881-2—ships, 239; lives, 591. The losses in the last year of which we have a record appear from the wreck register to be as follows:—1881-2—ships, 285; lives, 756." Mr. Chamberlain does not appear disposed at present to implicate any shipowners save those engaged in the coal, timber, and grain trades.

Now, it is quite indisputable that the figures given represent a grievous loss of life, but taking into account the circumstance that between 1878 and 1882 inclusive, our steam tonnage increased no less than 56 per cent., it does not seem that the shipowner is going from bad to worse as Mr. Chamherlain would have us believe. Mr. Chamberlain plainly goes on the assumption that the loss of life is preventable, and it follows, as a matter of course, that if the death of a single sailor could be prevented, and is not prevented, then someone is to blame. The weak point in Mr. Chamberlain's attack is that, like all enthusiasts, he jumps at conclusions. The skill and science of the present day, he argues, are so great that the loss of life at sea ought to be very small, and it would be very small if only the shipowners did what they ought and gave skill, science, and common sense a fair chance. But this we submit is simply begging the whole question. Is it really true that much can be done by the shipowner to avert disaster? To deal properly with this question it must be handled very broadly. Much must be taken into consideration that is unfortunately very easily overlooked; and we think it may be shown that to legislate hastily or without due consultation with shipowners, merchants, and sailors, can only result in disappointment. It is, of course, impossible to do more within the limits at our disposal than glance at certain conditions under which particular trades are carried on. For the moment let us take the case of grain-laden ships. Mr. Chamberlain is no doubt aware that competition has reduced the price paid for the carriage of grain from the United States to an extremely low figure. The profits made by the American farmer who grows wheat are extremely small, so small that if the price paid him for his produce were reduced as it would have to be if freights were augmented—unless, indeed, bread was to rise in price here—they would vanish altogether. But in order that a steamer may pay when freights are low, it is essential that she should not long lie idle. For this reason the Atlantic grain steamer gets filled up with corn in an incredibly short time. We have known as much as 2800 tons of maize to be put on board in nine hours. A grain ship will have, let us say, three hatchways; she is brought alongside the "elevator," or grain store, and three cascades of corn are poured into her. To stow this corn properly is next to impossible; men cannot live in the dust. A certain proportion of the corn is in sacks; taking these on board and placing them prolongs the operation, and leaves little time for dealing with the loose corn. While this is going on the captain is engaged in the discharge of other duties which take up all his time almost day and night. The first and second officers are about equally busy, and every effort is made to hurry the ship away. Finally she starts, and her motion begins to settle the cargo down. It is almost a matter of chance whether it will or will not settle in such a way as to give her a heavy list to port or starboard. Shifting boards help matters somewhat, but not much. Bad weather comes on, and the ship is lost. Now in this case who is to blame? In the first place, be it observed that, great as the loss of life is, it represents a very small number as compared to the amount of grain carried. In other words, a great many steamers stowed as we have stated cross and re-cross the Atlantic in safety. Indeed, it may be taken for granted that nothing short of a very heavy gale will cause them to founder. But what, we ask, can legislation do in such a case as this? It can compel the more careful stowing of grain ships, and it can insist that they shall be less heavily loaded. We have no hesitation in admitting at once that under the new conditions there might be a considerable saving effected in life and property; but what will be the cost of this? In dealing with this question we have to consider the trade both ways. The United States, owing to its tariff, takes comparatively little from us, and that little must be sent at a nominal rate. We could name an instance where a steamer took out a nearly full cargo, the gross profit on carrying which was only £5. The owners had to look to the grain cargo brought back to pay for both voyages. A ship going to the North or Black Seas can afford to take time in loading, because in both cases she will earn money in going out, and on the first-named trip, her run home will occupy only about seven days, while a cargo steamer is on the average about sixteen days crossing the Atlantic. Thus it will be seen that American tariffs indirectly raise the price of grain in this country.

Returning to the question of the risk run, we do not think that anyone argues that grain-laden ships are lost save through stress of weather. If Mr. Chamberlain will collect, as he may easily do, the captains' and engineers' logs of a number of ships which crossed the Atlantic laden with grain last winter, we have not the least hesitation in saying that so far from pronouncing grain-laden ships a prey prepared for the sea, he will be astonished to find how competent they are to grapple with tremendous storms. There is a very simple method by which indeed the losses of grain-laden ships may be almost entirely, if not entirely, prevented. Let an Act of Parliament be passed prohibiting the importation of grain into this country from America between the 25th of December and the 25th of March. Mr. Chamberlain, however, would not dare to introduce such a Bill as this, because the direct effect would be to raise the price of grain. We only make the suggestion to show that, if an Act of Parliament is to take a direction which will augment the cost of wheat or other breadstuffs, it cannot, or it will not, be passed; and it rests with Mr. Chamberlain to prove that legislation which will reduce the losses of grain-laden ships will not augment the price of corn. It may be that freights will not be affected, but this has to be shown.

We return now to the principal question. Let it be assumed that the effects which changes in system may have on the grain trade are to be quite disregarded; and we ask, What would Mr. Chamberlain have the shipowner do? In what way is he to blame? Why should all the fault be laid at his door? We have said that Mr. Chamberlain should attack system, not men; and the system he has to attack is that under which ships are crammed with grain in a hurry, and sent across the Atlantic in the stormy season. We do not support this system; far from it. We are prepared to go any length in denouncing it; but we know perfectly well that our denunciations will have no effect whatever; neither will Mr. Chamberlain's. There are two courses open. The shipowners may band together and say, "We will have no more of this work; our ships must lie long enough under the elevators to be slowly filled and properly stowed, and we will not run grain cargoes at all across the Atlantic in winter and early spring." Or Mr. Chamberlain may say, "I shall compel you, recalcitrant as you are, to take your time, however impatient you may be, and I shall close the Atlantic by law, as the winter closes the Baltic and the North Sea by ice." But unless either one or the other is done, the grain trade cannot be made exempt from more or less serious risks, and what is true of this is true of the coal trade and of the timber trade. Risk is run because people want to make money on the sea, and it is because the people of Great Britain are less thoughtful of the perils of the sea than any other nation living that we now have such a great share in the carrying trade of the world.

Much remains to be said concerning the Board of Trade Memorandum, but space fails us at this moment. We shall return to the consideration of a document which is important, because it shows what is passing through the mind of a man who is animated by the best and most praiseworthy motives, and who possesses as yet next to no practical information on a subject of gigantic importance to two nations. Mr. Chamberlain only sees now that sailors are lost at sea, and without further question he asserts that come what will such losses must cease. That there are abuses, and that legislation may within reasonable limits do good, we do not dispute. We hold now, as we have always held, that a change in the system of marine insurance is desirable, and that, furthermore, some one ought to be responsible for the way in which a ship is worked; but we repeat that legislation alone cannot possibly free a trade of its perils, but that Mr. Chamberlain, unless he is very careful, may do a good deal to render our ocean carrying trade at once safe and unremunerative. Circumstances will be too strong for him in this direction let us hope. That he may do much that is useful we do not doubt, but he will do well to avoid the practice of shipowners. If he is in too great a hurry he may lose his vessel altogether, instead of taking her safe into port.

The remedy for the existing state of affairs is, according to the President of the Board of Trade, to make it the interest of the shipowner to prevent the loss of ships:—"There are two possible remedies for an admitted evil. One, the extension of officialism; the other, the restoration of the law of liability and insurance to its sound and natural condition. Of these two possible remedies the extension of officialism is to be deprecated, not only because it is expensive, troublesome, and injurious, but because it is ineffectual. As to the other remedy, its essence is to so arrange the law as to set the keen, restless, Argus-eyed self-interest of commercial men in action on the side of safety; to throw the civil liability for loss and damage where it ought to fall; to put in the power and to make it the interest of those who are injured by shipwreck to seek their remedy in the right place, and to make it certain that those whose ships suffer shipwreck shall lose and not gain by it." We have shown that one possible effect of such legislation as is here hinted at, may be to raise the cost of importing corn and timber and of exporting coal. Concerning other aspects of the case, we have, for the moment, to reserve an expression of opinion. We shall, as we have said, return to the subject.

COST OF PRIMARY BATTERY CURRENTS.

The production of a primary battery which will provide electric currents on a large scale at a low cost has long been the dream, not only of amateur electricians, but of accomplished electro-chemists guided by electro-physics. The electro-motive force of almost or quite every possible couple under the sun has been tried, and the combining weights of elements consulted with a view to the discovery of a couple which will give a current without the expensive decomposition which goes on even in a carbon zinc battery. Almost everything has been tried that is even remotely likely to give any useful results as an electrolyte, and quite everything has been used which has given any real promise of increased efficiency. Every now and then amateurs recommence where experienced electro-chemists began long ago, and after going over ground which has been well trodden, they arrive at something which gives very encouraging results compared with their first efforts, and ultimately at results which show a high rate of efficiency—for a primary battery. After a long struggle with bad results, this success is so elating that a good deal must be said about it, and consequently the daily papers are supplied with the necessary useful information. Recently this sort of information has been going the round of the papers, and, as usual, we have people writing to us to know what is really the truth about and value of all the figures and statements that are published, and of those which are made to them direct.

In one instance, a primary battery has been for months under experiment by some recent electricians, the inventor—and he is an inventor because he does not know how much of his work has been done already long ago—being under the impression that sulphate of zinc, which he might get as a bye-product, would be saleable as a useful article. It is a useful article, but its sale is so small that this zinc battery will produce electricity at no less cost than batteries that could be ordered and made up by the thousand by any of the well-known manufacturers. Hence this inventor, after months of costly experiment, has found out what years and years of experience has already proved over and over again to those who have been constantly using batteries, and are acquainted with all the electro-chemical combinations of materials. We do not for one moment wish to insinuate that it is useless for amateurs to attempt any electrical improvements or inventions, for in electro-mechanics amateurs in electric knowledge have made some of the most important inventions. It is not so with that part of electrical invention which would busy itself with primary batteries, for here electricians are at home, and are self-sufficing and independent. In dynamo machines the knowledge and experience of the mechanical mind was necessary to the progress which has lately been made in that direction; but in primary battery work, electro-chemistry, and not electro-mechanics, is required. Men may be born mechanics, but they are not often born chemists, and electro-chemistry is like the starry firmament, it, as Shakespeare says, will not be deep-searched with saucy looks.

Attention has recently been directed to a primary battery, which, according to the *Times*, "goes far to solve the question of independent house and railway carriage lighting." This is, of course, the impression conveyed to a good many people; and many beside those who could afford to pay as a fancy for electric lighting a few rooms by incandescent lamps, fed by a primary battery have been led to make inquiries under the impression that now their days or nights of oil lamp and gas miseries are numbered. This, of course, may be true, though in those districts wherein responsible firms have not powers to supply the electric light, the number may not be easily countable. Certainly nothing that is yet before the public in the shape of a primary battery will lessen the number. The battery referred to has been tried on the Great Northern Railway, and for the purpose succeeds. Five-candle lamps are supplied by it, and the Great Northern Company might have been successful in this respect long ago if it had been prepared to go to the price. It is stated that a sixteen cell battery will supply 18 lamps of the above power. The electromotive force of the battery is thus not more than 16 volts, and is probably much less, that of the cell—carbon and zinc being used—being only about one volt. The cost of lighting by this battery, the detailed construction and electrolyte of which have not yet been described, has been given as one-eighth of a penny per 5-candle lamp per hour. This would be one-fourth of a penny for a 10-candle lamp. Some people and some applications may be able to afford this, but the great mass of people cannot. The same amount of light from a dynamo machine driven by a steam engine would cost not more than one-fourteenth that sum. At the most moderate estimate seven 20-candle incandescent lamps can be maintained per horse-power. The cost of this for fuel alone at 2·25 lb. per horse-power per hour with coal costing 20s. per ton, would be just one farthing, so that at this rate the cost of one 10-candle lamp would be 0·018d. per hour, or for a 5-candle lamp 0·009d. per hour. To compare these with the cost of a carbon-zinc battery, we may assume the zinc to cost not less than 2·5d. per pound in the battery. The electro-motive force of the couple will be practically 1 volt., and 2·02 lb. or, say, 2 lb. of zinc will be required to give 1-horse power, and 1-horse power cannot be supposed to give more than 200 candles even from a battery. This gives us then $\frac{2.5 \times 2 \times 5}{200} = 0.125$ or one-eighth of a penny as stated for a 5-candle lamp, as compared with 0·009. These figures only take into consideration the cost of the oxidising element in the cell, which is here taken at a very low price, and do not consider the electrotyte.

We may then assume that even the last primary battery does not offer much promise of "solving the question of independent house and railway carriage lighting." The Great-Northern Company may be able to pay the price, but oil-gas would probably suit the purpose better, and the public will have to look to something in the way of a lead or an iron battery for cheaper primary battery currents or to the distribution of dynamo-electric currents.

GAS TESTING.

London is supposed to be supplied with gas possessing a specified lighting power, and complying with certain conditions as to purity. As a guarantee that the public get what they pay for, the Corporation and the Metropolitan Board, but more especially the latter body, have an official staff, whose duty it is to test the gas day by day, and to report the results. If it were arranged that the gas examiner should walk into a house or shop just when and where he pleased, and bottle off a sample of the gas actually supplied on the premises, afterwards proceeding to examine this at his leisure, so as to ascertain its qualities, the gas companies would be under a very effective kind of *surveillance*. But no such method is supposed to be capable of rendering accurate scientific results. Hence the plan pursued is that of having fixed stations, where the official examiner mounts guard, as it were, for a portion of the day, or rather, of the night, and where he has an elaborate apparatus for the purpose of ascertaining the illuminating power of the gas, and the extent to which it is impregnated with sulphur and ammonia. Sulphuretted hydrogen must be entirely absent, and the pressure must be of a prescribed amount. In 1868 it was required that each testing place should be as nearly as possible a thousand yards distant from the place where the gas to be tested was made. When the great works at Beckton were opened, it was objected as absurd to test the City gas at a distance of seven or eight miles from the consumer, and the law was altered to permit of gas being tested in the district to which it was supplied. When amalgamation began to take effect, another difficulty presented itself. The Act of Parliament provided that if the gas was defective so as to come under the penalty clauses, the fine should be proportioned to the quantity of gas manufactured at the works from whence the defective supply proceeded. This answered very well, so long as it was possible to determine from what works the gas was actually sent out. But the progress of amalgamation so mixed up the supply, that it became impossible to determine at any given point where the gas came from. To escape this dilemma the law was altered three years ago, so as to fix a penalty irrespective of the quantity of gas concerned.

Such is the system which now exists; but it is evident that perfection is not yet attained. Amalgamation on the part of the Chartered Company has been carried to such a pitch that not only is it difficult to say where the gas which is examined comes from, but there is a decided apprehension that a considerable quantity of gas comes under no examination at all. There is something ludicrous in the spectacle of a duly qualified gas examiner sagely testing a stream of gas, while perhaps a couple of streams are passing away wholly unobserved. That is to say, three separate mains may proceed from one gasworks, and yet the testing station is only in communication with one of these mains. If the gas company can be trusted to do what is right with two-thirds of the supply, it would seem as if they might be trusted for the whole of it, and the trouble and expense of a delusive system might be got rid of altogether. The inadequacy of the plan now pursued is obvious when we find that the testing stations are actually less in number than the places at which gas is made. When we add to this the fact already mentioned, that a gasworks will sometimes have more than one main, it becomes still further evident that the quality of the metropolitan gas supply cannot be fully demonstrated by the official returns. It seems only reasonable to ask what the gas referees have been about to permit so lax a state of things to exist under their authority. These gentlemen, three in number, are well paid, and have ample powers wherewith to carry out their supervision effectually. It rests with them to specify what testing places are required, and to see that they are established. We know at least of one case in which they allowed a most extraordinary stretch of time for the establishment of a testing station, where one had become necessary owing to an amalgamation whereby a supply formerly outside their jurisdiction was brought within it. It appears to take about two years to get a testing station properly in order, and for all that time the gas supply takes care of itself. Now at last the Metropolitan Board find out for themselves that things are not quite as they should be. Mr. Dibdin, the chemical assistant to the Board, reports that a very important area lying between Notting-hill, Camden Town, Dalston, Shoreditch, and Chelsea, is "virtually unprotected by the action of the testing places." Thus the consumers of gas in Kilburn, Paddington, Oxford-street, Regent-street, Charing Cross, and Bloomsbury, are without any assured benefit from the law which prescribes the lighting power and quality of the gas supplied to them. Even on the very premises of the Metropolitan Board, the gas consumed has not been tested, but we hear a rumour of a test having been lately applied with very peculiar results. If this be so, we can understand how it comes to pass that the members of the Board have been suddenly awakened to the absurdity of the situation. It is now proposed that additional gas-testing places shall be established, including one at the offices of the Board. Application is to be made to the Metropolitan Gas Referees accordingly, and we trust they will not allow a couple of years to elapse before the testing places are in full operation.

ENGLISH AGRICULTURAL IMPLEMENTS IN INDIA.

We have received through the India Office a document giving details of the agricultural implements and machines which have been experimented with and found efficient and useful in India. Of ploughs a great variety is employed. The "Kaisar," which inverts as well as stirs the soil, is used in some localities for ploughing in light soils, its special advantages being cheapness, lightness, and simplicity of construction. It ploughs half an acre per day with ordinary country bullocks, inverting the soil to a depth of 5in., which is deeper than is done by the native plough. It is therefore very useful for crops like sugar-cane, which require for their cultivation that the ground shall have been carefully prepared. Except on very light soils, however, the "Kaisar" plough has not produced satisfactory results. In some districts various makes of the Swedish plough are used for general purposes on heavy or light soils. It combines strength, lightness, and efficiency; works excellently on heavy soils with two pairs of cattle. On light soils one pair is quite sufficient. The Swedish single stilt is said to be the best and cheapest plough yet introduced into India; 300 have been ordered for the Madras Presidency, while a native firm at Bellary has purchased 350 of the medium size for use on black cotton soil. With regard to Ransome's ploughs, several reports are given. Mr. W. R. Robertson, superintendent of the Government Farm, Madras, states that this firm's B.F.I. plough is used for general purposes but not adapted for very heavy work; it possesses great efficiency for the draught employed, but is costly compared with other ploughs. Ransome's primitive plough, which is used for irrigated land or for working between the rows of standing crops, is spoken of as being efficient, simple in construction, and low in cost if made up in India, resembling a country plough in appearance. Ransome's Scotch plough is particularly adapted for cultivating land in preparation for cane crops, as it goes deep and thoroughly eradicates weeds; and their turnwrest plough is in use on hill estates. Separate reports are given with regard to Howard's dwarf plough D, Howard's O.R. English plough, and Howard's No. S.B. patent plough. The first, which is not adapted for very heavy work, being "one of the lightest implements made," is described as a very good and useful plough, but costly compared with others. It does effective work, and can be drawn by one pair of strong bullocks. The second, used on light and sandy soil, cleanses the land of weeds which defy the native tool. The Commissioner of the Northern Provinces says that it exposes all the soil in turn to the influence of the sun and atmosphere, brings into use the hitherto untouched wealth of subsoil, and by loosening a greater depth of land enables it to retain moisture. The third of these ploughs is stated to be most effective in working stiff soil; by it such land can be ploughed when in a hard, dry state, and at seasons when water is not to be had for irrigating to soften the soil. It has been used on the Hyderabad farm for these purposes for upwards of eleven years, and has been found most effective in eradicating deep-rooted perennial weeds. For cotton and crops which require weeding, it effects a saving in the cost of this operation, according to the testimony of the Superintendent of the Hyderabad Government Farm. He further states that land ploughed deep with it does not require to be irrigated so often to mature the crop as does similar land with ordinary tillage. Not only does it effectually invert the soil, but by burying the vegetation by which the soil may be covered it improves the texture of the ground. Of the several other ploughs to which detailed reference is made, no special remark need be made here, most of them being of the ordinary native makes.

Several pages in the document before us are occupied by reports upon hoes, harrows, grubbers, &c. Ransome's bullock hoe, used for cultivating or hoeing between the rows of standing crops, is looked upon as an economical implement producing expeditious work. On moderately large farms it is, in fact, regarded as a very useful implement. The English four-pronged forks are being gradually substituted on the tea gardens for the hoe, than which they are more effective, especially on hill-sides, breaking up the earth more effectually. Howard's drag harrows have been experimented with, but the set tried was proved to be too heavy for an ordinary cultivator. Messrs. Ransome's jointed chain and other harrows are well spoken of for breaking clods and covering the seed. A corn drill of English manufacture—maker's name not mentioned—has been successfully tried for all kinds of seed except cotton. Messrs. Coleman and Morton's cultivators as used on the Government Farm, Hyderabad, are found to be too heavy for the cattle. Three pairs are not able to work them effectively, except on the lightest portion of the farm, and after the land has been softened by watering. Lighter cultivators are recommended for use by the Indian farmer. The other agricultural implements of English manufacture which have been found efficient in India may be summarised as follows:—Thomas Corbet's winnowing, corn-dressing, and screening machines; Rollins and Co.'s corn sheller, used for separating the maize from the cob on which it grows; Ransome's winnowers; Dell's winnowers; several varieties of English thrashers; Ransome's chaff-cutter and thrashing and winnowing machine; Burgess and Key's water lifts; Ransome's cake and corn mills; and Gordon and Co.'s cotton gins and bullock gears.

THE NORTH-EAST COAST EXHIBITION.

It is satisfactory to learn from a report just issued that the pecuniary result of the Exhibition of Marine Engineering and Naval Architecture, held last year at Tynemouth, is such as not only to relieve the guarantors from all question of responsibility, but to place a handsome balance for disposal in the hands of the committee. At a recent meeting held in Newcastle, the Earl of Ravensworth, president, in the chair, the report of the Executive Committee was read, and it stated that after paying all expenses a sum of a little over £1100 remained for distribution. Out of this it was proposed to invest £750 with trustees to form the nucleus of a fund for the foundation of a chair of naval engineering and architecture in the Durham College of Science at Newcastle-on-Tyne, and to hand the balance, in amounts varying from £25 to £120, to various charitable institutions in the neighbourhood. Seeing that the expenditure very largely exceeded the original estimate on account of the undertaking assuming so much greater dimensions than was at first contemplated, the report must be considered in the highest degree satisfactory, while the disposal of the surplus must be acknowledged to be extremely appropriate and judicious. That the Tyneside district, in which shipbuilding and engineering matters connected therewith are so largely represented, is at present without means of encouraging the acquirement of scientific and practical knowledge on such subjects, is certainly surprising; and though the amount voted by the committee is merely a nucleus of the £12,000 that would be required to properly endow a chair of naval architecture, we hope that now the matter is mooted there will be no difficulty in obtaining the rest. As Sir William Armstrong put it at the meeting, it would scarcely be creditable to the district if they remained in the background, and allowed Glasgow, Dundee, and other places which have already established and endowed chairs of naval architecture, to continue before them in the advancement of accurate knowledge.

The late Dr. Siemens was buried in Kensal Green Cemetery on Monday, the funeral service being performed in Westminster Abbey.

LITERATURE.

Strains on Braced Iron Arches and Arched Iron Bridges. By A. S. Heaford. London: E. and F. N. Spon. 1883.

Graphic Methods of Computing Stresses in Jointed Structures. By Charles Ormsby Burge, M.I.C.E. Excerpt "Minutes of Proceedings of the Institution of Civil Engineers," vol. lxxiv., Session 1882-3, Part IV.

In the first work cited above a laudable attempt is made to treat braced iron arches and arched iron ribs by purely graphic methods. In the very beginning of his work Mr. Heaford honestly states that he assumes the inclined reactions at the ends of the arch to pass through the crown; and in fact this principle is tacitly taken for granted throughout the whole of the work. It may therefore be said that the truth or error of the given methods depends entirely upon the fulfilment of this fundamental condition. Hence it is very necessary to examine what kind of arguments are adduced in favour of this indispensable hypothesis, and we find that the proof is wholly based upon analogy drawn from a comparison of straight and bowstring girders, the behaviour of which under strain is, according to the author's view, similar in this essential respect to that of the arch. Subsequently it is shown that, if this principle be once admitted, the component parts of the resultant thrust in an arch are given by the formula $\frac{W(a-b)}{2r}$, in which W is the particular weight considered, a the half span, b the perpendicular distance of the line of action of W from the centre of span, and r the central depth of the straight or bowstring girder, or again the vertical rise of the arch. The resultant thrust will be the sum of these component thrusts, and can be graphically represented by a line drawn perpendicularly to the vertical line of loads. The loose end of this line and the two extremities of the vertical line of loads furnish the nuclei necessary for the construction of the reciprocal figure of the arch. The reciprocal diagram when built up should hinge upon the outer end of the line-reciprocal of the thrust; or in other words, lines, reciprocal of members lying on opposite sides of the centre of the arch, should be related inversely in sense and direction relatively to the end of the horizontal thrust in the diagram of stresses. Hence, the end of the thrust might be fitly named the *point of inversion* of the diagram, which to our mind is a more apposite term than the expression "to turn upon," used by the author to convey the same idea. The above statement contains a brief but still fair exposition of the method of treating iron arches proposed in the little volume we have under review. It will be seen that everything depends upon the truth of the assumption that the end reactions pass through the crown of the arch, which is nowhere proved to demonstration. This hypothesis is open to much criticism. Many authors lean to the belief that the end reactions lie tangent to the curve of the arch at the abutments, or normal to the face of the abutments themselves. In any case a wide difference exists between parallel and bowstring girders and braced iron arches or arched iron ribs, and therefore it is very dangerous to argue by analogy from one class of structures to the other. For example, a bowstring girder constitutes a perfect framework. Its great tie-rod or lower boom pulls in a definite way and direction; whereas in an iron arched rib the abutments deliver upon the curved line of the arch a reaction, the direction of which depends to a vast extent upon the angles of the bedding and the character of the connection. On this account the assumption made seems far too general, and scarcely tenable in the majority of cases. In certain particular instances the end reaction may pass through the crown of the arch, but in a far greater number of cases we incline to the belief that these reactions will fall on the near side of that point. But, granting the truth of the first hypothesis, the theory built upon it is strictly correct, and the treatment of the subject clear and logical. The elucidation of the principle that "all forces or strains acting about any point in the structure or polygon shall keep that point in equilibrium" is exceptionally good. But in other places we find traces of a want of logical sequence. For instance, we can readily admit the principle that a structure may be hinged on any point where the stress changes sign by passing through zero; but it is scarcely legitimate to argue, as the author does on p. 33, that, because the stress is *nil* at a certain part of the straight boom or platform of the arch, it can be hinged somewhere else at a point on the curved rib situate between two members in which the stress is continuously compressive, and attains the values of 10·02 and 12·15 tons respectively. Moreover, there are a few false references and clerical errors which should be corrected if the book reaches a second edition. The well-known name of Clerk Maxwell is invariably spelt Clark Maxwell. On page 7, line 3, the thrust should be 17·5 tons not 12·5 tons. On page 13, Plate III, should read Plate II. On page 17, line 14, for H read A. Again, the author often uses capital letters in the text corresponding to small italics on the plates.

Taken as a whole, Mr. Heaford's little work represents a conscientious effort to grasp the difficult problem of treating arched iron ribs and braced iron arches by purely graphic methods; and, although the assumption upon which the method hinges appears to us false, or at least not generally true, the author has made a great step in advance, and has thrown new light on a problem which may be classed as one of the geometric puzzles of the age.

In the paper on "Graphic Methods," by Mr. Burge, a second attempt is made to grapple with the same problem, but not with equal success. The author evidently has not matured his notions of the first principles of graphic statics. To take an instance, on page 4 he states that where in a framework structure "there is a joint around which there are more than two forces to be ascertained, the problem is insoluble by the graphic method;" whereas, as a matter of fact, the problem is directly soluble by the graphic method of sections—see "Levy, La Statique Graphique," or "Graham's Graphic and Analytic Statics," pp. 19 and 67. Again, Mr. Burge invariably assumes the reactions to have been previously "estimated," instead of finding them by the graphic method of polar polygons. The treatment of wind pressure on roofs by means of separate diagrams is quite superfluous, not only because the same operation can be performed in one combined diagram, but also because in all cases exemplified the superadded stresses due to wind are of the same sign as those due to the vertical loading, and approximate very closely to what would have resulted from corresponding increase in the distributed loads in the ratio of the wind pressures. In the part where he deals with the braced arch, Mr. Burge is guilty of a *petitio principii*, for at the outset he assumes the horizontal thrust to be known, which, in a paper dealing *ex professo* with the subject, is a very easy way indeed of cutting the Gordian knot of the problem. The author, however, is more consistent in his treatment of unbraced arched ribs; but here again he makes an assumption that the vertical reactions at the ends of the arch are equal. Hence the method is crippled in its birth by being limited to a particular case. After implicitly making this assumption, the author next proceeds to draw a curve of equilibriums approximating to the true form of the arch. The following preliminary hypothesis is then established:—"From points on the centre line of the arch where it is at its maximum distance from the curve of equilibrium, suppose members to be introduced connecting these points to the centre of the arch." Under these conditions the reciprocal diagram is constructed in the usual way, and the two "gaps," corresponding to the introduced members, typify, according to Clerk Maxwell's principle, the stresses acting in the directions of the ideal struts or ties. Reserving our right to question the author's first assumption, we are inclined to agree in this particular case with his conclusion that "at the intersection of the two curves—of arch and equilibrium—the transverse strains are evidently *nil*. For the point where the arch is at its maximum distance from the curve the stresses are approximately the same as would be produced in a girder of the same dimensions as the section of the rib between the intersections with a load, the resultant of which is equal to the stress on the supposed introduced member."

The inference to be drawn from a comparison of these two attempts to deal with the difficult problem of the arch is that both methods rest on broad and very questionable assumptions. Eliminating the truth or error of these preliminary hypotheses, the first work may be said to solve the problem in a very lucid and scientific form; whereas there is not a page in the second paper which does not betray insufficient grasp of the ordinary graphic processes. Moreover, the notation adopted by Mr. Burge is clumsy and needlessly complex. A good notation should be founded upon the mutual and intrinsic relations existing between the outline of the structure and the lines of the reciprocal figure, not upon any arbitrary notion which may suggest itself to the mind of the writer. If the letter system be adopted, then Bow's method of lettering the spaces is far the best; but if the number method be chosen, which is better adapted for large and important structures, its purely numerical character should be preserved, and a hybrid compound of both systems sedulously avoided.

Designing Wrought and Cast Iron Structures: Part I.: Notes, Calculations, and Working Drawings for Wrought and Cast Iron Girders of 20ft. Span. By Henry Adams, M. Inst. C.E., M. Inst. M.E., Professor of Engineering at the City of London College. London: 60, Queen Victoria-street.

This book, published in the interest and for the use of the engineering classes of the City of London College, will greatly assist those who are commencing to design structural ironwork before they have acquired that practical experience which is necessary to qualify theoretical rules. Indeed, as a mere enumeration of the points to be regarded, the book will be of use to those of older years, whose general practice requires only occasionally the designing of girders. We fear, however, that in this, as in many other handbooks, no royal road to learning has been discovered; and the would-be designer will find himself puzzled when a case presents itself demanding modifications of the simple examples given. It is one of the teacher's difficulties how to realise the condition of mind of his pupils; and how to approach his subject from a point sufficiently rudimentary without descending to trivialities, and this difficulty must be increased when writing for pupils in various stages of advancement. For instance: If it be necessary to describe, as on page 3, the difference between wrought and cast iron, the pupils who need such a description will hardly be able to appreciate the subsequent rules. The estimates of cost, though approximately correct, are given only in a summary fashion, and are likely to mislead those who are unaware of the numerous and ever-varying items of expense which go to make up the actual cost or selling price. We are glad to see the remarks on page 24, as to the necessity for allowing a margin of strength for future years, the possible loss by oxidation being too often ignored; but we should have preferred to see the caution applied to wrought iron rather than to cast iron. As this book is published in connection with lectures at the College of which the author is a Professor, the rules and examples given may, as an adjunct or supplement to such lectures, serve a wider purpose than is apparent on the face of them; and our sympathies are so entirely with the College and its aims that, if only as part of an admirable whole, we give this first part of the book a hearty welcome, and shall look with interest for the succeeding chapters which are promised.

COLONEL RICH AND THE SOUTH-WESTERN ROLLING STOCK AND PERMANENT WAY.

A report to the Railway Department of the Board of Trade affords scope for considerable speculation on some of the future possibilities of the London and South-Western Railway, not only as a passenger-carrying concern, but as affording occasional amusement for railway people in particular and everybody in general, especially those who have enjoyed some of the vagaries of trains on South-Western railways. Colonel Rich has written a report on the accident that occurred on September 17th in Portsmouth Town station-yard, on the London and South-Western and London, Brighton, and South Coast Joint Railway, when the coach at the tail of the 3.40 p.m. fast train from Waterloo station, London, left the rails. It is true that only one passenger is returned as having been shaken; but this is a case of the proverbial last straw, and though it is a very small straw indeed, it seems to have been enough to turn the balance of Colonel Rich's equanimity, for he has written a report which probably may be looked upon as a lash that had been prepared, but withheld in deference to a misplaced mercifulness.

The train consisted of an engine and tender, two first-class, one second and three third-class coaches, the last of which was fitted with a brake compartment, in which the guard in charge was travelling with the luggage. The brake and luggage compartment was at the back of the train, which was fitted throughout with the automatic vacuum brake. This brake was not in working order when the train left Waterloo, so that a steam brake on the engine and the screw-brakes on the tender and in the guard's compartment, were the only brakes available during the journey.

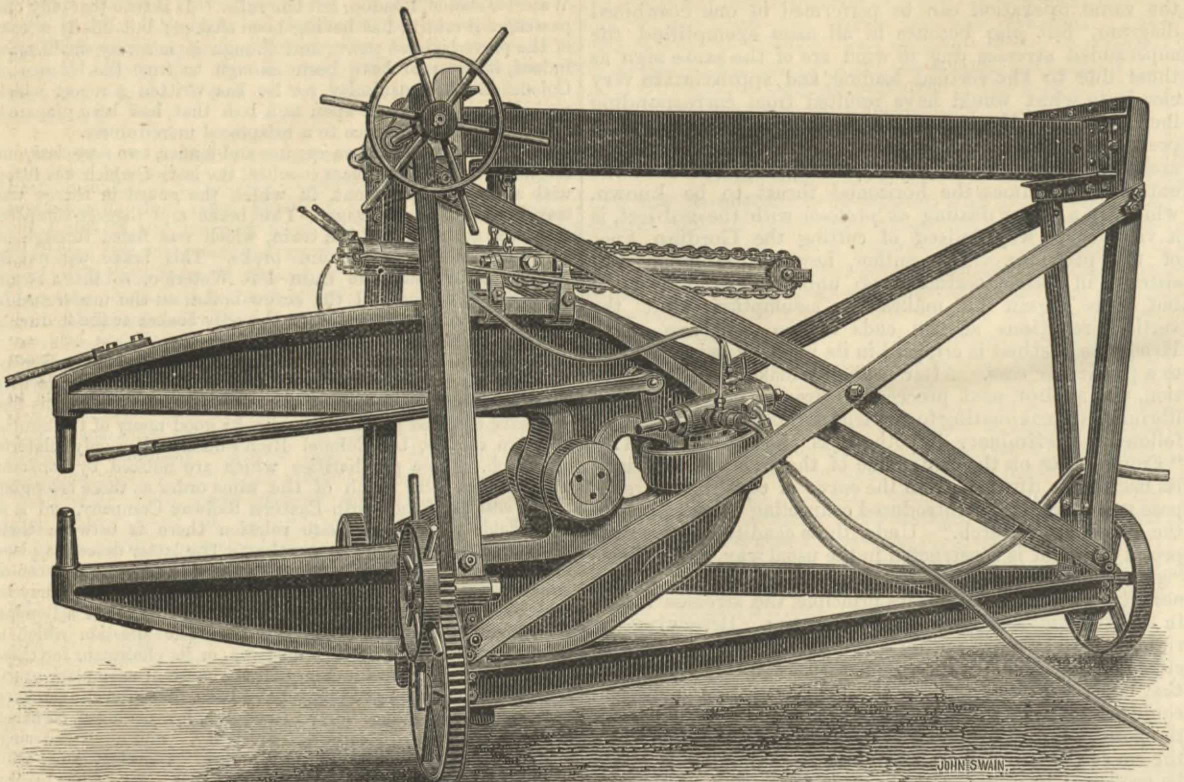
Colonel Rich says he observed peculiarities about a South-Western coach and the permanent way. There are peculiarities about some coaches. Some of the constant travellers on this line will have observed peculiarities about a good many of the South-Western coaches, but Colonel Rich's observations only relate to one coach. Those peculiarities which are noticed by constant travellers are very much of the same order as those belonging to the coaches of the South-Eastern Railway Company, and it is remarkable what an intimate relation there is between their number and the age of the coaches. The latter deserve a place in a museum of antiquities, for by the side of some of those of one or two northern lines they suggest the relation that may be said to exist between the appearance and comfort of a London river steamer and a Mississippi boat. The affection which is evidently entertained by the company, or its chairman, for these old coaches is almost touching in the sense of exemplary gratitude to things for the good they have been. Nothing else can keep such things on the line. They are square, low-ceilinged, cornered everywhere, cold, straight, draughty, noisy, wandering, vibrating, stuffy, dirty, dark, dingy, creaking, loose-windowed, worn out, dangerous old coaches, and plenty of the old South-Western stock is nearly as bad. But this is not what Colonel Rich observed. He observed that the London and South-Western Railway Company's gauge for the wheels of the rolling stock is slightly—about $\frac{1}{16}$in. to $\frac{1}{32}$in.—wider than the permanent way guage which was given to him to gauge the road. This should conduce to steady running, but he does not think it is conducive to safe running, particularly on curves or in passing through points and crossings. He observed that the springs were seated on the axle-boxes and that the coach was hung to the springs by a chain link and pin, which allowed a foot of play. The accident was brought about by the springs upsetting under the carriage. Colonel Rich has directed the company's attention to its railway, as the "motion of the trains is decidedly less smooth than the movement of trains on the principal lines at the north side of London." He believes this to be partly attributable to the permanent way, but more so to the rolling stock. The running at the south side of Petersfield is particularly rough. Colonel Rich makes an amusing suggestion. He says:—"In cases where trains or parts of trains have left the rails, and the company has failed to discover and to give any satisfactory reason for the accident, I think it would be well if the chief engineer and chief locomotive and carriage superintendent attended the inquiry, as the cause of vehicles leaving the rails when trains are running must be some defect in the permanent way or rolling stock." Let us imagine Mr. Jacomb and Mr. Adams face to face settling this question of defect in the permanent way, or in the rolling stock, or in something that causes the derailments. If Mr. Jacomb were to agree that his permanent way was bad all through, and Mr. Adams that much of his rolling stock was defective, then nothing more might be heard about the matter until the next derailment; but if these gentlemen began to describe the results of the other's work, outsiders might find a good deal to amuse them. After all, the fault is not with Mr. Jacomb or Mr. Adams, but with the directors, who limit expenditure.

Mr. Robertson, M.P., has intimated to the Chester Town Council that he finds the difficulties in the way of canalising the Dee to be so great that he has been reluctantly compelled to abandon the project. The cleaning of the Dee by scouring and natural action will be promoted.

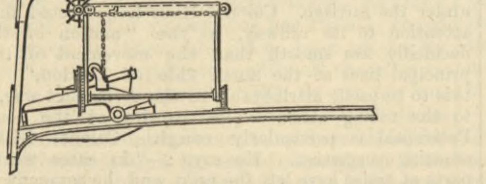
South Kensington Museum.—Visitors during the week ending Nov. 24th, 1883:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 9142; mercantile marine, Indian section, and other collections, 2073. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 1388; mercantile marine, Indian section, and other collections, 127. Total, 12,730. Average of corresponding week in former years, 12,591. Total from the opening of the Museum, 22,589,430.

New Process for Covering Iron with a Bronze-like Surface.—According to L. Meyer, in the *Polytechnisch. Journal*, the following method is admirably successful in producing a bronze-like surface. All the methods as yet known for producing a bronze-like surface, by rubbing over the surface of the iron an acid solution of copper or an iron solution, letting it dry in the air, brushing off the rust produced in this way, and an abundant repetition of this method, give a more or less light or dark reddish-brown crust of rust on the iron body. Objects formed of iron can easily be covered with copper or brass by dipping them in the requisite solution, or by submitting them to the galvanic method. The surfaces so prepared, however, peel off in a short time, especially if the surface of the iron be not polished bright at the time; by exposure to moist air in particular. By the method given below, it is possible to cover iron objects, especially such as have an artistic aim, with a fine bronze-like surface; it resists pretty satisfactorily the influence of moisture, and one is, moreover, enabled to apply it to any object with great ease. The clean, polished objects, devoid of all traces of fat, are to be exposed to the action of the vapours of a heated mixture of hydrochloric acid and nitric acid, in equal portions, for from two to five minutes; they are not to be shifted, and the temperature may range from 300 deg. to 350 deg. C. The heating is continued so long that the bronze-like surface is well developed on the surface of the objects. After the objects have cooled, they should be well rubbed down with vaseline, and again heated till the vaesline begins to decompose. When again cold they should be a second time treated with vaseline in the same way. If the vapour of a mixture of the two concentrated acids is allowed to act on an iron object in this manner, a light reddish-brown tone is developed. If some acetic acid be mixed with the two acids, and the vapour of all the acids together be allowed to act on the metallic surface, a surface of a fine bronze yellow colour can be obtained. By using different mixtures of these acids every tint, from a dull red-brown to a light brown, and from a dull brownish-yellow to light brown-yellow can be produced on the surface of the iron. In this way some T-rods for iron boxes were covered with a bronze-like surface, and at the end of ten months, although exposed during the whole time to the action of the acid fumes of a laboratory, they had undergone no trace of any change.

HYDRAULIC SHIP-RIVETTING MACHINE.

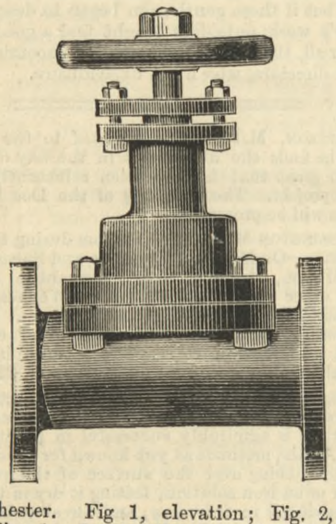


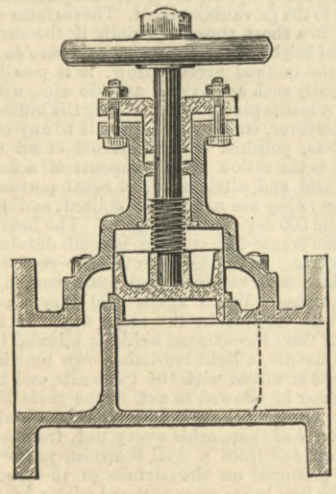
Mr. Tweddell has modified the hydraulic rivetter until the places into which it cannot be got are extremely few. A powerful machine has been in use for some time for rivetting keels. The accompanying engraving illustrates a machine tool, made by Messrs. Fielding and Platt, engineers, Gloucester, now being much used in ship-yards. The little diagram shows it in position, and explains the nature of the work which it is intended to do, namely, closing up rivets in comparatively inaccessible places about the covering boards and waterways of iron vessels. The drawing explains itself, the tool being of a pattern now very well known indeed.



FURNESS AND ROBERTSHAW'S VALVES.

The accompanying engraving illustrates a stop valve now being brought out by Messrs. Furness and Robertshaw, of Simpson-street, Manchester. Fig 1, elevation; Fig. 2, section. By referring to Figs. 1 and 2 it will be seen that the cover or spindle portion and the body of the valves are bolted together; and by unscrewing the bolts the cover or spindle portion can be removed without disturbing the pipes or body of the valve. The valve seat is raised above the flange of the body, as shown in Fig. 2, thereby rendering it easy to repair. It is claimed for these valves that a decided economy in cocks and valves is effected, as the parts most liable to use or wear can be repaired indefinitely at small cost and with great facility, thus making the old valve equal to a new one, and avoiding the necessity of disturbing any of the pipes when this valve requires repairs.





THE INVINCIBLE PUMP.

The accompanying illustrations from the American *Sanitary Engineer*, Figs. 1 and 2, show a pump, the principle of which is claimed to be new. It consists of a valve section *a* that is stationary, with hollow ends, which extend through each end of the pump cylinder and the cylinder itself, which is pivotted on the protruding ends of the valve section, and to which is attached the sector piston. This sector in connection with the valve section divides the cylinder lengthwise into two chambers. The rocking of the cylinder by the handle gives alternate vacuum and displacement in each chamber. There are four valves—two suction and two delivery. The packing in the valve section consists of strips of leather let in flush, or nearly so, with the metal. The sector is also packed in the same way. It is made with interchangeable parts, which are lettered and numbered to facilitate the duplication. Fig. 2 shows the pump arranged to go on wash-bowl slabs in places where the water does not rise to the bowl. It is called the Invincible. Messrs. Nathan and Dreyfus, Liberty-street, New York, are the manufacturers.

FIG 1

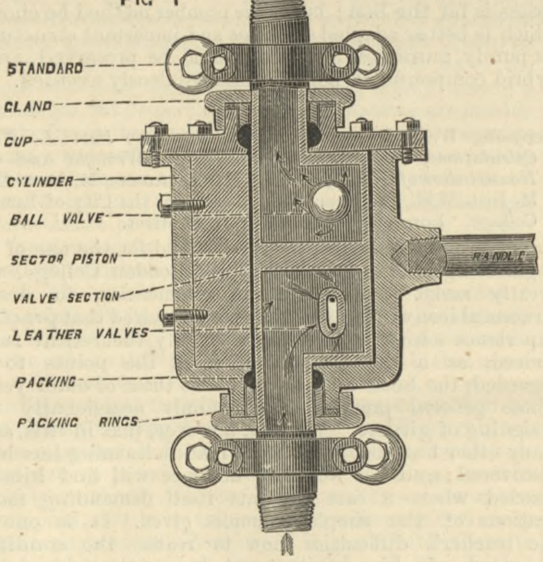
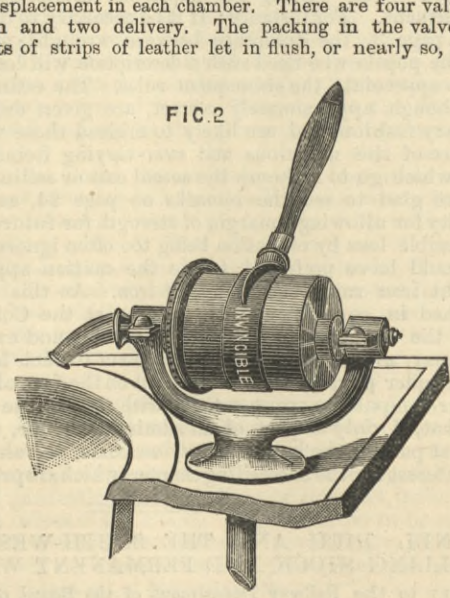


FIG.2



PICTET'S ICE MACHINE.

On page 420 we illustrate one of Raoul Pictet's patent ice machines, capable of producing 3 tons 12 cwt. of pure transparent ice in twenty-four hours, which was exhibited in operation at the Engineering and Metal Trades Exhibition by Messrs. Emmerson, Murgatroyd, and Co., Stockport, the sole makers for this country. It depends for its action on the rapid vaporisation of sulphurous anhydride (SO_2), a volatile liquid whose boiling point at atmospheric pressure is 14 deg. Fah., and which has an absolute vapour tension of about 75 lb. per square inch at a temperature of 95 deg. Fah., and a latent heat of vaporisation of 182 thermal units. Sulphurous anhydride is therefore intermediate between the very volatile liquids, such as carbonic acid, ammonia, methylic ether, &c., and liquids of comparatively low volatility, such as sulphuric ether, sulphide of carbon, &c. The machine consists essentially of a water jacketted pump A with the suction connected to a refrigerator B, and the delivery to a condenser C, the pump being a double-acting one, such as is ordinarily used for the compression of gases, while the refrigerator and condenser are long cylindrical copper vessels containing tubes, through which, in the one case, brine, or any liquid it is desired to cool, is caused to flow, and in the other a current of cold water is circulated. Assuming the air to have been exhausted, and the refrigerator partially filled with sulphurous anhydride, if the pump is set in motion a portion of the vapour will be drawn off, so causing a reduction in pressure on the surface of the liquid, which will therefore immediately commence to boil and give off fresh vapour to replace that removed. This boiling causes a certain weight of liquid to pass to the state of vapour, and each pound so changed absorbs 182 thermal units, which must be supplied from the metallic sides of the refrigerator. At each stroke of the pump the temperature of the liquid will be lowered and the vapour tension diminished, and when this tension equals that of the atmosphere, the temperature will be exactly 14 deg. Fah. It will thus be seen that brine or any uncongealable liquid in which the refrigerator is immersed can be made the medium for supplying the heat absorbed in the formation of the vapour, and with its temperature thus reduced, can also, in turn, be utilised for abstracting heat from any other hotter substance.

If the evaporated sulphurous acid was not returned to the refrigerator the operation would not last long, but would cease as soon as the supply of liquid was exhausted. To avoid this the pump delivers the vapour into the condenser, which is kept cool by means of a circulation of cold water. The vapour being discharged at each stroke, the pressure in the condenser will gradually rise after starting until it reaches the tension due to the temperature of the water, after which condensation will take place, provided enough water be supplied to carry off the heat of vaporisation which is here set free. In this manner at each stroke of the pump a quantity of liquid is formed in the condenser exactly equal to that withdrawn from the refrigerator by evaporation, and by connecting the two vessels by a pipe with regulating valve, the superior pressure in the condenser causes it to flow back in a constant stream to be again evaporated and condensed. The flow of the sulphurous anhydride through the apparatus is indicated in the engravings by the arrows in dotted lines.

The quantity of cold produced, that is to say, the number of thermal units abstracted, is directly proportioned to the weight of liquid evaporated, while the degree of cold depends on the vapour tension in the refrigerator; the lower the tension, the lower being the temperature at which the liquid will boil.

The method of utilising the cold is of course subject to modification according to the nature of the application. The engravings show a small ice-making plant, which, though not representing the size and number of ice moulds and tanks actually employed in an apparatus suitable for a machine of this capacity—special arrangements having to be made to suit the limited space at the Exhibition—will serve to illustrate the process. The refrigerator B is entirely immersed in brine contained in the insulated wrought iron tank D, in which also are suspended the four ice moulds E. At the end of the refrigerator is placed a screw, which is caused to revolve by a spindle passing through a stuffing-box to the outside of the tank, and which sets up a current of brine through the tubes of the refrigerator, round partitions in the tank, past the ice moulds, and back to the refrigerator, the direction being shown by the arrows in full lines. In this way the brine is alternately cooled by the refrigerator and warmed by the heat given off in the ice moulds during the formation of ice. If it is desired to produce transparent ice, it is necessary to agitate the water during the process of freezing, otherwise particles of air would be occluded and cause opacity. The agitation is accomplished by means of weigh bars G extending across the tank, and having a rocking motion imparted to them by a small crank on a shaft driven by a belt from a pulley on the overhead shaft, levers on the weigh bars giving a vibratory motion to wood plungers in the moulds, so inducing a continual movement of the water. When it is not of importance to produce clear ice the agitators are dispensed with.

In addition to the manufacture of ice, machines of this type are applied to the cooling of liquids direct, without the intervention of brine, the liquid itself being passed through the refrigerator by a pump. They are also used for cooling cold storage rooms either in conjunction with ice making or alone. In this case either a part or the whole of the brine is pumped from the refrigerator into thin iron trays forming the roof of the chamber, and allowed to flow from one end to the other over a series of transverse dams back to the refrigerator to be again cooled, while the air is reduced in temperature by contact with under surfaces of the trays. Such an arrangement was exhibited at the Agricultural Hall, the pipe, shown broken off in the engraving, leading the brine to the chamber, while crank pipe returns it to the tank. The brine pump K is shown in elevation, and is driven by an excentric on the overhead shaft.

We understand that a considerable number of these machines is at work in various parts of the world, making ice and performing other cooling operations, and that they have given great satisfaction. Among the advantages claimed for sulphurous anhydride over other liquids commonly in use are that the pressure in the condenser is not excessive, generally averaging from 20 lb. to 40 lb. per square inch above the atmosphere; that but little vacuum is required in the refrigerator; that the pump is of much smaller capacity than when ether is used; and that the material itself is a good lubricant and has no deleterious action upon metals. The vapour pump may be driven direct by a steam engine, as in the plant illustrated, or by means of a belt from any independent motor. The apparatus shown at the Exhibition was well designed and exceedingly neat in appearance, the workmanship also being of a very high character.

A terrible accident occurred on the 23rd inst. on the Lake of Geneva between Evian and Ouchy. The steamboat Cygne ran into the steamer Rhône and sank her. Twenty of the passengers were drowned.

THE SOCIETY OF ENGINEERS.

THE following syllabus of lectures to be given in the reading-room of the Society of Engineers, 6, Westminster-chambers, S.W., during the winter session, 1883-84, commencing punctually at 7.30 p.m. each evening, has just been issued :—

First Course.—"On Meteorology," by Mr. Wm. Marriott, F.R. Met. Soc., assistant secretary of the Royal Meteorological Society.

Lecture I. (December 6th).—Temperature.—Introductory—Constitution of the atmosphere—Temperature of the Air—The thermometer—Scales—Maximum, minimum, and self-recording thermometers—Verification—Exposure—Diurnal and annual range of temperature—Mean temperature—Decrease of temperature with elevation—Balloon observations—Boiling-point thermometer.

Lecture II. (December 13th).—Temperature (continued).—Isothermal charts—Distribution of temperature—Influence of land and water—Extreme temperatures—Great heat—Severe frosts—Freezing of lakes—Temperature of the soil—Sea temperature—Solar radiation—Actinometer—Black-bulb thermometer *in vacuo*—Sunshine recorder—Terrestrial radiation.

Lecture III. (December 20th).—Atmospheric pressure.—The barometer—Construction—Corrections—The aneroid—Sympiesometer—Glycerine barometer—Measurement of heights by the barometer—Diurnal and annual range of atmospheric pressure—Flow of underground water—Colliery explosions—Isobaric charts—Cyclones—Anti-cyclones—Distribution of pressure.

Lecture IV. (January 3rd).—Wind.—Direction—Pressure—Velocity—Anemometers—Beaufort's scale—Conversion of velocity into pressure—Extreme pressures—Diurnal and annual variation of the wind—Wind-roses—Relation of wind to barometric pressure—Land and sea breezes—Buys Ballot's law—Prevailing winds—Trades—Anti-trades—Law of storms—Monsoons—Typhoons—Scirocco—Hill and valley winds—Föhn—Whirlwinds—Tornado—Dust-storms.

Lecture V. (January 10th).—Moisture.—Aqueous vapour—Evaporation—Atmometers—Hygrometry—Absorption and condensation hygrometers—Dry and wet bulb thermometers—Dew-point—Relative humidity—Dew—Hoar-frost—Mist—Fog—Clouds—Halo—Rainbow.

Lecture VI. (January 17th).—Rainfall.—Cause of rain—Rain-gauges—Exposure—Influence of height—Influence of mountains—Excessive falls—British rainfall system—Wet and dry years—Floods—Droughts and famines—Sunspots and rainfall—Influence of forests on rainfall.

Lecture VII. (January 24th).—Snow, Hail, and Electrical Phenomena.—Snow—Formation—Snow crystals—Measurement of snow—Hail—Theory of the formation of hail—Hailstones—Fall of ice—Damage by hail—Atmospheric electricity—Electrometers—Lightning—Forms of lightning—Thunder—Action of lightning—Lightning conductors—Thunderstorms—Diurnal and annual periods—Ozone.

Lecture VIII. (January 31st).—Climate and Weather.—Insular and continental climate—British climate—Influence of the Gulf Stream—Health resorts—Weather and disease—Weather forecasts—Storm warnings—Weather prognostics—Conclusion.

Second Course.—"On Electrical Engineering," by Mr. John C. Fell, M.I.M.E., Wh. Sc., Fel. Inst. P.A., professor of electrical engineering, City of London College.

Lecture I. (January 7th).—Electricity—Mechanical theory—Magnetism—Electro and permanent magnets—Inductive discharge—Spark igniters, and character of the current.

Lecture II. (January 14th).—Galvanic electricity—Commercial galvanic batteries—Varieties—Arrangement of batteries for maximum effect—Internal resistance—Electrolysis—Electro-plating.

Lecture III. (January 21st).—Dynamo-electricity—Current generation—Units of current strength and resistance—Dynamo-electric machines—Varieties—Modern improvements.

Lecture IV. (January 28th).—Electric arc lights—Varieties—The Gramme—The Weston—The Brockie—The Brush, &c.—Automatic adjustments—Heating and lighting effects of current—Conductors and dielectrics.

Lecture V. (February 11th).—Electric incandescent lights—Varieties—The Edison—The Swan, &c.—Current resistances—Sub-divisions of current—The filaments—Shunts—Safety junctions.

Lecture VI. (February 18th).—The electric motor—Essential principles—Varieties—The Siemens—Ayrton and Perry's—Modes of application—Electrical haulage—The transmission of electrical power.

Lecture VII. (February 25th).—The accumulator—Secondary batteries—Varieties—The Faure, &c.—Applications to electric lighting—To launches, railways, and tramways—Ammeters—Volt-meters, &c.

Lecture VIII. (March 10th).—Thermo-electricity—Direct conversion of heat into work—Thermo-piles—Telephony—The Gower-Bell—The Edison—Transmitters and receivers—Primary and secondary currents.

Third Course.—"On General Engineering Construction," by Mr. J. W. Wilson, M. Inst., C.E., M.I.M.E., and Mr. J. W. Wilson, jun., Assoc. M. Inst., C.E., M.S.E. (Principal and Vice-Principal of the Crystal Palace School of Practical Engineering).

Lecture I. (February 14th).—Mr. J. W. Wilson: General Introduction to the Consideration of the Materials used by Engineers in Construction.—Introductory remarks—Importance of a thorough knowledge of the nature of materials to the engineer—Hints upon iron ores and their workings—Upon fuels—Upon the preparation of wrought iron and steel—Upon stone, brick, and concrete—Upon glass, slates, tiles, and other materials for covering.

Lecture II. (February 21st).—Mr. J. W. Wilson, jun.: The Work of the Drawing Office.—Implements and materials—The preparation of working and finished drawings, tracings, &c.—Free-hand sketching—Figuring dimensions—Calculation—Getting out quantities—Estimating—The preparation of specifications—The use of drawings, specifications, &c., for the superintendence of work in construction.

Lecture III. (February 28th).—Mr. J. W. Wilson, jun.: The Work of the Pattern Shop and Foundry.—Hints upon pattern-makers' tools, and their use—The preparation of patterns—Different kinds of patterns—Shrinkage, draught, &c.—Cores and core-boxes—General arrangement of foundries—Moulding—Different kinds of moulds—Special arrangements for large castings—Testing.

Lecture IV. (March 6th).—Mr. J. W. Wilson: The Work of the Fitting, Erecting, and Smiths' Shops.—General arrangement of fitting and erecting shops with shafting and lifting gear—History of machine tools and their improvements—Steel tools and their manufacture—Appliances for the transmission of power—Hand and machine forging.

Lecture V. (March 13th).—Mr. J. W. Wilson, jun.: Roof Construction.—The general nature of a roof—Different conditions of thrust and strain—Accessory roofs—The use of corrugated iron, &c.—The saw roof—Timber roofs work—Principals, parts and joints—Iron roof work—Details of junctions—Employment of wrought and cast iron—Covering—Erection—Some special roofs.

Lecture VI. (March 20th).—Mr. J. W. Wilson, jun.: Open Pier Construction.—Timber pier work—Its disadvantages—Deterioration of timber—Pile driving—Iron pier work—Cast and wrought iron—Piles and their sinking—Superstructure—Bracing, &c.—Deck and framing—Arrangement of body and head—Seats, toll-houses, &c.—Structures on the deck—Remarks as to position, length, breadth, elevation, &c.—Cost.

Lecture VII. (March 27th).—Mr. J. W. Wilson, jun. Bridge Construction.—Consideration of various materials—Brick and stone bridge work—Centreing—Piers and abutments—Foundations—Roadway—Cast and wrought iron bridge work—Girder bridges—Cast and wrought iron work—Arrangements for roadway—Details of girder work—Bridges of large span—Testing.

Lecture VIII. (April 3rd).—Mr. J. W. Wilson: Construction of the Exhibition Building of 1851, and of the Crystal Palace.—General remarks upon temporary structures—The origin and history of the Exhibition Building of 1851—The advantages and disadvantages of this form of structure—Its transportation from Hyde Park to Sydenham—Its alterations and improvements—The water towers—The pumping engines and fountains—The general cost of maintenance—Concluding remarks.

THE INSTITUTION OF CIVIL ENGINEERS.

THE GENERAL THEORY OF THERMODYNAMICS.

THE first of the six lectures on "Heat in its Mechanical Applications," was delivered on Thursday evening, the 15th of November, by Professor Osborne Reynolds, M.A., F.R.S., the subject being "The General Theory of Thermodynamics." The following is an abstract of the lecture :—

Thermodynamics was a very difficult subject. The reasoning involved was such as could only be expressed in mathematical language; but this alone would not prevent the leading facts and features of the subject being expressed in popular language. The physical theories of astronomy, light, and sound involved even more mathematical complexities than thermodynamics; but these subjects had been rendered popular, and this to the great improvement of the theories. What rendered the subject of thermodynamics so obscure, was that it dealt with a thing or entity (heat), which, although its effects could be recognised and measured, was yet of such a nature that its mode of operation could not be perceived by any of our senses. Had clocks been a work of nature, and had the mechanism been so small that it was absolutely imperceptible, Galileo, instead of having to invent a machine to perform a definite function, would have had, from the observed motion of the hands, to have discovered the mechanical principles and actions involved. Such an effort would have been strictly parallel to that required for the discovery of the mechanical principles of which the phenomena of heat were the result. In the imagined case of the clock, the discovery might have been made in two ways. By the scientific method; from the observed motion of the hands the fact that the clock depended on a uniform intermittent motion would have led to the discovery of the principle of the uniformity of the period of vibrating bodies; and on this principle the whole theory of dynamics might have been founded. Such a theory of mechanics would have been as obscure, but not more obscure than the theory of thermodynamics based on its two laws. But there was another method, and it was by this that the theory of dynamics was brought to light—to invent an artificial clock, the action of which could be seen. It was from the actual pendulum that the principles of the constancy of the periods of oscillating and revolving bodies were discovered, whence followed the dynamical theories of astronomy, of light, and of sound.

As regarded the action of heat, no visible mechanical contrivance was discovered which would afford an example of the mechanical principle and motions involved, so that the only apparent method was to discover by experiment the laws of the action of heat, and to accept these as axiomatic laws without forming any mental image of their dynamical origin. This was what the present theory of thermodynamics purported to be. In this form the theory was purely mathematical, and not fit for the subject of a lecture. But as no one who had studied the subject doubted for one moment the mechanical origin of these laws, Professor Reynolds would be following the spirit if not the letter of his subject if he introduced a conception of the mechanical actions from which these laws sprang. This he should do, although he doubted if he should have so ventured, had it not been that while considering this lecture he hit upon certain mechanical contrivances, which he would call kinetic-engines, which afforded visible examples of the mechanical action of heat, in the same sense that the pendulum was a visible example of the same principles as those involved in the phenomena of light and sound. Such machines, thanks to the ready help of Mr. Foster, his assistant in constructing the apparatus, he should show, and he could not but hope that these kinetic engines might remove the source of the obscurity of thermodynamics on which he had dwelt. The general action of heat to cause matter to expand was sufficiently obvious and popularly known; also that the expanding matter could do work was sufficiently obvious. But the part which the heat played in doing this work was very obscure. It was known that heat played two, or it might be said three, distinct mechanical parts in doing this work. These parts were :—(1) To supply the energy necessary to the performance of work. (2) To give to the matter the elasticity which enabled it to expand—to convert the inert matter into an acting machine. (3) To convey itself, *i.e.*, heat, in and out of the matter. This third function was generally taken for granted in the theory of thermodynamics, although it had an important place in all applications of this theory. The idea of making a kinetic engine which should be an example of action such as heat had no sooner occurred to him than various very simple means presented themselves. Heat was transformed by the expansion of the matter caused by heat. At first he tried to invent some mechanical arrangement which would expand when promiscuous agitation was imparted to its parts, but contraction seemed easier—this was as good. All that was wanted was a mechanism which would change its shape, doing work when its parts were thrown into a state of agitation. In order to raise a bucket from a well either the rope was pulled or the windlass wound—such a machine did not act by promiscuous agitation; but if the rope was a heavy one—a chain was better—and it was made fast at the top of the well so that it just suspended the bucket, then if it was shaken from the top waves or wriggles would run down the rope until the whole chain had assumed a continually changing sinuous form. And since the rope could not stretch, it could not reach so far down the well with its sinuosities as when straight, so that the bucket would be somewhat raised and work done by promiscuous agitation. The chain would have changed its mechanical character, and from being a rigid tie in a vertical direction would possess kinetic elasticity, *i.e.*, elasticity in virtue of the motion of its parts, causing it to contract its vertical length against the weight of the bucket. Now, it was easy to see in this case that to perform this operation the work spent in shaking the rope performed the two parts of imparting energy of motion to the chain and raising the bucket. A certain amount of energy of agitation in the chain would be necessary to cause it to raise a bucket of a certain weight through a certain distance, and the relation which the energy of agitation bore to the work done in raising the bucket followed a law which, if expressed, would coincide exactly with the second law of thermodynamics. The energy of agitation imparted to the chain was virtually as much spent as the actual work in raising the bucket, that was to say, neither of these energies could be used over again. If it was wanted to do further work, the raised bucket was taken off, and then to get the chain down again it must be allowed to cool, *i.e.*, the agitation must be allowed to die out; then attaching another bucket, it would be necessary to supply the same energy over again. He had other methods besides the simple chain, which served better to illustrate the lecture, but the principle was the same. In one there was a complete engine with a working pump. By mere agitation the bucket of the pump rose, lifting 5 lb. of water 1ft. high; before it would make another stroke the agitated medium must be cooled, *i.e.*, the energy which caused the elasticity must be taken out, then the bucket descended, and, being agitated again, made another stroke. He felt that there was a childish simplicity about these kinetic-engines, which might at first raise the feeling of "Abana and Pharpar" in the minds of some of his hearers. But this would be only till they realised that it was not now attempted to make the best machine to raise the bucket, but a machine that would raise the bucket by shaking. These kinetic-engines were no mere illustrations or analogy of the action of heat, but were instances of the action of the same principles. The sensible energy in the shaking rope only differed from the energy of heat in the scale from the energy of heat in a metal bar. The temperature of the bar, ascertained from absolute zero, measured the mean square of the velocity of its parts multiplied by some constant depending on the mass of these parts. So the mean square of the velocity of the links of the chain multiplied by the weight per foot of the chain, really represented the energy of visible agitation in the chain. The waves of the sea constituted a source of energy in the form of sensible agitation; but this energy could not be used to work continuously one of these kinetic machines, for exactly the same reason as the heat in the bodies at the mean temperature of the earth's surface could not be used to work heat engines. A chain attached to a ship's mast in a rough sea would become elastic with agitation, but this elasticity could not be used to raise cargo out of the hold, because it would be a constant quantity as long as the roughness of the sea lasted. Besides the waves of the sea, there was no other source of sensible agitation, so there had been no demand for kinetic engines. Had it been otherwise, they would not have been left for him to discover—or had they been, he might have been tempted to patent the inventions. But there had been a demand for what might be called sensible kinetic-elasticity to perform for sensible motion the part which heat elasticity performed in the thermometer. And it had not been left for him to invent kinetic-mechanism for this purpose, although it might be that its semblance to the thermometer had not been recognised. The principle was long ago applied by Watt. The common form of governors of a steam engine acted by kinetic-elasticity, which elasticity, depending on the speed at which the governors were driven, caused them to contract as the speed increased. The governor measured by contraction the velocity of the engine, while the thermometer measured by expansion the velocity in the particles of matter which surrounded it; so that it could now be seen that having to perform two operations, the one on a visible scale, the other on a molecular scale, the same class of mechanism had been unconsciously adopted in performing both operations. The purpose for which these kinetic engines was put forward was not that they might be expected to simplify the theory of thermo-dynamics, but that they might show what was being done. The theory of thermo-dynamics could be deduced by the laws of motion from any one of these kinetic engines, just as Rankine deduced it from the hypothesis of molecular vortices. Nothing had yet been said of the third part which heat played in performing work, namely, in conveying heat in and out of matter. It was an innovation to introduce such considerations into the subject of thermo-dynamics, but it properly had a place in the theory of heat engines. It was on this part that the speed at which an engine would perform work depended. The kinetic machines showed this. If one end of a chain was shaken the wriggle ran along with a definite speed, so that a definite interval must elapse before sufficient agitation was established to raise the bucket; further, an interval must elapse before the agitation could be withdrawn, so that the bucket might be lowered for another stroke. The kinetic machine, with the pump, could only work at a given rate. He could increase this rate by shaking harder, but then he expended more energy in proportion to the work done. This exactly corresponded with what went on in the steam engine, only owing to the use of separate vessels, the boiler, cylinder, and condensers, the connection was much confused. But it was clear that for every horse-power (2,000,000 foot-pounds per hour) 15,000,000 foot-pounds had to be passed from the furnace into the boiler, as out of the 15,000,000 no more than 2,000,000 could be used for work, the remaining 13,000,000 were available for forcing the heat into the boiler and out of the steam in the condenser, and they were usefully employed for this purpose. The boilers were made as small as sufficed to produce steam, and this size was determined by the difference of the internal temperatures of the gases in the furnaces, and the water in the boiler; and whatever diminished this difference would necessarily increase the size of the heating surface required, *i.e.*, the weight of the engine. The power which this difference of temperature represented could not be used in the steam engine, so it was usefully employed in diminishing the size of the engine. Most of this power, which in the steam engine was at least eight times the power used, was spent in getting the heat from the gases into the metal plates, for gas acted the part of conveyance far less readily than boiling water or condensing steam. If air had to be heated inside the boiler and cooled in the condenser with the same difference of temperature, there would be required thirty or forty times the heating surface—a conclusion which sufficiently explained why attempts to substitute hot air for steam had failed. In one respect the hot air engines had an advantage over the steam engine. During the operation in the cylinder the heat was wanted to be kept in the acting substance; this was easy with air, for it was such a bad conductor of heat that unless it was in a violent state of internal agitation it would lose heat but slowly, although at a temperature of 1000 deg. and the cylinder cold. Steam, on the other hand, condensed so readily that the temperature of the cylinder must be kept above that of the steam. It was this fact which limited the temperature at which steam could be used. Thus, while hot air failed on account of true economy, the practical limit of the economy of steam was fixed by that which a cylinder would bear. These facts were mentioned because at the present time there appeared to be the dawn of substituting combustion engines in place of steam engines. Combustion engines, in the shape of guns, were the oldest form of heat engine. In these, the time required for heating the expansive agent was zero, while they had the advantage of incondensible gas in the cylinder, so that if the cylinder was kept cool it cooled the gas but slightly, although this was some 3000 deg. in temperature. The disadvantage of these engines was that the hot gas was not sufficiently cooled by expansion, but a considerable amount of the heat carried away might be used again could it be extracted and put into the fresh charge; to do this, however, would introduce the difficulty of heating surface in an aggravated form. However, supposing the cannon to have been tamed and coal and oxygen from the air to be used instead of gunpowder. Thermodynamics showed that such engines should still have a wide margin of economy over steam engines, besides the advantage of working with a cold cylinder and at an unlimited speed. The present achievement of the gas engine, stated to be some 2,000,000 foot-pounds per ton of coke, looked very promising, and it was thus not unimportant to notice that whatever the art difficulties might be, thermodynamics showed no barrier to further economy in this direction, such as that which appeared not far ahead of what was already accomplished with steam engines. But however this might be, he protested against the view, which seemed somewhat largely held, that the steam engine was only a semi-barbarous machine, which wasted ten times as much heat as it used—very well for those who knew no science, but only waiting until those better educated had time to turn their attention to practical matters, and then to give place to something better. Thermo-dynamics showed the perfections, not the the faults of the steam engine, in which all the heat was used, and could only enhance the admiration in which the work of those must be held who gave us, not only the steam engine, but the embodiment of the science of heat.

STEAM LAUNCH BUILDING AT POPLAR.—Messrs. Yarrow and Co. have at the present moment in hand a large variety of small steamers. They are building three for Batavia, 60ft. in length by 12ft. beam; three are being constructed for the West Coast of South America, 50ft. long by 10ft. beam; one second-class torpedo boat; two shallow draught stern wheel steamers, one for the river Congo, for the Association Internationale Africaine, and one for a river in South America—these boats are both 81ft. in length by 17ft. 6in. beam, and will have a draught of 12in. They are also constructing one very shallow draught paddle boat to draw only 7in. of water; one launch to be propelled by electricity for a French firm; and also a side-wheel steamer, 145ft. long by 25ft. wide, for the Argentine Government; and one launch, 40ft. long by 7ft. beam, for Egypt.

DOCKYARD OFFICERS.

A MINUTE, which is dated the 19th inst., and is addressed to Rear-Admiral Thomas Brandreth, the Controller of the Navy, has just been issued by the Admiralty. It is to the following effect:—

"My Lords having received the report of the committee appointed to consider the entry, training, and promotion of the professional officers of the dockyards and in your department, and having carefully weighed the important recommendations of that committee, their Lordships have decided to adopt the various proposals made. I am to acquaint you that, under the provisions of an Order in Council, dated August 23rd, 1883, a corps of shipbuilding officers has been established, with the concurrence of the Lords Commissioners of her Majesty's Treasury, termed, 'the Royal Corps of Naval Constructors,' the number, designation, and salaries of the members of the corps to be as follows:—Admiralty.—Director of Naval Construction, £1500 to £1800 a year after five years; Surveyor of Dockyards and Chief Constructor, £600 to £850 a year, increments, duty pay £100 a year for acting as Director of Naval Construction, and London allowance, £150 a year. Two Chief Constructors, £600 to £850 per year each, rising by £25 per year; London allowance, £150 per year each. Three Constructors, £400 to £550 per year each, rising by £20 a year; London allowance, £120 per year each. Five Assistant Constructors, first-class, £300 to £450 a year each, rising by £15 a year; £50 duty pay to Assistant Constructor in charge of foreign records; the same to Assistant Constructor acting for Chief Constructor. One Assistant Constructor, first-class—for scientific experiments—£250 to £300 a year, rising by £15 per year. Six Assistant Constructors, second-class, £160 to £240 per year each, rising by £10 per year; London allowance, £50 a year each. Dockyards.—Three Chief Constructors, one each at Chatham, Portsmouth, and Devonport, £700 to £850 per year each, rising by £25 a year, and a house each. Three Chief Constructors at Sheerness, Pembroke, and Malta, £600 to £700 a year, each rising by £25 per year, and a house each. Eight Constructors, £400 to £550 a year each, rising by £20 a year, and a house each. One Constructor at Hongkong, £400 to £550, rising by £20 a year, and a house, or £150 in lieu, and colonial allowance of £100 a year. One Constructor at Bermuda, £400 to £550 a year, rising by £20 a year, a house, and colonial allowance of £100 a year. Ten Assistant-Constructors, first-class, £250 to £500 a year each, rising by £15 per year. Eighteen Assistant-Constructors, second-class, from £160 to £240 a year each, rising by £10 a year. Nine Assistant-Constructors, third-class, from £110 to £150 a year each, rising by £10 a year.

"The undermentioned officers have been appointed to form the corps, viz.:—Nathaniel Barnaby, C.B., Director of Naval Construction, London. Mr. Barnaby to receive the maximum allowance laid down for this appointment from the 7th of July, 1883. Frederick K. Barnes, Surveyor of Dockyards and Chief Constructor, London. Mr. Barnes to receive £100 per year for acting as Director of Naval Construction." Then follow the names of the various officers for the different yards. The minute concludes:—"A further communication will be made to you with reference to vacancies that remain unfilled in the various classes. The appointments referred to herein, with the exception of Mr. Rows, to Bermuda, will take effect from the 7th of July, 1883. Copies of the instructions of the Royal Corps of Naval Constructors are herewith enclosed for information. Attached to the drawing-office of your department will be a curator of drawings, salary £150 to £200 a year. This office will be held by Mr. Todd.—By command of their Lordships.—E. N. SWAINSON."

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

(*From our own Correspondent.*)

THE position of the iron trade in this district is improved upon the date of my last report. This comes about by reason of the less threatening aspect of the colliers. There is now a fair probability of the men continuing at work.

At the close of last week the men appeared very irate at the position which the masters had taken up in declaring that they did not recognise the agents' notices as legal, and in intimating that if a strike occurred they would enforce a drop of 4d. per stint in the thick coal seams and 2d. per stint in the thin seams; and the Old Hill men met and resolved to abide by their former decision and come out on strike.

This week, however, when they had had time to reflect, and when it had become known that the North Wales colliers had withdrawn their notices, some of the men's leaders began to think that perhaps it would be wiser to abandon the false position which they had taken up. At a meeting at Oldbury on Tuesday night some of these leaders advised the men to follow the example of North Wales, and it was resolved: "That this meeting, considering the action of the surrounding districts, recommends the District Council to withdraw the notice for an advance of wages."

On 'Change in Birmingham this—Thursday—afternoon, no less than in Wolverhampton yesterday, the belief amongst coalowners was that this decision will act as the watchword to the other localities and that there will not now be a fight.

The action of the men on the Dudley side of the district, however, is uncertain. In that part of South Staffordshire they are known to be very strongly in favour of an advance.

In preparation for eventualities numbers of the ironmasters in alike the raw and manufactured branches of trade have been getting in extra supplies of fuel and other minerals. Others, however, are content to know that supplies will be available from Cannock Chase even should a strike occur in the old portion of the Staffordshire field, and also from Shropshire and Derbyshire, and these ironmasters have not laid in stocks.

The demand for iron has not improved on the week. Merchants in London, Liverpool, and other large centres refuse to believe in the probability of a strike, and will not order in advance of requirements.

The closing of the Baltic ports, too, makes against the export business at date, particularly in sheets. There have been former years when in the present month a big business has been doing by this district in iron for the United States, but except under those special circumstances it is not unusual for the Staffordshire iron trade to, as now, quiet down in November and December.

Prices are not stronger on the week. Marked bars are £8 2s. 6d. to £7 10s. Very good bars, though not rolled by the branded houses, are abundant at £7 to £6 15s. Inferior sorts are £6 10s., and common sorts taper down to £6. Hoops remain at £6 10s. for ordinary export qualities, and £7 for superior sorts.

"Monmoor" hoops of from 16 to 19 w.g. were quoted this afternoon at £7 10s.; 20 w.g. of ⅞in., £8 5s.; and ¾in., £9. Hoops rolled by John Bagnall and Sons and other "list" houses were quoted £8 of from 14 to 18 w.g. "Monmoor" crown bars, ½in. to 3in., round and square, or to 6in. flat, were quoted £7 5s.; best ditto, £8 5s.; and double best ditto, £9 5s. "Monmoor" best rivet iron of the usual sizes are £9; and double best, £10. Angle bars, to eight united inches, from the same mills, were £7 15s. for ordinary sorts, £8 15s. for best, and £9 15s. for double best. T bars were £8 5s. for ordinary, £9 5s. for best, and £10 for best best.

Sheets, best thin, for working-up purposes, sold this afternoon on the basis of £11 for singles. For galvanising sheets prices were:—Singles, £7 15s.; doubles, £8 to £8 7s. 6d.; and trebles, £9 to £9 7s. 6d.

Tank makers did not report much business, and the boiler-plate makers were in no better case. The former asked £7 12s. 6d. to £8, and the latter £8 10s. to £9 for good qualities. Superior sorts were £9 10s.

Galvanisers were very chary of making their prices public. But it may be safely assumed that supplies are plentiful at £13 for 22 to 24 w.g. in bundles delivered Liverpool, and £13 5s. delivered London. Some consumers stated to-day that they were purchasing at under these rates.

Wire rod makers still complain of the competition of Westphalian makers, who are materially helped by the favourable freights which they obtain from the railway and steamship companies. Against some of the prices of the Westphalian makers it is impossible to compete. Shropshire-made wire rods were quoted to-day at £5 per ton upwards, varying according to sizes and quality.

To determine whether they will continue manufacturing under the present old gauge, or whether they will memorialise the Board of Trade to legalise a standard flat metal gauge for use by the iron trade, the hoop and sheet makers will hold a special meeting in Birmingham next Thursday.

Pigs are without alteration on the basis of 85s. to 82s. 6d. for native cold blast all-mines, and 65s. to 62s. 6d. for hot blast. Part-mine pigs are 55s. to 45s., and common sorts 40s.; best forge hematites are nominal at 60s. per ton delivered in this district.

Delegates constituting the Midland Counties Ironworkers' Association, the formation of which was effected at a conference held in Birmingham a month ago, met on Monday in the same town. The delegates present from South Staffordshire, North Staffordshire, East Worcestershire, and Shropshire represented over 6000 men. The proceedings were devoted to the consideration of a draft code of rules.

Machinists are fairly well employed on general machinery, steam pumps, and vertical engines, and heavy constructive ironwork contracts will find work in most of the yards for several months, the outputs being chiefly for bridges, piers, and girders for use in large business structures.

At the heavy ironfoundries some satisfactory orders are being executed, but there is less work being ordered at the light ironfoundries, the falling off being noticeable in the hollow-ware branch.

Makers of steel mills, agricultural implements, and some other hardwares hereabouts express much satisfaction at the improved prospects of trade with South America. During the past week or two certain of these manufacturers have been visited by South American buyers in person, who have left behind them orders, which indicate that probably better buying may take place at an earlier date than has been observable for several years past.

Manufacturers who are doing business with the colony of Victoria note with much pleasure that the proposal of the Chairman of the Victorian Tariff Commissioners to place a duty of 20s. per ton on fencing wire has been negatived by the Commissioners as a body met to consider the draft report; and that the duty on cast iron pipes, which it was proposed to fix at 40s. per ton, has now been reduced to 20s. It is not, however, so satisfactory that a proposal to exempt engineers' tools and turning lathes from duty was negatived by the Commissioners; and that the duty on axles and nuts has been altered from a fixed one of 25 per cent. to an *ad valorem* of 30 per cent.

The death is announced this week of Mr. William North, mining engineer, of Dudley, in his seventy-first year. The deceased gentleman was senior partner in the Rowley Hall Colliery Company, and had been connected as proprietor with collieries upon Cannock Chase. Mr. North was a popular man of long standing, and had been twice Mayor of Dudley.

At the Wednesbury Oak Colliery, near Tipton, belonging to Messrs. Phillip Williams and Co., an explosion occurred last Friday. It is stated that, contrary to custom and also to orders, the men took naked lights into the workings. Fire-damp suddenly appeared, an explosion followed, and three men were burnt. The explosion is attributed to recklessness.

Good progress is being made with the important work's extensions and improvements which are being carrried out at the Windsor-street Gasworks of the Birmingham Corporation. The construction of larger and more scientifically-planned works than came into the hands of the Corporation when the property was purchased from the gas company was begun about four years since, and will not be completed until three more years have elapsed. When finished they will represent an outlay of a-quarter of a million sterling, and of this sum more than half has already been expended. The extensions possess unusual interest on account of the large scale of their design. The new retort house, 487ft. in length by 210ft. in breadth, is in several respects superior to the ordinary run, and is the only retort house that has both rail and water communication. A railway siding has been put down branching into three single lines, which, supported on strong lattice girder viaducts, are carried 20ft. above the ground level into the retort house at the end where the canal enters. The purpose of bringing in the coal at such a height is to spare the immense labour of stacking expended under the old *régime*. When the house is completed there will be retorts with 1512 mouthpieces, a number which represents, at the ordinary rate of working, a production of 9,000,000 cubic feet of gas per diem. Only a third of the whole number of retorts is at present in position, and the house will not be brought into full use within three or four years. Two of the new machines which are employed at the works are the first of the kind built in this country, and are American inventions. Similar machines have, however, since been employed in one of the London gasworks. One of the machines is a special hopper, by means of which the retorts are charged. It holds 9 cwt. of coal, which is a sufficient quantity for three mouths, and it moves backwards and forwards in the avenue between the retorts and the coal trucks upon a line of rails having a gauge of 8ft. 10in. The mode of charging is to project the coal through a nozzle by means of strong jets of steam. The other American machine is used for clearing the retorts preparatory to their receiving a fresh charge. Moving in the same line of metals, and requiring the care of only one man, it will draw seventy or eighty retorts per hour. The construction is proceeding of two gasholders, which, it is claimed, are at present the largest in the world. A conception of the giant proportions of these reservoirs is obtained when it is stated that New-street Station could be passed through them. They stand close together, and each is 240ft. in diameter, will have a capacity of 6,250,000 cubic feet, and when filled with gas will stand 170ft. high. The big tanks, which have already been formed, are 51ft. deep. The standards upon which the holders are supported are of wrought iron. The engines, which supply the whole of the power required at present upon the works, with the exception of the hydraulic power, are three very small ones of admirable design. The Patent Shaft and Axletree Company has supplied the ironwork for the retort houses. The contractors for the gasholders are Messrs. Cutler and Sons, of London, and for the tanks have been Messrs. Aird and Sons, also of London. The Horsley Company was entrusted with the extension of the purifying shed, and the purifiers are of the pattern furnished by Messrs. A. and W. Horton.

The Birmingham Corporation have of late been considering the advisability of removing the present site of their cattle market to Rupert-street, Neckells, but the scheme was objected to on the ground that it would give the London and North-Western Railway Company a practical monopoly. Now, however, the mayor has made known that a meeting of the three great companies serving the town will shortly be held to try and arrange a scheme whereby all of them shall be able to convey cattle to the market. The key to the problem lies with the North-Western, and when the desired concession has been made by that company, there is but little reason to doubt that the Midland will meet the Great Western in such a spirit as will lead to a speedy settlement.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—The present trade outlook in this district is of anything but an encouraging character. Two of the leading branches of industry are apparently on the threshhold of a serious struggle with regard to wages; on the one hand the operatives in the cotton trade are showing a very determined front in opposition to a reduction; on the other the colliers have entered upon the preliminary steps for enforcing an advance. On the other side the employers are equally determined; the cotton manufacturers contend that a reduction of wages is, in the present condition of the cotton trade, absolutely imperative, and evidently they are resolved to enforce it; the coalowners contend on the strongest possible grounds that the present state of the coal trade does not justify any advance in wages, and they are thoroughly resolved not to concede the demands of the men. So far as the coal trade is concerned the struggle is not confined to Lancashire, but extends over a wide area embracing the chief coalfields of the country, and is therefore a serious question affecting the iron trade generally. An uneasy feeling as a result prevails in the market, and with trade itself in no very buoyant condition, with ironworks and nearly all the allied branches of industry only kept going, under the most favourable conditions, with the lowest possible margin of profit, it is impossible to estimate what may be the consequences of the present ill-advised action of the men should they persist in bringing about a general stoppage of the pits in the various large coal producing districts. Trade is already struggling under difficulties, and so far from any indication of improvement, the reports I have recently received point to a falling off in the demand for labour in some of the engineering branches of industry, which will only be intensified if works have to be carried on under the additional difficulty of an increased cost of fuel, or have to suspend operations through a temporary stoppage of supplies. There are many considerations which should cause the men to pause in so reckless an enterprise as that on which they would appear to be embarking, and it is to be hoped that wiser counsels may prevail, which will prevent a serious blow being inflicted upon trade at a moment when every assistance is required to enable it to barely maintain its own.

There was only a quiet iron market at Manchester on Tuesday. At very low figures there are inquiries, but unless it is where nervous buyers are influenced by an uneasy feeling with regard to the future as the result of the present unsettled state of the labour question, there is no great anxiety to buy. Lancashire makers of pig iron are still without orders at their quoted rates of 45s. to 45s. 6d. less 2½ for forge and foundry qualities delivered equal to Manchester; in fact, buyers do not come within 1s. to 1s. 6d. per ton of these figures. Local makers are, however, kept going with old contracts, and show no disposition to give way. In district brands a fairly large quantity of Lincolnshire iron has been sold during the week on the basis of 44s. 4d. less 2½ delivered equal to Manchester, and at this price fairly good offers are reported in the market, but the leading makers are holding for 44s. 10d. to 45s. 10d. less 2½ for forge and foundry qualities delivered here. In Middlesbrough iron only odd lots are being sold, and prices, which do not yet bring it within reach as a really competing brand in this market are without material change from last week.

In hematite there is but little doing, and where business is offered it is at very low figures.

Orders for finished iron are in some cases reported to have been coming forward rather more freely during the past week, but the weight of business doing generally is not large, and if anything prices show a want of steadiness. For bars, £6 2s. 6d. is getting nearer the average price than £6 5s.; in hoops there is a good deal of underselling, £6 7s. 6d. being a price which is being taken freely, whilst £6 10s. is about the maximum on which actual business is done, and sheets do not average more than £7 15s. to £7 17s. 6d. per ton delivered into the Manchester district.

At the meeting of the Manchester Association of Employers Foremen, and Draughtsmen on Saturday the president, Mr. Thos Ashbury, C.E., called attention to the serious loss the scientific world had sustained in the death of Sir Wm. Siemens; personally he felt an intense grief at the loss of so public a man who had rendered such enduring service to the country. Other members having spoken of the willingness with which the late Sir Wm. Siemens had always imparted to others the knowledge derived from his own experience, a resolution was unanimously passed to the effect that the association expressed its deep regret at the death of Sir Wm. Siemens, and begged to convey to Lady Siemens its sincere condolence in the great loss she had sustained.

Subsequently an interesting paper on the recovery of bye-products in the manufacture of coke was read by Mr. Joseph Nasmith, of Sunderland. After describing the efforts that had been made in this direction, and referring to the Simon Carvé and the Jameson processes as practically the only competing methods of coke making in which a recovery of the bye-products were secured, Mr. Nasmith dealt with the value and purposes to which these bye-products could be applied. One of the most valuable of the products was of course sulphate of ammonia, but it will be interesting to notice the purposes to which Mr. Nasmith pointed out the tar oils could be applied. One of these was for the manufacture of lubricating oils, and another for the manufacture of hydrocarbon oils for lighting purposes, whilst a further application of these oils which deserved special notice was their adaptability for fuel and for use in gas engines. In their use as fuel an instance had been communicated to him of steam being raised in a 5-horse power tubular boiler from cold water up to 70 lb. pressure in ten minutes, and in the application of the oil gases to gas engines a wide field was open. With regard to the large body of combustible gases produced in coking, he urged that it was more than probable that this gas could be used in places where heat was required, and that it would pay the proprietors of iron and steel works to coke their coal, recover the bye-products, and utilise the gas produced for their various furnaces. As a step in this direction he might mention that negotiations were in progress with a large firm of ironmakers who intended to put down coke ovens to make their coke, which they would use for foundry purposes, recover the bye-products, and use the vast body of gas produced in their puddling and other furnaces.

Any one passing through a colliery district cannot have failed to notice the enormous heaps of waste which have been put down round many of the pit banks, and which are not only unsightly in themselves, but frequently become a source of danger and a nuisance to the surrounding district. Although not directly connected with the utilisation of the bye-products of coke, Mr. Nasmith in his paper referred, as a further application of the principle of the utilisation of waste, to two attempts which had been made to deal with these heaps profitably. The first experiment was made at Seaton Burn, where a heap in the immediate neighbourhood of the village was causing great discomfort to the people. By covering it with sand and withdrawing the gas by a blower, through perforated pipes sunk to a depth of 6ft. in the heap, the nuisance was entirely stopped; and a considerable recovery of ammoniacal liquor, with a small quantity of oil, was obtained. At Kelvinside, near Glasgow, a heap treated in a similar way yielded ammoniacal liquor to the extent of several hundred gallons per day, the liquor containing 5 oz. of sulphate of ammonia per gallon. As a permanent method of treating these heaps it was proposed, by a patent of Mr. L. H. Annom's, to build them over culverts laid in the ground, and when the heap was complete and fired the gas could be withdrawn through the permanent pipes.

In the coal trade there has been quite a push of orders during the past week owing to the anxiety on the part of buyers to accumulate stocks in anticipation of a strike, and many colliery proprietors have more orders on hand than they can at present execute. This applies to all classes of fuel, and slack, which a short time ago was a drug, is now moving off freely at advanced prices. This pressure on the market is naturally giving an upward movement to prices, and with the close of the month the coalowners in the Manchester district are advancing their list rates for all descriptions of round coal 10d. per ton, whilst there is also a stiffening-up in engine fuel. In other districts there is not as yet any announced advance, but it is pretty certain the upward movement will be general. At the pit mouth prices are firm at 10s. for best coals, 8s. for seconds, 6s. to 7s. for common coals, 5s. for burgy, 4s. to 4s. 6d. for good slack, and about 3s. 6d. for medium qualities.

Shipping has been only quiet, with Lancashire steam coal delivered at the high-level, Liverpool, or the Garston Docks averaging 7s. 6d. to 8s. per ton.

In the West Lancashire districts notices for an advance of 15 per cent. in wages have been pretty generally served upon the colliery proprietors. These expire on December 7th, two days after the Yorkshire notices; but in many quarters it is still doubted whether the men will really come out on strike. The action they may take will in all probability be regulated by the course events take in Yorkshire. In the Manchester district the men have not yet taken any actually definite action, but they will no doubt come to some decision in the course of the next few days.

Barrow.—As I have stated for some weeks past, makers of hematite pig iron would be under the necessity of restricting the output of metal if the low state of market continued. I hear that this week this statement has been verified, and that both the Millom and North Lonsdale companies has each blown out a furnace, and the Askam Company has damped down a furnace. I expect that the example of these firms will soon be followed by others in the district. The weight of metal stored by makers is not heavy, as it has been for some time past; but now that the output has been restricted, the production of metal will be more equal to the deliveries, and the stocks thus further reduced. Orders are far from plentiful either on home or American account. Ordinary parcels of Bessemer have sold at 47s. 6d. per ton this week, while white qualities have realised 47s. per ton net at works prompt delivery. Steel makers are not so well employed as they have been, and few orders of any extent have been received. Rails are quoted at from £4 10s. to £4 15s. per ton net. Shipbuilders are still in a quiet position; but I hear that at Barrow two new orders have been booked during the past week. Boiler makers, engineers, and iron-founders have all a dearth of orders. Iron ore is in fair demand at from 9s. to 10s. 6d. per ton net at mines. Stocks have not decreased. Coal and coke firmer, and a tendency to higher prices.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE last hope the miners may have had that the coalowners would give way, or make any concession in regard to wages, must now be abandoned. At a very largely-attended meeting of the colliery proprietors of South and West Yorkshire and North Derbyshire, held on Monday at Sheffield, the feeling was as determined as ever not to concede any advance. Indeed, several of the coalowners would have gone further than refuse any increase in wages; they were prepared to demand a return of the 10 per cent. conceded in November last, and the least one or two of them thought of was the withdrawal of 5 out of the 10 per cent. The North Derbyshire coalowners were firm in concentrating their energies on the bare question of declining the present demand, and as the great object aimed at was to be perfectly unanimous, the resolution was framed accordingly. As it is in the nature of an ultimatum, its exact words may be given :—"That this meeting has heard with regret that the majority of the colliers have given in their notices, but sees no reason to withdraw from the previously expressed decision of the coalowners that no advance whatever in the rate of wages is warranted either by the state of the coal trade, or of the iron trade, or any of the other great industries of the country; and that should the colliers be so misguided as to act upon their notices, each coalowner here present pledges himself not to concede any advance." A discussion took place as to how this decision should be communicated to the men, several of the owners preferring that it should be done in the form of a pit-head notice, and others that it should be left to each colliery proprietor to take such a course as he thought desirable. Ultimately it was left to the discretion of each colliery proprietor to communicate the resolution to his workmen in the manner he thought best. It was suggested that an assurance association should be established to reimburse owners who might be sufferers by a partial strike, but, on full consideration, it was decided to leave this point in the hands of the chairman and secretary—Mr. J. D. Ellis and Mr. C. E. Rhodes, of Aldwarke Main and Car House Collieries, to confer with a number of the leading owners of the district, and report to a future meeting. On the same day conferences of miners were held at Barnsley and Chesterfield. At the Barnsley meeting it was stated that there are now 39,000 men under notice. At Chesterfield it was reported that 8667 notices had been already delivered in the district, and it was added that at the end of the week the number would be largely increased. The employers will not be in so bad a position as the colliers. Large firms have had considerable notice of the difficulty, and thus forewarned, have forearmed against it. Manufacturers as well as the gas companies have laid in heavy stocks, and by judiciously limiting their production to the most profitable departments—as will undoubtedly be done—the time of enforced idleness in the coalfield will be tided over without so much loss as has been experienced in previous strikes. That loss, however, will be serious under any circumstances, for the expense of keeping a colliery in good working order when coal is not being drawn is inevitably heavy. All the leading owners have now intimated to those with whom they have contracts that they intend to take advantage of the strike clause, which enables them to escape penalties for non-delivery of coal. The practical effect is only to postpone deliveries. If coal were to rise in price the coalowners would still be liable to deliver at the low rates contracted for. Very few household consumers can have failed to provide themselves against the strike. For nearly a month the demand for house coal has been something extraordinary. Since the notices were handed in, there has been something like a panic, and it is not too much to say that the public generally are provided for any contingency short of six weeks. By that time the strike will be at an end, for the Union officials have no funds with which to supply strike money for a single week; the colliers are generally anything but frugal, and there never was a time when the townspeople had less sympathy. By the beginning of 1884, the colliers, who have been really misguided into taking a false step, will be ready enough to resume work at present wages, but it would not surprise me to find several of the coalowners only consenting to re-open their pits on condition that the miners conceded part of the 10 per cent. granted a year ago.

It is interesting at this moment to note the price of coal, though care should be taken not to assume present figures as the fair value. The public alarm has temporarily caused quotations to leap up. The Thorncliffe Collieries are now quoting at their Sheffield depôt as follows:—Best Silkstone, 14s. 6d.; thin seam, 12s. 11d.; Silkstone nuts, 10s. 5d.; Silkstone brights, 10s. 10d.; common house, 10s. 5d.; engine, 7s. 1d. per ton.

Messrs. Vickers, Sons, and Co., of the River Don Works, Brightside, steel manufacturers, &c., have been the first in this district of the large companies who are not coalowners to take action in regard to the strike. There are about 1300 men employed at these works, and the company have issued a fortnight's notice in consequence of the strike. The notice states:—"We regret to have to announce that, in case we are unable to obtain coal during the strike of colliers, our works will of necessity be closed. We are therefore obliged to give you notice that in such case your services will not be required till the coal supply is resumed. Notwithstanding this notice, we shall endeavour to find employment for as many workmen as possible by using the coal we have been able to stock and what we may be able to obtain from other districts. We hope, at any rate, to keep the large forge and machine shop at work."

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE was but a poor attendance at the Cleveland iron market held at Middlesbrough on Tuesday last, and only very small quantities of pig iron were sold. It was satisfactory to note, however, that prices were about the same as a week before. Merchants offered No. 3 g.m.b. at 37s. per ton for both prompt and forward delivery. Makers' quotations ranged from 37s. 3d. to 37s. 6d. per ton, and offered only small quantities at these rates. Consumers, as a rule, are still keeping back their orders in the hope that lower prices will be accepted shortly. The general quotation for No. 4 forge was 35s. 9d. per ton, but the demand was by no means active.

The nominal value of warrants is now 37s., but they are seldom inquired for.

The stock of pig iron in Messrs. Connal's store at Middlesbrough was on Monday exactly the same as a week previous, namely, 63,895 tons. At Glasgow their stock is steadily decreasing, the quantity held on Monday being 585,487 tons.

Shipments have fallen off somewhat during the last few days, but are still about 6000 tons in advance of October. The total quantity shipped up to Monday night was 87,078 tons. In the corresponding period of November, 1882, 56,021 tons were shipped.

There are few fresh inquiries for finished iron, but the pressure for prompt delivery against old contracts is very great, and all the works are fully employed. Prices are maintained at about the same rates as quoted last week. Ship plates are £6 per ton; angles, £5 12s. 6d.; and common bars, £5 15s. free on trucks at makers' works less $2\frac{1}{2}$ per cent.

The Dinsdale Wire and Steel Company has commenced operations—day shift only—at the new works at Fighting Cocks, near Darlington. For the present forty men are employed, and the output of steel wire will probably reach 200 tons per week.

The Newcastle Chemical Company has decided not to proceed further with the boring operations at their No. 1 bore-hole at Port Clarence. A depth of 1200ft. has been attained without finding salt. The last case brought up is from a hard grey rock, composed mostly of gypsum and magnesian limestone. All hope of finding salt at this particular spot has been abandoned. The company intends, however, to push on with another bore-hole in a locality which their geologist considers more promising.

The Cleveland miners have decided by a large majority not to agree to the suggestion made by the mineowners, that a small sum should be deducted from the earnings of each workman to defray expenses in connection with the working of the sliding scale.

The Cleveland blast furnacemen at lodge meetings held during the last few days have unanimously decided to ask that the following amendments be made to the sliding scale now in operation :—(1) An increase of 5 per cent. in the standard rate of wages now paid to all men working at blast furnaces; (2) that a shift and a-half be paid for Saturday and for Saturday night; (3) that the furnaces be allowed to be off blast for twelve hours each Sunday as the best means of restricting the output.

The accountant to the North of England Board of Conciliation and Arbitration made his bi-monthly report for September and October on the 21st inst. It appears that the average net selling price of manufactured iron during that period was £6 0s. 7d. per ton, being a reduction of 1s. $9\frac{1}{2}$d. when compared with the previous similar period. Under the sliding scale arrangement entered into in March last the present rate of wages will remain unaltered until the 29th of December. The return shows an increase of 8472 tons in deliveries, most of which is in plates and bars.

At a meeting of the employers, held on the 22nd inst., the following resolution was passed :—"That in view of the termination—by notice received from the operative secretary to the Board of Conciliation—of the existing sliding scale on the 29th December next ensuing, notice be at once given to the said operative secretary for a reduction of 6d. per ton on puddling and 5 per cent. on all other forge and mill wages; to come into operation on and after that date and until further notice."

Touching the sale of the Middlesbrough owners' railways to the North-Eastern Railway Company, Sir J. W. Pease has written a letter to one of the ironmasters interested, saying he consented to sell on certain conditions only. Among these were the following, viz.:—(1) That no existing way leases should be augmented or other privileges abrogated. (2) That no existing firm without rights of way should be charged more than those firms which have right of way. (3) That any firm who may hereafter establish works bordering on leases shall have the same rights and privileges as the aforesaid. It is needless to say that this letter has given the greatest satisfaction to all the parties interested.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow warrant market has been dull this week, in consequence chiefly of the depression that is foreshadowed in the Clyde shipbuilding trade, by the paying off of workmen and the suspension of payments by Messrs. Dobie and Co. There can be no doubt that a chief source of activity in the iron trade is always the shipbuilding and marine engineering departments, and the present lack of orders will certainly react most injuriously upon iron merchants and manufacturers. In warrants there was a moderate business in the course of the week, but the prices had a tendency to decline. The shipments of Scotch pig iron are much smaller than usual, but this has resulted in some degree from the stormy weather, and may possibly be made up in succeeding weeks. Notwithstanding the small exports, the stock of pigs in Messrs. Connal and Co.'s Glasgow warrant stores shows a diminution on the week of about 1250 tons. There are 101 furnaces in operation against 114 at the same date in 1882.

Business was done in the warrant market on Friday at 44s. 7d. cash. On Monday forenoon the market was flat, with transactions at 44s. 5d. to 44s. 2d. cash, the quotations in the afternoon being 44s. 2d. to 44s. $3\frac{1}{2}$d. cash, and 44s. 4d. to 44s. 5d. one month. On Tuesday morning business took place at 44s. 3d. to 44s. $1\frac{1}{2}$d. cash, and 44s. $4\frac{1}{2}$d. to 44s. $3\frac{1}{2}$d. one month, the prices in the afternoon being 44s. 2d. to 44s. $2\frac{1}{2}$d. cash. Business was done on Wednesday at 44s. 6d. to 44s. 2d. cash, and 44s. 7d. to 44s. 4d. one month. To-day—Thursday—market was quiet at 44s. 1d. to 44s. 2d. cash. Mr. Morton, iron merchant, Glasgow and Greenock, has intimated that he has been obliged to stop payments, owing to large debts due to him by Dobie and Co., shipbuilders, Glasgow, whose suspension occurred on Monday.

Owing to the backward condition of the warrant market, there is no improvement in the quotations of makers' iron, which are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 53s.; No. 3, 50s.; Coltness, 55s. 6d. and 51s. 3d.; Langloan, 55s. 6d. and 51s.; Summerlee, 54s. 6d. and 49s. 6d.; Chapelhall, 53s. 6d. and 50s. 6d.; Calder, 55s. 6d. and 48s.; Carnbroe, 53s. 6d. and 48s.; Clyde, 48s. and 46s.; Monkland, 45s. 9d. and 43s. 6d.; Quarter, 45s. 3d. and 43s. 3d.; Govan, at Broomielaw, 45s. 9d. and 43s. 6d.; Shotts, at Leith, 55s. 6d. and 52s. 6d.; Carron, at Grangemouth, 49s. (specially selected, 56s. 6d.) and 47s. 3d.; Kinneil, at Bo'ness, 47s. 6d. and 46s. 6d.; Glengarnock, at Ardrossan, 53s. 3d. and 46s. 3d.; Eglinton, 46s. 6d. and 43s. 9d.; Dalmellington, 48s. 6d. and 47s.

The imports of iron ore from Spain are being just now conducted upon a fairly active scale, the arrivals at Glasgow in the past week amounting to 8930 tons.

In certain kinds of manufactured iron and machinery a large business is being done. The shipments of these articles from Glasgow in the course of the week embraced £23,400 worth of machinery, £11,194 steel manufactures, £9531 sewing machines, and £42,400 miscellaneous iron goods, exclusive of pig iron, the exports of which were valued at £8808. At the malleable works the prospect has not improved since I intimated that some of the larger contracts were running out, there being no others to take their places.

There is still a fair measure of activity in the coal trade. Steam coals in the Glasgow and Lanarkshire district are especially in request, and the prices have now been increased in proportion to the values of other sorts which were raised some time ago. At Glasgow the foreign shipments of coals aggregated 15,000 tons. There are numerous inquiries for shipping coal, and owing to the stormy weather the household demand is well kept up. On the southern side of the Frith of Forth the ports are fairly active, the shipments from most of these being a fair average. In Fifeshire there appears to be less doing, and the masters have reduced the prices of coals, in order that they might compete on more favourable terms with the North of England.

A conference of miners' delegates was held in Glasgow on Monday. Mr. Weir, of Fife and Clackmannan, presiding, when it was reported that the advance of 6d. a day was now general in Lanark, Stirling, and Linlithgowshire. It was resolved to continue the agitation in those districts where the increased wages have not yet been paid, and also to secure a restriction of the working time to eight hours per day.

The Clyde shipbuilders have intimated that ironworkers' wages will be reduced by ten per cent. from the 1st December, and that the wages of all other operatives in their employment will be lowered after the Christmas holidays. For a considerable time back the wages paid, especially to ironworkers, have been excessively heavy. It has been no unusual thing for a rivetter to earn £1 a day. So long as the yards were pressed for delivery of work, they were obliged to have labour at whatever price it was available; but now that slack times are approaching, it is regarded as essential that the workmen should accept reduced pay. Upwards of 1000 men were discharged on Monday from the yard of Messrs. Dobie and Co., of Govan, who have intimated suspension of payment, and since the middle of summer 4000 operatives—exclusive of the 1000 above alluded to—have had to leave their employment in the different yards on the Clyde.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE great coal tide is still flowing vigorously, but last week the stormy weather interfered somewhat with it, and the result has been a material reduction in the totals exported from the various ports. This is, of course, only incidental, and will be speedily rectified. Looking generally at the coal trade, the impression conveyed is that the demand for all varieties is on the increase. Small coal and anthracite have lagged somewhat as regards malting varieties, but the anthracite is in fuller demand, and better prices are obtained for both. The chief coals in most active inquiry are the Rhondda and the colliery screened of the principal pits; but even seconds are inquired after, and large quantities of the 6ft. and 9ft. seams are being cleared away.

I am glad to see, in the present immense output, that extra vigilance is used in detecting offences against the Mines Act. Several colliers have been fined during the week for having pipes in their possession past the lamp station, and one man who was fined 20s. happened to be one of the injured during the late explosion at Gelly Colliery. After the explosion his jacket was found with pipe and tobacco in it.

Steady improvement is setting in at Harris Deep Navigation Colliery, and one day last week the output exceeded 800 tons. This is a stride in the right direction. When it reaches 1000 tons some nearer approach will be made to the margin of profit.

All the ports are full of business, Swansea has been particularly so. During the last week nearly 100 steamers and sailers came into port. The impression there is that a good deal of coal trade is drifting hitherward on account of the unsatisfactory relation between coalowners and colliers in the North. Newport has been very busy, and prices are well maintained.

Unfortunately the briskness has not extended to the iron trade. The only busy feature is in the demolition of old ironworks and sale of materials. Plymouth is being rapidly cleared, and as the iron is of the old cold blast kind, for which Anthony Hill acquired so high a reputation, there is no difficulty in getting purchasers. Staffordshire, I hear, is a large buyer.

Rails, even best steel, are low in quotation. Singularly enough the busiest ironworks in the district at present is Cyfarthfa. The picture at midnight one night this week was worthy of the old times, when Robert Crawshay would bring down his little tin and take his turn at puddling. The steel works machinery is coming rapidly to hand, and is evidently carefully selected.

The Dowlais hauliers still remain stubborn, and hamper movements there, though reasonable overtures have been made to them.

The tin-plate trade is brisk, and most of the works are full of orders, accepted at the last improvement in prices. New trade does not promise quite so well, and some fears are entertained of of another drop. A new company, the Clayton, is on the eve of starting at Swansea. A new ship industry is also spoken of at Cardiff, promoted, I hear, by one of the Tyne firms.

A decision has been arrived at in the Forest of Dean to carry out a sliding scale until March next to see how it works. The arrangement is $2\frac{1}{2}$ per cent. advance on every 6d. advance, that of the South Wales district being $2\frac{1}{2}$ on every 4d. advance. This week is expected to decide the transfer of the Glamorgan Canal and of the Aberdare branch to the Marquis of Bute. The offer made is a generous one of 6 per cent. in perpetuity, though it is notorious that one-half the extent of the canal is literally unworked, and the dividend has been but 4 per cent. for a long time. In the event of a line on the east of the Taff a reduction upon this small dividend would have to be feared.

Pitwood is in free demand at 22s. Fatal accidents are reported from Blaen Rhondda Colliery, and two injuries from the Llan, Pentyrch. The wire trade is dull and unprofitable, and iron ore is in the same position.

SANITARY INSTITUTE OF GREAT BRITAIN.—An important meeting was held in Dublin on the 19th inst., to appoint the local officers, and to consider the various arrangements to be made for the Congress and Exhibition to be held in that town by the Sanitary Institute in 1884. Sir John Lentaigne presided, and there was a large attendance of gentlemen representing the various leading societies in Dublin. A deputation from the Institute, consisting of Dr. Alfred Carpenter, chairman of the Council; Professor W. H. Corfield, chairman of the Exhibition Committee; Mr. Ernest Turner; and Mr. E. White Wallis, secretary, attended the meeting to explain the objects of the Institute, and the nature of the Congress and Exhibition held in connection with it. The deputation from the Institute visited the buildings for the meetings of the Congress and Exhibition, and from the way that the preliminary arrangements have been made by the local committee, there is every prospect of a very successful Congress and Exhibition. Sir Robert Rawlinson, C.B., has accepted the presidentship of the Congress, which will open on October 14th.

DIARIES FOR 1884.—The approach of the end of the year brings, as usual, a parcel of Letts' well-known diaries, the publication of which presupposes the coming of a new year to be crammed with events, facts, and figures which need to be recorded, or which people will, as heretofore, consider of sufficient importance to claim record. Whether important or not, people like to have books conveniently arranged for diary purposes, and in this Messrs. Letts, Son, and Co. are pre-eminent. They have nearly 380 different forms of diary, and 200 in the pocket-book form. The printed information in these different forms and sorts pertains to the requirements of every walk in life, from the driest of the driest forms of male business, to the simplest, though perhaps not the least consequential, cut-and-dry pabulum for the women. We have amongst others the No. 45 diary, which is of a handy small octavo size, giving a page to a day, the No. 47, of the same size, giving a page to four days, and interleaved with blotting paper; the No. 43—small quarto—giving a day to a page. All these are provided with as much printed information as anyone would look for in a diary; they are printed on good paper, and are not expensive. We have also a copy of the "Commercial Tablet Diary," the "Pocket Diary and Office Calendar," from Messrs. Letts. The "Masonic Diary and Pocket Book for 1884," just issued from the office of the *Freemason* in Great Queen-street, contains a mass of information useful to all members of the craft, together with full particulars of every Grand Masonic body throughout the world.

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.

20th November, 1883.

5453. Insulating Electrical Wires, H. J. Allison.—(*C. C. Gilman, Eldora, U.S.*)
5454. Railway Rail Joints, T. H. Gibbon, U.S.
5455. Harrows, S. Pitt.—(*F. Nishwitz, U.S.*)
5456. Washing Machines, J. Bryson, Bolton.
5457. Treatment of Grain, J. G. Walker, Leith.
5458. Boots and Shoes, St. J. V. Day.—(*J. Popham, Montreal.*)
5459. Breech-loading Guns, H. J. Hadden.—(*J. P. Burkhard and F. Novotuy, Minnesota.*)
5460. Hammers for Pianofortes, H. J. Haddan.—(*M. Junger, Leipzig.*)
5461. Unfermented Drinks, E. Perrins, Birmingham.
5462. Railway Signalling, H. Morris, Manchester.
5463. Heating Beer, &c., E. Birch and P. J. Catterall, Manchester.
5464. Producing Coloured Photographs, A. Kepler, A. M. de Premion, and A. Pigeau, London.
5465. Meter for Electric Currents, A. M. Clark.—(*L. Hours-Humbert, France.*)
5466. Indicating and Registering Apparatus, J. H. Johnson.—(*Ateliers de Construction de Mulhouse, Paris.*)
5467. Plastic Compounds, M. Mackay, London.
5468. Rivetted Joints, J. A. Rowe, North Shields.
5469. Secondary Batteries, F. M. Lyte, Putney.
5470. Dynamo-electric Machines, H. H. Lake.—(*T. J. McTighe and J. T. McConnell, Pittsburgh.*)
5471. Telegraph Lines, H. H. Lake.—(*J. C. Chambers, Cincinnati, and N. C. Gridley, Chicago.*)
5472. Electric Lamps, H. H. Lake.—(*T. J. McTighe and J. T. McConnell, Pittsburgh.*)

21st November, 1883.

5473. Producing Oxide of Iron, A. P. Price, London.
5474. Tricycles, &c., G. Illston, Birmingham.
5475. Valves, &c., for Steam Hammers, J. Cochrane, Barrhead.
5476. Synchronising Clocks, H. J. Allison.—(*R. W. Wilson, New Haven, U.S.*)
5477. Tentering Machines, &c., J. Chadwick, Littleborough.
5478. Cleaning, &c., Boots, T. O. Jones, London.
5479. Preventing the Tearing of Button-holes, H. H. Lake.—(*E. Hambujer and J. Koch, Detroit.*)
5480. Substitute for Milk, C. Simpson, London.

22nd November, 1883.

5481. Hand Fire Engines, S. Bauer, Bonn-on-the-Rhine.
5482. Electrodes, R. Barker, jun., Forest Hill.
5483. Obtaining Thiocyanates, H. J. Haddan.—(*S. Marasse, Berlin.*)
5484. Tricycles, J. G. Parker, London.
5485. Elastic Pad for Damp Stamps, J. E. Walsh.—(*A. Callawaert, Brussels.*)
5486. Velocipedes, T. Lawson, Rochester.
5487. Rotary Engines, A. A. W. van Reede, Holland.
5488. Furnaces for Heating Ingots, E. W. Richards, Middlesbrough-on-Tees.
5489. Treating Alkaline Salts, C. A. Faure, Paris.
5490. Velocipedes, N. Salamon, London, and A. G. Meeze, Redhill.
5491. Cutting, &c., Memorandum Forms, B. C. Scott, London.
5492. Affixing Postage Stamps, J. C. Wallace, London.

23rd November, 1883.

5493. Chimney Cowls, &c., F. Leslie, London.
5494. Sugar-cane Mills, F. M. Rogers.—(*A. Leblanc, Cienfuegos.*)
5495. Looms for Weaving, T. Blamires, Huddersfield.
5496. Purification of Water, W. Anderson, London.
5497. Preserving Milk, &c., R. Hornby, London.
5498. Bicycles, E. K. Dutton.—(*J. Lewis, Chicago.*)
5499. Gloves, L. Rogers, Putney.
5500. Production of Mineral Phosphates, &c., C. D. Abel.—(*J. Brandt, Berlin.*)
5501. Book-sewing Machines, R. Frank, Hamburg.
5502. Blast Furnaces, G. G. M. Hardingham.—(*L. D. York, Portsmouth, U.S.*)
5503. Telegraphic Apparatus, H. H. Lake.—(*F. van Rysselberghe, Schaarbeck.*)

24th November, 1883.

5504. Automatically Breaking Electrical Currents, F. G. Howard, Oaklands.
5505. Obtaining Volatile Hydrocarbons from Coal Gas, &c., E. Drew, London.
5506. Non-alcoholic Beverages, A. Weigel, Brighton.
5507. Mechanically Cooling Air, &c., J. J. Coleman, Glasgow.
5508. Checking the Receipt of Money from Persons riding in Public Vehicles, B. C. Scott, London.
5509. Miners' Lamps, E. Evans, Llanruest.
5510. Automatic Detaching and Safety Attaching Gear for Ships' Boats, J. Dixon, M. Waddle, and R. Dawson, Blyth, and E. Marshall, North Shields.
5511. Cigar Holders, &c., E. Edwards.—(*F. Bailac, Toulouse.*)
5512. Ship Railways, &c., J. B. Eads, London.
5513. Flues, &c., R. Evans, London.
5514. Looms for Weaving, A. P. Dickinson and J. Conlong, Blackburn.
5515. Colouring Matters, W. R. Lake.—(*L. Vignon et Cie, Lyons.*)

26th November, 1883.

5516. Manufacturing Gimp, F. C. Glaser.—(*C. L. Hohl, Dresden.*)
5517. Control Apparatus for Public Vehicles, G. Prölss, Dresden.
5518. Sculls and Oars, J. O. Spong, London.
5519. Preserving and Hardening Wood, A. Egestorff, Kingston-upon-Hull.
5520. Gas Burners, F. Siemens, Dresden.
5521. Sewing Machines, J. E. Péchard, Paris.
5522. Grinding the Treads on Railway Wheels, E. P. Alexander.—(*A. W. McIntyre, Chicago.*)
5523. Volocipedes, W. Hillman, Coventry.
5524. Secondary Batteries, G. F. Prescott, Dublin.
5525. Substitute for Bisulphide of Carbon, P. G. W. Typke and W. R. King, London, and T. T. P. B. Warren, Forest Gate.
5526. Fastenings for Doors, H. Hancock, London.
5527. Ventilators and Chimney Cowls, &c., J. H. Reynolds.—(*A. J. Robinson, Boston, U.S.*)
5528. Propelling Ships, B. Dickinson, Bourne End.
5529. Electrical Railways, J. Enright, London.
5530. Furnaces, &c., W. Farnworth, Swindon, and W. Felton, Wilden.
5531. Hydraulic Hoists, B. Walker, Leeds.

Inventions Protected for Six Months on Deposit of Complete Specifications.

5423. Dredging Machinery, W. E. Gedge, London.—A communication from H. B. Angell, San Francisco.—*17th November*, 1883.
5431. Steam Engines, W. P. Thompson, Liverpool.—A communication from F. D. Cumnver, Detroit.—*17th November*, 1883.
5432. Fire Screens, A. Hildesheimer, London.—A communication from E. Nister, Nuremburg.—*17th November*, 1883.
5447. Telephones, C. A. Jackson, Laurence, U.S.—*19th November*, 1883.
5453. Insulating Electrical Wires, H. J. Allison, London.—A communication from C. C. Gilman, Eldora, U.S.—*20th November*, 1883.
5454. Railway Rail Joints, T. H. Gibbon, Albany, U.S.—*20th November*, 1883.
5455. Harrows, S. Pitt, Sutton.—A communication from F. Nishwitz, Millington, U.S.—*30th November*, 1883.
5476. Synchronising Clocks, H. J. Allison, London.—A communication from R. W. Wilson, New Haven, U.S.—*21st November*, 1883.
5497. Preserving Milk, &c., R. Hornby, London.—*23rd November*, 1880.

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

4886. Dynamo-electric Machines, J. Hopkinson and A. Muirhead, London.—*24th November*, 1880.
4794. Packing Cases, &c., W. R. Lake, London.—*19th November*, 1880.
4806. Pumping Valves, W. Stainton, London.—*20th November*, 1880.
5241. Brushes for Dressing Pile Fabrics, J. Worrall and J. Lawrence, Ordsall, and J. Lea, Eccles.—*14th December*, 1880.
4815. Pressing Woollen Fabrics, &c., G. H. Nussey and W. B. Leachman, Leeds.—*20th November*, 1880.
4822. Instantaneous Capillary Generator, A. C. Henderson, London.—*22nd November*, 1880.
4887. Speaking Tubes, &c., G. Jennings and E. G. Brewer, Stangate.—*24th November*, 1880.
5362. Regulating the Supply of Steam to Steam Engines, J. Churchill, London.—*21st December*, 1880.
4843. Attaching Curtains to Window Frames, &c., G. Moore, London.—*22nd November*, 1880.
4977. Hydraulic Presses, J. Watson, London.—*30th November*, 1880.
4990. Fastening, &c., Casements, &c., J. Bruce, Edgbaston.—*30th November*, 1880.
5003. Mixing, &c., Various Substances, P. Pfleiderer, London.—*1st December*, 1880.
5088. Harvesting Machines, W. G. Manwaring, Banbury.—*7th December*, 1880.
5206. Steam Generators, H. J. Allison, London.—*13th December*, 1880.
4856. Looms for Weaving, J. Crook, Blackburn.—*23rd November*, 1880.
4890. Metallic Packings, J. A. Osgood and E. P. Monroe, U.S.—*24th November*, 1880.
4889. Lifting Heavy Weights by Hydraulic Power, A. Lafargue, London.—*24th November*, 1880.
4902. Looms for Weaving, J. Lyall, New York.—*25th November*, 1880.
4996. Cocks and Taps, J. Walker, London.—*1st December*, 1880.

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

4515. Floating Lights, C. D. Abel, London.—*21st November*, 1876.
4562. Hollow Bossed Self-lubricating Wheels, R. Hadfield, London.—*24th November*, 1876.
4579. Manufacturing Tobacco, R. Thomson and J. Porteous, Edinburgh.—*27th November*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition*, 14*th December*, 1883.)

3516. Electric Signalling Apparatus, W. R. Lake, London.—A com. from J. H. Cary.—*17th July*, 1883.
3529. Raising Sunken Vessels, R. P. Wylie, London.—*18th July*, 1883.
3551. Pocket Knives, J. H. Johnson, London.—A com. from J. Thurnauer and Co.—*19th July*, 1883.
3558. Producing Coloured Patterns, H. C. Webb, Worcester.—*19th July*, 1883.
3564. Tricycles, &c., J. A. Griffiths, Liverpool.—*20th July*, 1883.
3572. Studs or Solitaires, W. C. Alldridge, Birmingham.—*20th July*, 1883.
3574. File-cutting Machine, L. A. Groth, London.—A communication from F. Bathe.—*20th July*, 1883.
3579. Manufacture of Wood Screws, W. R. Lake, London.—A com. from E. Nugent.—*20th July*, 1883.
3592. Gas Distributor, H. Marlow, London.—*21st July*, 1883.
3595. Small-arms, H. C. Suft, Fulham.—*21st July*, 1883.
3621. Telegraphic and Telephonic Apparatus, H. H. Lake, London.—A communication from F. van Rysselberghe.—*24th July*, 1883.
3634. Hygienic Joints for Doors, &c., B. J. B. Mills, London.—A com. from J. Couturier.—*24th July*, 1883.
3640. Warp Beams for Looms, J. Wetter, Wimbledon.—A com. from C. Syländer, jun.—*24th July*, 1883.
3682. Emptying Centrifugal Machines, &c., G. H. Bolton, Widnes.—*27th July*, 1883.
3688. Guiding Ropes or Chains, R. J. Rudd, Croydon.—*28th July*, 1883.
3725. Treating Bituminous Shales, &c., C. M. Irvine, Blackwood, and R. Slater, Blackheath.—*30th July*, 1883.
3832. Die Stocks, H. J. Allison, London.—A communication from C. Hart.—*7th August*, 1883.
3846. Transmitting Electric Currents, A. L. Fyfe and L. Goldberg, London.—*7th August*, 1883.
4396. Steam Boilers, D. Francis, Rhymney.—*14th September*, 1883.
4512. Propelling Tram-cars by Ropes, C. Hinksman, London.—*21st September*, 1883.
4758. Treating Ores containing Antimony, J. Beveridge, Runcorn.—*6th October*, 1883.
4781. Conductors of Electricity, J. G. Parker, Plymouth.—*9th October*, 1883.
4858. Valves, M. Williams and A. Schottler, Cardiff.—*12th October*, 1883.
4876. Kilns for Burning Limestone, J. Briggs, Buxton.—*13th October*, 1883.
4897. Packing Cases, D. Rylands, Stairfoot.—A communication from J. B. Groot.—*15th October*, 1883.
4935. Spinning, &c., Fibrous Materials, W. Tatham, Rochdale.—*17th October*, 1883.
4945. Electrical Conductors, W. Siemens, London.—A com. from E. W. Siemens.—*17th October*, 1883.
4946. Vacuum Pumps, W. H. Cullen, London.—*17th October*, 1883.
4947. Measuring Electrical Energy, W. Siemens, London.—A communication from E. W. Siemens.—*17th October*, 1883.
4967. Flashing Signal Lights, W. B. Rickman, London.—A communication from R. and O. Pintsch.—*18th October*, 1883.
4974. Braces or Suspenders, W. Varney, London.—*18th October*, 1883.
4991. Manufacturing Gas, J. Somerville, London.—*20th October*, 1883.
5016. Packing Frilling, &c., J. MacCullum, Manchester.—*22nd October*, 1883.
5017. Extinguishing Lamps, &c., G. W. Smiley, London.—A communication from T. J. L. Smiley and C. H. Stombs.—*22nd October*, 1883.
5019. Securing Glass in Greenhouses, E. Newton, Hitchin.—*22nd October*, 1883.
5423. Dredging Machinery, W. E. Gedge, London.—A com. from H. B. Angell.—*17th November*, 1883.
5432. Fire-screens, &c., A. Hildesheimer, London.—A com. from E. Nister.—*17th November*, 1883.
5447. Telephones, C. A. Jackson, Laurence, U.S.—*19th November*, 1883.
5454. Railway Rail Joints, T. H. Gibbon, Albany, U.S.—*20th November*, 1883.
5455. Harrows, S. Pitt, Sutton.—A communication from F. Nishwitz.—*20th November*, 1883.

(*Last day for filing opposition*, 18*th December*, 1883.)

3480. Removing Refuse, W. K. Sidgwick, Surbiton.—A com. from G. A. Sidgwick.—*14th July*, 1883.
3575. Voltaic Batteries, W. R. Lake, London.—A com. from J. M. Stebbins.—*20th July*, 1883.
3599. Treating Straw, &c., T. H. Cobley, Dunstable.—*23rd July*, 1883.
3604. Distilling Coal, H. L. Pattinson, jun., Felling.—*23rd July*, 1883.
3605. Lids of Boxes, G. W. von Nawrocki, Berlin.—A communication from H. Lorentz.—*23rd July*, 1883.
3606. Sulpho Acids, F. Wirth, Frankfort-on-the-Main.—A communication from the Farbfabrik vormals "Brönner."—*23rd July*, 1883.
3612. Railway Chairs and Keys, J. K. Thompson and G. R. Race, Leeds.—*23rd July*, 1883.
3615. Treating Leather, F. Wirth, Frankfort-on-the-Main.—A com. from L. Klöpfer.—*23rd July*, 1883.
3617. Compound for Covering Drawing Rollers, &c., E. Edwards, London.—A communication from J. Appelt.—*23rd July*, 1883.
3625. Printing, &c., Tickets, T. King, East Dulwich, and R. Wilson, Wandsworth.—*24th July*, 1883.
3626. Hair-pins, W. A. Anderton, Bradford.—*24th July*, 1883.
3633. Obtaining Electric Currents, E. Jones, Leeds.—*24th July*, 1883.
3638. India rubber Cloth, &c., W. R. Lake, London.—A com. from F. E. Aldrich.—*24th July*, 1883.
3646. Floating Bridges, S. Lampard, London.—*25th July*, 1883.
3657. Treating Spent Lime, W. R. Lake, London.—A communication from A. T. Schuessler, V. Zeis, and M. D. Hanover.—*25th July*, 1883.
3659. Fallers for Preparing Flax, &c., J. W. Bradley, Bradford.—*26th July*, 1883.
3670. Traction or Locomotive Engines, J. H. Johnson, London.—A communication from J. E. E. Pécourt.—*26th July*, 1883.
3674. Clippers or Shears, J. Sabatier, London.—A com. from J. Bariquand and Son.—*27th July*, 1883.
3694. Spinning Yarns, W. Lancaster, Accrington.—*28th July*, 1883.
3702. Dynamo-electric Machines, S. Z. de Ferranti and A. Thompson, London.—*28th July*, 1883.
3712. Wick Holders, W. P. Thompson, Liverpool.—A com. from J. Scrafton.—*30th July*, 1883.
3714. Tapping Casks, W. S. and W. A. Dackus, Birmingham.—*30th July*, 1883.
3741. Stays or Corsets, W. H. Symington, Market Harborough.—*31st July*, 1883.
3749. Releasing Harnessed Cattle from Vehicles, W. Corbould, Peckham.—*31st July*, 1883.
3770. Gates, R. Allen, near Wolverhampton.—*1st August*, 1883.
3771. Making Envelopes, &c., J. C. Mewburn, London.—A com. from A. T. Howard.—*1st August*, 1883.
3775. Constructing Roofs, T. W. Webber, Kellyville Athy.—*1st August*, 1883.
3776. Grinding, &c., Articles of Metal, R. Wallwork, Manchester.—*2nd August*, 1883.
3809. Rivetting Umbrella Frames, W. Clark, London.—A com. from D. M. Redmond.—*3rd August*, 1883.
3828. Calculating Machines, W. R. Lake, London.—A com. from K. Duschanek.—*4th August*, 1883.
3982. Lace, C. D. Abel, London.—A communication from E. Davenière.—*16th August*, 1883.
4090. Velocipedes, H. H. Lake, London.—A communication from J. A. Larroque.—*23rd August*, 1883.
4109. Supplying Disinfectants, J. C. Kent, Bedfont.—*24th August*, 1883.
4180. Automatically Controlling Electric Circuits, &c., F. C. Phillips, London.—*29th August*, 1883.
4184. Shuttles for Looms, W. E. Gedge, London.—A com. from J. P. Thompson.—*30th August*, 1883.
4361. Preventing Corrosion, J. B. Hannay, Glasgow.—*12th September*, 1883.
4398. Filling and Stoppering Bottles, J. Phillips, London.—*14th September*, 1883.
4535. Playing Cards, E. Seedhouse, near Dudley.—*22nd September*, 1883.
4672. Governing Apparatus for Engines, D. J. Dunlop, Port Glasgow.—*2nd October*, 1883.
4674. Gas Cooking Ovens, S. Leoni, London.—*2nd October*, 1883.
4850. Torpedoes, C. A. McEvoy, London.—*11th October*, 1883.
4881. Electrical Belt, C. B. Harness, London.—*13th October*, 1883.
5026. Twisting Yarns, W. Cunningham, Dundee.—*23rd October*, 1883.
5069. Secondary Batteries, J. S. Sellon, London.—*24th October*, 1883.
5075. Valve Gear, A. Paul, Dumbarton.—*25th October*, 1883.
5085. Gas Motor Engines, C. A. Bullock, Blackheath.—*25th October*, 1883.
5086. Valves, T. Lewis, Cardiff.—A communication from P. H. Stangaard.—*25th October*, 1883.
5163. Revolving Fire-arms, W. W. Colley, London.—*30th October*, 1883.
5170. Detaching Coal and Stone, T. W. Asquith and R. E. Ornsby, Seaton Delaval Colliery, and T. Nicholson, Hexham-on-Tyne.—*31st October*, 1883.
5190. Bobbin-net or Twist Lace, W. Birks, jun., Nottingham.—*1st November*, 1883.
5476. Synchronising Clocks, H. J. Allison, London.—A com. from R. W. Wilson.—*21st November*, 1883.

Patents Sealed.

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

2589. Range-finder, F. Weldon, Farnham.—*24th May*, 1883.
2592. Telephonic Apparatus, G. E. Gouraud, London.—*24th May*, 1883.
2605. Chronographs, W. H. Douglas, Stourbridge.—*25th May*, 1883.
2611. Saddle Bars, H. Born, Hounslow.—*25th May*, 1883.
2614. Torpedo Boats, W. R. Lake, London.—*25th May*, 1883.
2617. Automatic Lathes, F. Wirth, Frankfort-on-the-Maine.—*25th May*, 1883.
2620. Money-boxes, &c., E. A. Jahncke and H. W. Herbst, London.—*26th May*, 1883.
2621. Extracting Sulphurous Acid from Fumes, E. A. Brydges, Berlin.—*26th May*, 1883.
2622. Excavating Earth, &c., J. F. Sang, London.—*26th May*, 1883.
2640. Making Lasts, A. Stürmer, Elberfeld, Germany.—*28th May*, 1883.
2642. Bill Files, C. H. Brampton, Birmingham.—*28th May*, 1883.
2646. Breech-loading Rifles and Small-arms, W. Field, Birmingham.—*28th May*, 1883.
2648. Hydrate of Strontia, C. F. Claus, London.—*28th May*, 1883.
2691. Artificial Manufactures, J. R. Young, jun., Norfolk, U.S.—*30th May*, 1883.
2693. Ornamentation of Painted Surfaces, J. A. Meginn, Liverpool.—*30th May*, 1883.
2710. Protecting Coating of Rust, &c., L. A. Groth, London.—*31st May*, 1883.
2711. Scissors, &c., L. A. Groth, London.—*31st May*, 1883.
2771. Ligneous Compounds, C. D. Abel, London.—*4th June*, 1883.
2787. Marine Steam Engines, J. G. Kincaid, Greenock.—*5th June*, 1883.
2790. Gas Motor Engines, W. P. Thompson, Liverpool.—*5th June*, 1883.
2798. Extracting Glycerine from Fatty Substances, W. R. Lake, London.—*5th June*, 1883.
2803. Safety Apparatus for Gas Burners, J. W. Plunkett, Dunstall Priory, and J. C. Hart, London.—*6th June*, 1883.
2819. Fasteners for Buttons, W. R. Lake, London.—*6th June*, 1883.
2842. Regenerative Furnaces, W. Spence, London.—*7th June*, 1883.
2859. Manufacturing Glass, J. Reynolds, Gateshead.—*8th June*, 1883.
2866. Roadways for Tram-cars, T. E. Knightley, London.—*8th June*, 1883.
2872. Electric Arc Lamps, H. J. Allison, London.—*8th June*, 1883.
2873. Spittoons, W. Vale, Birmingham.—*8th June*, 1883.
2902. Safes, H. W. Chubb, London.—*11th June*, 1883.
2906. Dyeing Textile Fabrics, H. H. Lake, London.—*11th June*, 1883.
2944. Driving Centrifugal Machines, A. Watt, Liverpool.—*13th June*, 1883.
2990. Soda and Potash, J. H. Johnson, London.—*15th June*, 1883.
3080. Telephones, A. W. Rose, London.—*21st June*, 1883.
3136. Lacing Gloves and Boots, A. C. Mather, Liverpool.—*17th July*, 1883.
3165. Attaching Rails to Metallic Sleepers, R. H. Brandon.—*26th June*, 1883.
3835. Counteracting the Thrust of Shafts, G. A. Teulon, London.—*7th August*, 1883.
3836. Holding Cables, &c., F. C. Guilleaume, Cologne.—*7th August*, 1883.
3950. Cigar and Cigarette Holders, J. H. Johnson, London.—*15th August*, 1883.
4072. Securing Fur to Hardened Wool, &c., C. Vero and J. Everitt, Atherstone.—*22nd August*, 1883.
4292. Securing the Lids of Baskets, T. Humphreys, Salford.—*6th September*, 1883.
4304. Lubricating Cylinders, W. R. Lake, London.—*7th September*, 1883.
4346. Self-levelling Berths, B. F. Merrill, Boston, U.S.—*11th September*, 1883.
4382. Carrying and Delivering Wire, H. J. Haddan, London.—*13th September*, 1883.
4629. Buckles, H. J. Haddan, London.—*28th September*, 1883.
4632. Rabbit, &c., Traps, W. Burgess, Malvern Wells.—*28th September*, 1883.
4685. Cartridge Shells, A. J. Boult, London.—*2nd October*, 1883.
4746. Raising Water from Wells, A. J. Boult, London.—*5th October*, 1883.

(*List of Letters Patent which passed the Great Seal on the 27th November*, 1883.)

2653. Ploughs, E. Edwards, London.—*29th May*, 1883.
2661. Electric Arc Lamps, J. Brockie, London.—*29th May*, 1883.
2664. Purifying Mildewed Hay, C. Perkin, Northernden.—*29th May*, 1883.
2681. Making Horse Nails, E. A. Brydges, Berlin.—*30th May*, 1883.
2684. Harvesting Machines, J. Wild, Tetney.—*30th May*, 1883.
2685. Flexible Combination Button and Fastener, T. W. Taylor, Birmingham.—*30th May*, 1883.
2688. Steam Boilers, H. Johnson, Burgess Hill.—*30th May*, 1883.
2690. Oil cans, G. A. J. Schott, Bradford, and G. Robinson, Sheffield.—*30th May*, 1883.
2694. Trucks or Rolling Stock, A. J. Boult, London.—*30th May*, 1883.
2696. Staiths, &c., G. Taylor, Penarth.—*30th May*, 1883.
2700. Banjos, &c., W. Lake, London.—*30th May*, 1883.
2714. Treating Lager Beer, J. P. Jackson, Liverpool.—*31st May*, 1883.
2722. Indicating Speed, R. P. Sellon, Surbiton.—*31st May*, 1883.
2730. Manufacturing Shot, G. Lampen, Gateshead-on-Tyne.—*1st June*, 1883.
2738. Coal Staith or Tip, G. Taylor, Penarth.—*1st June*, 1883.
2743. Regulating Electric Arc Lamps, F. L. Willard, London.—*2nd June*, 1883.
2751. Cutting Slate Rolls, O. Thomas, Bangor, and R. G. Thomas, Menai Bridge.—*2nd June*, 1883.
2752. Steam Engines, W. H. Watson, near Leeds, W. Strother, near Ripley, and J. Spence, High Harrogate.—*2nd June*, 1883.
2755. Constructing Roads, H. F. Williams, London.—*2nd June*, 1883.
2766. Revolving Back Collars or Caps of Axles, E. Partridge, Smethwick.—*4th June*, 1883.
2768. Generating Electric Currents, H. H. Lake, London.—*4th June*, 1883.
2769. Electric Lamps, W. R. Lake, London.—*4th June*, 1883.
2793. Hermetically Closing Bottles, W. E. Gedge, London.—*5th June*, 1883.
2816. Soluble Black, T. W. Appleyard, jun., and W. K. Appleyard, Leeds, and J. Longshaw, Manchester.—*6th June*, 1883.
2874. Tin and Terne Plates, D. Grey, Maesteg.—*8th June*, 1883.
2927. Gas Motor Engine, F. H. W. Livesey, London.—*12th June*, 1883.
2949. Insulating Wires, J. H. Johnson, London.—*13th June*, 1883.
2955. Regenerative Lamps and Gas Burners, C. Pieper, Berlin.—*14th June*, 1883.
2975. Ends of Braces, G. Walker, Birmingham.—*15th June*, 1883.
3009. Steam Boilers, T. Carter, Sunderland.—*16th June*, 1883.
3021. Stoppering Bottles, J. Phillips, London.—*19th June*, 1883.
3240. Fibrous Ligneous Cellulose, A. M. Clark, London.—*29th June*, 1883.
3505. Telephonic Apparatus, J. Graham, London.—*17th July*, 1883.
3654. Curling or Waving the Hair, H. Roman, London.—*25th July*, 1883.
3755. Tricycles, J. and T. Webb, Coventry.—*31st July*, 1883.
3791. Direct-acting Pumping Engines, W. Clark, London.—*2nd August*, 1883.
4158. Checking the Time of Workmen, N. C. Firth, Chester.—*28th August*, 1883.
4291. Gas Engines, C. H. Andrew, Stockport.—*6th September*, 1883.
4293. Operating Corliss Valves, J. Musgrave, Bolton.—*6th September*, 1883.
4431. Producing Ice-flower-like Figures on Glass, C. Pieper, Berlin.—*17th September*, 1883.

List of Specifications published during the week ending November 24th, 1883.

1221, 4d.; 1516, 4d.; 1534, 6d.; 1575, 8d.; 1681, 6d.; 1699, 2d.; 1708, 2d.; 1711, 6d.; 1715, 6d.; 1716, 2d.; 1720, 2d.; 1723, 4d.; 1727, 2d.; 1735, 2d.; 1741, 6d.; 1745, 6d.; 1746, 6d.; 1749, 6d.; 1752, 2d.; 1753, 6d.; 1754, 6d.; 1756, 6d.; 1757, 2d.; 1759, 4d.; 1760, 6d.; 1761, 8d.; 1762, 6d.; 1764, 2d.; 1765, 6d.; 1767, 6d.; 1772, 2d.; 1773, 2d.; 1774, 4d.; 1775, 6d.; 1776, 4d.; 1778, 2d.; 1780, 6d.; 1781, 2d.; 1782, 6d.; 1784, 2d.; 1785, 6d.; 1787, 2d.; 1789, 4d.; 1790, 6d.; 1791, 6d.; 1792, 2d.; 1793, 2d.; 1795, 2d.; 1796, 2d.; 1797, 8d.; 1798, 4d.; 1799, 6d.; 1800, 6d.; 1801, 2d.; 1802, 1s. 2d.; 1804, 8d.; 1805, 4d.; 1806, 6d.; 1807, 4d.; 1809, 2d.; 1810, 2d.; 1812, 10d.; 1814, 8d.; 1815, 2d.; 1816, 6d.; 1817, 2d.; 1818, 6d.; 1820, 4d.; 1821, 6d.; 1822, 2d.; 1823, 6d.; 1824, 8d.; 1826, 2d.; 1829, 8d.; 1830, 6d.; 1831, 2d.; 1832, 4d.; 1833, 6d.; 1834, 6d.; 1836, 2d.; 1837, 2d.; 1838, 6d.; 1839, 4d.; 1841, 4d.; 1842, 4d.; 1843, 8d.; 1844, 4d.; 1845, 4d.; 1846, 4d.; 1847, 2d.; 1848, 2d.; 1850, 2d.; 1852, 6d.; 1855, 2d.; 1856, 2d.; 1858, 6d.; 1861, 2d.; 1862, 6d.; 1864, 6d.; 1866, 4d.; 1867, 6d.; 1873, 6d.; 1876, 2d.; 1878, 8d.; 1879, 6d.; 1888, 6d.; 1890, 6d.; 1898, 6d.; 1902, 6d.; 1912, 4d.; 1917, 6d.; 2039, 4d.; 2068, 6d.; 2089, 4d.; 3149, 4d.; 3391, 6d.; 3705, 6d.; 3837, 6d.; 3989, 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.*

1221. TORPEDOES USED IN WARFARE, *A. J. Boult, London.*—7*th March*, 1883.—(*A communication from A. Weeks, Minneapolis, U.S.*)—(*Not proceeded with.*) 4*d.*
This relates partly to a marine torpedo socket adapted to be fired from a detaching davit, which serves to give initial direction to the socket.

1516. COFFEE ROASTERS, *G. H. Pfeifer, Freiburg.*—22*nd March*, 1883. 4*d.*
This relates to a drum or cylinder, the axis of which is hollow, and through which a heated bolt or rod is inserted.

1534. LOOMS, *J. Hodgson and S. Greenwood, Brearley.*—24*th March*, 1883. 6*d.*
This consists partly in making the chain barrel and star wheel in separate pieces.

1575. ELECTRO-MAGNETIC PRINTING TELEGRAPH APPARATUS, *W. P. Thompson, London.*—28*th March*, 1883.—(*A communication from H. Van Hoevenbergh, Elizabeth, U.S.*) 8*d.*
The principal object of the invention is to secure increased rapidity of operation. To this end it is sought to reduce to a minimum the number of mechanical operations performed by the apparatus at the receiving station. Thus the type wheel is caused to advance normally through successive arcs, each subtending two characters, or in other words, so as to skip one character at each step. When any one of the characters thus skipped is to be printed, the wheel is arrested on arriving at the character next in advance of the required character, and a device is brought into action which mechanically advances the wheel through an arc subtending one character. This brings the required character into exact position, and the impression is then taken therefrom. The invention further includes a transmitting mechanism for operating the apparatus at the receiving station, thus completing a system both simple in construction and rapid in operation.

1681. PROCESS AND APPARATUS FOR UTILISING THE EXHAUST STEAM OF STEAM ENGINES, *A. J. Boult, London.*—3*rd April*, 1883.—(*A communication from D. Renshaw, Braintree, U.S.*) 6*d.*
This consists partly in the process of taking a portion of the water from the steam generator that supplies steam to the engine or other source of supply, and passing said water through a cooling medium in a vessel outside of the boiler, the water so taken from the generator being under the boiler pressure from which it came, and then conveying this water to an injector, where it meets the exhaust steam of the engine, the exhaust steam taking the place of the live steam heretofore used, the water being sufficiently cooled to cause a partial condensation of the exhaust forming a partial vacuum, and then the partially cooled water and the exhaust steam are forced into the boiler on the principle of the injector.

1699. ROOF LAMPS FOR RAILWAY CARRIAGES, *J. Hinks and F. R. Baker, Birmingham.*—4*th April*, 1883.—(*Not proceeded with.*) 2*d.*
This relates to the construction of the wick cases.

1708. TOY CANNON, *H. J. Allison, London.*—5*th April*, 1883.—(*A communication from A. Le Meunier and La Société A. Bain et Heude, Paris.*)—(*Not proceeded with.*) 2*d.*
The principle of this cannon is based upon the application of gases, producing with air a detonating or explosive mixture.

1711. FLEECE-DIVIDING ATTACHMENTS TO CARDING MACHINES, *H. J. Haddan, London.*—5*th April*, 1883.—(*A communication from J. S. Bolette, Belgium.*) 6*d.*
This consists partly in dividing the fleece when it leaves the carding machine into slivers on the rubber of the carding machine itself, by means of endless steel bands passing over rollers on both sides of the dividing cylinders, and arranged in such a manner as to pass twice between the dividing cylinders, so that both parts nearly come in contact with each other at the point where the division takes place.

1715. APPARATUS FOR DRYING EXCRETA, URINE, AND OTHER SUBSTANCES, *J. M. Sutton, Manchester.*—5*th April*, 1883. 6*d.*
This relates to the construction of apparatus and to the process of treating and utilising the gases emanating from drying excreta, urine, and other similar substances by mixing the same with hydro-carbon or other gases.

1716. APPARATUS FOR PROPELLING TRICYCLES AND HAND PADDLE-WHEEL BOATS, *W. Brierley, Halifax.*—5*th April*, 1883.—(*A communication from R. Perl and F. Tischek, Vienna.*)—(*Not proceeded with.*) 2*d.*
The object is to facilitate ascent by transferring the motion of the hands, which is similar to that in a rowing boat, to the axle of the wheels of a tricycle or to the axle of the paddles of a hand-propelled or other boat.

1720. PACKING AND PRESERVING BUTTER, &c., AND PACKING CASES EMPLOYED THEREFOR, *G. Partridge, London.*—5*th April*, 1883.—(*Not proceeded with.*) 2*d.*
This relates to an enamelled iron vessel provided with a removable air-tight hydraulic-seal lid or cover.

1723. MACHINE HAMMERS AND APPARATUS FOR ACTUATING THE SAME, *F. C. Glaser, Berlin.*—5*th April*, 1883.—(*Not proceeded with.*) 4*d.*
Connected with the motor engine is an intermediate motor.

1725. APPARATUS FOR ENABLING PERSONS IN CABS OR OTHER VEHICLES TO COMMUNICATE WITH OR GIVE DIRECTIONS TO THE DRIVER OF THE SAME, *T. Armstrong, Beckenham.*—5*th April*, 1883. 6*d.*
A series of indicators or tablets are arranged within a case having suitable apertures, through which they can be caused to pass and exhibited to the driver when actuated by suitable means from within the cab or other vehicle.

1726. MANUFACTURE OF JEWELLERY AND OTHER ARTICLES OF WOOD COATED OR COVERED WITH METAL, *W. R. Lake, London.*—5*th April*, 1883.—(*A communication from G. L. Moës and H. A. V. Wirth, Paris.*) 4*d.*
This consists in coating wood with metal by covering it with plumbago, and then coating it first with an electro-deposition of copper, and then with an electro-deposition of gold or silver.

1727. MANUFACTURE OF ICE, &c., *W. R. Lake, London.*—5*th April*, 1883.—(*A communication from S. B. Hunt and F. E. Pinto, New York.*)—(*Not proceeded with.*) 2*d.*
The invention consists essentially in the employment of dry atmospheric air under pressure by means of suitable apparatus.

1728. TOOL FOR USE IN POINTING THE JOINTS OF BRICKWORK AND MASONRY, *F. Service, London.*—5*th April*, 1883. 6*d.*
The tool is intended for what is called "tuck pointing," and its purpose is to pare or cut the edges of the "putty." Two blades are connected preferably so that their cutting edges (which are at right angles to the length of the blades) can be adjusted to the required distance apart.

1730. COVERING IRON AND STEEL WITH LEAD AND ITS ALLOYS, *W. H. Spence, London.*—6*th April*, 1883.—(*A communication from B. Mühlau, Germany*) 6*d.*
This consists essentially in the application of the oxyhydrogen flame to the covering of iron with lead or alloys.

1732. COUPLING BICYCLES TO FORM A DOUBLE CARRIAGE WHEN REQUIRED, *C. N. Baker, Birmingham.*—6*th April*, 1883.—(*Not proceeded with.*) 2*d.*
The two bicycles are connected by rods secured preferably to the backbones of each, the steering handles being also connected together so as to be turned in the same direction.

1733. ROTARY KNOTTERS USED IN THE MANUFACTURE OF PAPER, *H. J. Haddan, Kensington.*—6*th April*, 1883.—(*A communication from Reinicke and Jasper, Coethen*) 6*d.*
The inventors claim, First, a partially acting spray producer or injecting apparatus fed by a distributing apparatus constructed in the manner of a revolver, and provided with ratchet mechanism and weighted lever; Secondly, causing the paper pulp to pass from the interior of the sieve cylinder through the circumference of the latter, so that the shaking plate works in the clarified paper pulp.

1734. EGG BEATERS, *A. H. Frost and F. Earl, St. Ives*, —6*th April*, 1883. 4*d.*
The egg is broken and the contents poured into a receptacle provided with a diaphragm. The whole apparatus is shaken.

1735. GAS AND OTHER LAMP GLASS AND SMOKE CAP HOLDERS, *S. Falk, London.*—6*th April*, 1883.—(*Not proceeded with.*) 2*d.*
This relates to the construction of the support for the smoke cap or cover.

1738. ORDNANCE, *P. M. Parsons, Blackheath.*—6*th April*, 1883. 6*d.*
This relates partly to the mode of casting.

1739. PYROMETERS, *A. Longsdon, London.*—6*th April*, 1883.—(*A communication from A. Krupp, Essen.*)—6*d.*
The inventor claims in an apparatus constructed on the injector principle, and intended for determining the temperature of hot air or gas, the application of means for obtaining a constant pressure of the entering hot blast, and of a thermometer for measuring the temperature of the drawn-in cold air.

1740. APPLYING DABBING BRUSHES TO COMBING MACHINES, *H. Portway, Bradford, and J. C. Walker, Shipley.*—6*th April*, 1883. 6*d.*
This relates to the employment of dabbing brushes having imparted thereto a horizontal reciprocating movement in combination with the vertical reciprocating movement.

1741. CONSTRUCTION OF FLY WHEELS AND PULLEYS FOR ROPE DRIVING, *W. Hargreaves and R. Harwood, Bolton.*—6*th April*, 1883. 6*d.*
This consists in a novel way of forming the periphery or rim with grooves, together with the means for supporting the same from the centres or bosses from the shaft on which they revolve.

1742. MACHINERY FOR SEVERING OR DIVIDING DOUBLE-PILED FABRICS, *J. H. Johnson, London.*—6*th April*, 1883.—(*A communication from T. Diederichs, Bourgoin, France*) 6*d.*
This consists in apparatus for severing or dividing the pile threads of double-piled fabrics, of the employment of toothed cutters sliding one over the other, and acting to sever the threads.

1743. UTILISATION OF PHOSPHATIC METALLIC SCORIA, *G. Pitt, Sutton.*—6*th April*, 1883.—(*A communication from G. Rocour, Liege.*) 4*d.*
The inventor claims, First, the process and method of utilising phosphatic cinders or slags by melting them with convenient fluxes and fuel in cupola blast furnaces or other reducing furnace, to obtain a "phosphorous matte" containing the phosphorus iron and manganese of the cinders or slags. Secondly, the method of transforming the phosphorus of the matte into alkaline phosphate soluble, by heating in a reverberatory or other furnace the ground phosphorus matte mixed with sulphate of sodium or potassium and coal in powder, with or without sulphur or pyrites.

1744. RENDERING WOOD, CELLULOSES, TEXTILES, &c., UNINFLAMMABLE AND INCOMBUSTIBLE, *F. K. de Stosicki, London.*—6*th April*, 1883.—(*A communication from B. Hoff, Jaroslau, Austria.*) 4*d.*
This relates partly to the impregnation by pressure of wood and other materials with a soluble sulphite, and with the salt of an alkaline earth, whereby the same are rendered uninflammable.

1745. ELECTRIC LAMPS AND APPLIANCES IN CONNECTION THEREWITH, *F. H. Varley, London.*—6*th April*, 1883. 6*d.*
This consists, First, of a spool or coil frame, upon or into which the carbon candle may be coiled or otherwise folded; Secondly, of reducing guides, through or by means of which the pole or burning ends of the carbon candles are brought together for establishing the circuit to produce light; Thirdly, of conducting rollers or propellers for feeding the carbon forward at the rate requisite for its consumption; Fourthly, a magnetic regulator for determining the length of the arc; Fifthly, an arrangement for centralising the arc by means of a thermostat or variable resistance; Sixthly, a driving train of clockwork controlled by an electric current to regulate the feed; Seventhly, an automatic propeller, in which the current passing through the lamp determines the rate of the feed; Eighthly, the combination of these various devices for regulating the rate of feed, and likewise the potential, a quantity of the current passing across the carbon poles; Ninthly, the provision of a casing for extinguishing the combustion of carbon when current is not passing.

1746. VELOCIPEDES, *A. L. Bricknell, Brixton.*—6*th April*, 1883. 6*d.*
The inventor claims in velocipedes driven by or through oscillating levers, the pivotting or hinging of the pedal to the end of the treadle lever, so that it can be made to assume different positions for power or speed.

1747. VELOCIPEDES, *A. L. Bricknell, London.*—6*th April*, 1883. 6*d.*
This relates to the construction of the hubs.

1748. DISTRIBUTING APPARATUS FOR THE FEED HOPPERS OF FURNACES, *W. R. Lake, London.*—6*th April*, 1883.—(*A communication from E. Shepard, U.S.*) 6*d.*
This relates to the combination of a hopper and a distributing bell arranged to close the hopper from below, the said bell being provided with a yielding valve for the escape of gases.

1749. FILTERING IN CENTRIFUGAL MACHINES, &c., *C. H. Haubold, Chemnitz.*—6*th April*, 1883. 6*d.*
The inventor causes the liquid to be filtered to pass through the filtering material in the filtering apparatus, not centrifugally, but in an opposite direction, that is to say, from the periphery to the centre, therefore in a direction opposite to the centrifugal force. The centrifugal power motion of the filtering itself will then tend to move the filtering material outward, in a direction opposite to the motion of the fluid to be filtered, in such manner that the filtering material is continually compressed more firmly and is never carried away.

1750. FACILITATING THE REMOVAL OF SAND, GRAVEL, MUD, &c., FROM HARBOURS, RIVERS, &c., *W. R. Lake, London.*—6*th April*, 1883.—(*A communication from L. Coiseau, Antwerp*) 6*d.*
This relates to the employment of compressed air for the disaggregation and distribution or suspension in water of sand, mud, gravel, or the like, to permit their removal or transport by natural or artificial currents.

1751. APPARATUS FOR DRYING PAPER AND WOVEN AND OTHER WEB FABRICS, *A. Alexander, Dunbar.*—7*th April*, 1883. 6*d.*
The apparatus consists of rotating steam-heated cylinders having laths or spars fixed round and rotating with them, but touching their surfaces only at a few supporting points, such laths or spars keeping the paper or fabric a short distance off the surfaces of the cylinders.

1752. CONSTRUCTION OF MACHINES KNOWN AS "MIDDLINGS PURIFIERS," *J. S. Sutcliffe, Bacup.*—7*th April*, 1883.—(*Not proceeded with.*) 2*d.*
One part consists in placing between the valves or openings leading into the fan chamber a series of drawers preferably extending from either side and meeting in the centre of the said chamber. Also at the end of the fan chamber a drawer is arranged lengthwise on either side of the fan.

1753. ELECTRIC ARC LAMPS, *J. T. King, Liverpool.*—7*th April*, 1883.—(*A communication from J. R. Finney, Pittsburgh, U.S.*) 6*d.*
The invention consists principally in constructing electric arc lamps with a hollow core electro-magnet, through which the feed rod of the top carbon or electrode passes in combination with a gripper or grippers disposed so as to act on the said feed rod, and to be actuated radially by varying magnetism in the said hollow core electro-magnet. Other improvements are described.

1754. ELECTRODES FOR ELECTROLYTIC AND LIKE PURPOSES, *F. E. Elmore, London.*—7*th April*, 1883. 6*d.*
The inventor claims, First, the application in electrolytic operations of electrodes surrounded by, cased, or enveloped in, a textile, felted, or other suitable porous material for the purposes of retaining the residues within such covering or envelope, and for preventing short circuits; Secondly, constructing electrodes for use in the electrolytic amalgamation of precious metals from their ores, and for such like purposes, of carbon or other difficultly oxidisable material in combination with a porous envelope or covering.

1755. CONSTRUCTION OF VEHICLES FOR CARRYING FURNITURE, *J. W. and H. J. Davey, Bristol.*—7*th April*, 1883. 4*d.*
This relates to the means of constructing the vehicles principally of iron or steel.

1756. METERS FOR ELECTRICITY, &c., *S. Pitt, Sutton*—7*th April*, 1883.—(*A communication from J. Cauderay, Lausanne.*) 6*d.*
The current according to its intensity deflects more or less the needle of a galvanometer, which needle oscillates in front of a regularly rotating cylinder having projections on it which come into contact with the needle. The projections are arranged in rings transversely to the cylinder, the ring at the central or zero position of the needle having no projections, the rings on each side which are opposite to the positions of the needle corresponding to an intensity of current of, say, one ampère, having each one projection, the next pair of rings opposite the positions corresponding to an intensity of two ampères, having each two projections, and so on. The needle, each time it comes into contact with a projection, completes an electric circuit, which actuates a step-by-step dial recording apparatus, and advances the pointers one unit. Thus the number of units recorded by the dial during the time occupied by each revolution of the cylinder varies as the strength of the current passing through the conductor.

1757. MANUFACTURE OF WALL PAPERS, *F. Ramsay, London.*—7*th April*, 1883.—(*Not proceeded with.*) 2*d.*
The object is to produce imitations of marbles and wood. The patterns are produced by removing colour from the paper surface after a colour or colours have been placed upon it at hazard in irregular patches or markings.

1758. AMALGAMATING APPARATUS, *A. K. Huntingdon and W. E. Koch, London.*—7*th April*, 1883. 6*d.*
The inventor claims in an amalgamating apparatus, consisting of a vessel in which revolves a vertical tube with tubular arms for ejecting the ore or tailings, constructing these arms of tapering ovate form with elongated slits along their hinder sides.

1759. APPARATUS FOR THE PRODUCTION AND REGULATION OF THE ELECTRIC LIGHT AND POWER, *T. Wiesendanger, London.*—7*th April*, 1883.—(*Not proceeded with*) 4*d.*
This relates, First, to dynamo machines or generators of electric energy and electro-motors; and Secondly, to electric regulator arc lamps.

1760. APPLIANCE FOR FEEDING THE CARBONS OF ELECTRIC ARC LAMPS, *J. Henry and H. B. Bourne, London.*—7*th April*, 1883. 6*d.*
The invention is based upon the principle that by a gentle tapping or rapping at the side of a tube, a rod within and just fitting it can be caused to fall gradually, and in proportion to the force exerted, and the rapidity of action coupled with the weight of the tube and its contents. A magnet and a spring armature are arranged close to the tube or rod which carries, say, the upper carbon of an electric arc lamp, said spring armature being of the required length and provided with a button or knob to knock against the carbon supporting rod or tube at each pulsation of the armature produced by the flow of the current. The spring armature is so connected to its support as to be capable of sensitive adjustment in order to regulate its action to the utmost necessity.

1761. APPARATUS FOR EVAPORATING BY COMPRESSION AND BY MULTIPLE EFFECT, *J. Weibel, Geneva, and P. Piccard, Lausanne.*—7*th April*, 1883. 8*d.*
This relates to constructing apparatus for evaporating by compression and by multiple effect, in such manner that the vapour from the liquid which is being evaporated by the compressed steam becomes mixed with the vapour from the liquid which is being evaporated by the exhaust steam from the engine cylinder.

1762. CONSTRUCTION OF FLUES, CHIMNEYS, AND GRATES FOR SMOKE-CONSUMING AND VENTILATING PURPOSES, *R. H. Reeves and S. Reeves, London.*—7*th April*, 1883. 6*d.*
This relates to the combination of a continuous air shaft formed with a hollow air chamber at the back, sides, and bottom of the grate, for the purpose of creating a hot-air blast with the obstruction in the air shaft for assisting the consumption of smoke.

1764. PICKERS AND THE PARTS UPON WHICH THEY SLIDE, &c., *J. Holding, Lower Broughton.*—7*th April*, 1883.—(*Not proceeded with.*) 2*d.*
This relates to means for preventing the shuttle from flying out of the race.

1765. CONSTRUCTION OF APPARATUS FOR BINDING SHEAVES, &c., *B. G. Hall, Malvern Wells.*—7*th April*, 1883. 6*d.*
This relates to the general combination and arrangement of mechanism for binding sheaves.

1766. GAS REGULATORS, *J. and W. Goodson, London.*—7*th April*, 1883. 6*d.*
This relates to a gas regulator into which the nipple is screwed.

1767. WEATHER-PROOF EXPLOSIVE COMPOUNDS AND CARTRIDGES, *P. Jensen, London.*—7*th April*, 1883.—(*A communication from J. Schulhof, Vienna.*) 6*d.*
This relates to the manufacture of a material for shooting and other explosive purposes from greased gun-cotton.

1768. TREATMENT OF PLANTS OF THE GENUS GENISTA FOR USE IN MANUFACTURE OF FIBROUS MATERIAL, *W. A. Barlow, London.*—7*th April*, 1883.—(*A communication from F. Globotsching, Bologna, and M. Müller, jun, Vienna.*) 4*d.*
This relates to the chemical treatment of the plant.

1769. MANUFACTURE OF CUT PILE FABRICS AND APPARATUS EMPLOYED THEREIN, *J. H. Johnson, London.*—7*th April*, 1883.—(*A communication from L. T. Lepage, Brenot, France*) 6*d.*
This relates partly to cutting the pile threads in the looms by means of revolving cutters acting upon loops of the pile threads.

1771. CONSTRUCTION OF STUDS AND FITTING AND SECURING THEM IN LINKS, LOOPS, AND RINGS OF CHAINS, CABLES, &c., *J. Buchanan, jun., and J. Brown, Liverpool.*—9*th April*, 1883. 6*d.*
The stud is constructed in two or more parts, but by preference of two parts, with convex and concave ends fitting together, and secured when so fitted by a key, pin, cotter, or equivalent means.

1772. CONSTRUCTION OF BATHS FOR CONTAINING MOLTEN ZINC, &c., *W. H. Luther, Glasgow.*—9*th April*, 1883.—(*Not proceeded with.*) 2*d.*
The baths are constructed of a double casing, the space between which casings may be filled with fireclay or other suitable material, or such lining may be dispensed with, in which case the inner casing fits closely into the outer casing.

1773. CONSTRUCTION OF GLASS ROOFING FOR GREENHOUSES, &c., *C. E. Osborn, London.*—9*th April*, 1883.—(*Not proceeded with.*) 2*d.*
The sheets of glass are inserted in grooved bars.

1774. ELECTRIC ARC LAMPS, *L. B. Miller, London.*—9*th April*, 1883.—(*Not proceeded with.*) 4*d.*
This relates to lamps in which the electro-magnets or solenoids used to regulate the descent of the carbon fall with the latter as it is consumed.

1775. MECHANISM FOR PREPARING AND DISTRIBUTING TOBACCO IN CIGARETTE MACHINES, *A. E. Henderson, London.*—(*A communication from E. F. Leblond, Paris.*) 6*d.*
The object is to mechanically distribute the tobacco, to equalise it in portions in accordance with the dimensions of and weight of the cigarettes to be manufactured, and at the same time press it equally into cake so that it is uniform throughout in bulk.

1776. CONSTRUCTION OF INCANDESCENT ELECTRIC LAMPS, *E. Müller, London.*—9*th April*, 1883. 4*d.*
The horseshoe filament is made of box-wood carbonised, and the invention relates to the means of fixing the same.

1778. STRETCHING AND RESTORING TROUSERS TO THEIR ORIGINAL SHAPE, *E. Nunan, London.*—9*th April*, 1883.—(*Not proceeded with.*) 2*d.*
The object is to counteract the bagging at the knees.

1779. APPARATUS FOR REGISTERING DISTANCES TRAVELLED AND TIME OCCUPIED BY VEHICLES, *J. Imray, London.*—9*th April*, 1883.—(*A communication from F. Bisson, Paris*) 6*d.*
A set of dials marking miles, multiples or fractions thereof, have their indices moved either by connection from a wheel of the vehicle or from clockwork, so as to register, either the actual distance travelled, or a distance representing, according to some predetermined ratio, the value of the time during which the vehicle waits.

1780. APPARATUS FOR SIFTING AGRICULTURAL PRODUCE, *B. Page, Essex.*—9*th April*, 1883. 6*d.*
This relates to the combination with a sieve frame adapted to receive detachable sieves of various gauges and means for reciprocating the same, of suspension straps and rollers or their equivalent for accurately raising and lowering and adjusting the inclination of the sieve frame, both with respect to the gauge of sieve in use, and to the nature of the produce under treatment.

1781. SECURING THE RAILS IN THE PERMANENT WAY OF RAILWAYS, *G. Wood and T. Wilton, Brandon.*—9*th April*, 1883.—(*Not proceeded with.*) 2*d.*
The object is to provide means for securing rails in position, whereby the necessity for using wooden keys is avoided.

1782. WINDOW BLIND ROLLERS AND PARTS CONNECTED THEREWITH, *H. A. Walker, London.*—9*th April*, 1883. 6*d.*
This consists of a device to hold window blinds without the use of springs or ratchet wheels.

1783. MACHINERY FOR COVERING WIRE OR STRAND WITH GUTTA PERCHA OR OTHER MATERIAL, *A. C. Moffatt and W. H. Wardale, London.*—9*th April*, 1883. 6*d.*
The machine is composed of one right and one left-hand worm working together, and confined in a steam jacketted chamber of a suitable form to receive the two worms.

1784. COUPLINGS AND FITTINGS CONNECTED THEREWITH FOR RAILWAY CARRIAGES, &c., *R. Pearson, Glasgow.*—9*th April*, 1883.—(*Not proceeded with.*) 2*d.*
This relates partly to improvements for vertically engaging and disengaging the automatically and laterally oscillating, and jointed spring coupling hooks.

1785. SECONDARY PILES OR BATTERIES, *E. G. Brewer, London.*—9*th April*, 1883.—(*A communication from Arnould and R. Tamine, Mons*) 6*d.*
Instead of the metallic electrodes now generally employed in secondary piles or batteries, according to this invention metallic electrodes made of wires or bands of suitable section are wholly or partially used, and the said wires are arranged in any desired form or shape.

1786. WHEELS FOR TRACTION ENGINES, &c., *J. and H. McLoren, Leeds.*—9*th April*, 1883. 6*d.*
This relates partly to constructing wheels for traction engines or other purposes, with spring spokes each formed in parts with turned-in or bent end portions, and connecting them to the rim of the wheel by a clamp or clamps, without the necessity for bolt holes through the springs.

1787. ALBUMS FOR CONTAINING CRYSTOLEUM PAINTINGS, *L. Wise, Bristol.*—9*th April*, 1883.—(*Not proceeded with.*) 2*d.*
The object is to provide an album for containing the bevelled paintings.

1789. GALVANIC BATTERIES, *G. Baron de Overbeck, London.*—9*th April*, 1883.—(*Partly a communication from Dr. F. Hornung, Magdeburg.*) 4*d.*
The inventor constructs a primary battery composed of elements, the one electrode of which consists of carbon alone, or platinum alone, or carbon covered with platinum, or lead or any other metal or substance covered with platinum placed in an oxidising fluid or solution yielding chlorine, the other electrode consisting of aluminium metal placed in a solution of alkalies and alkaline carbonates.

1790. GAS REGULATOR, *H. J. Haddan, London.*—9*th April*, 1883.—(*A communication from J. Fleischer, Cologne.*) 6*d.*
This relates to that class of gas-pressure governors which act by the pressure of the gas on one side of a movable diaphragm.

1791. APPLICATION OF ELECTRICITY TO VEHICLES ON TRAM AND RAILWAYS, &c., *F. Wynne, London.*—9*th April*, 1883. 6*d.*
This relates to the mode of applying electricity from a stationary producer of electricity or reservoir to the propulsion of tram-cars, railway cars, or carriages, or other vehicles on rails or tramways by means of a carrier or contact maker.

1792. APPARATUS FOR REMOVING SCREW PROPELLERS FROM THEIR SHAFTS, *J. H. Johnson, London.*—9*th April*, 1883.—(*A communication from H. B. Gouget and A. D. E. Vincent, Paris.*)—(*Not proceeded with.*) 2*d.*
The apparatus is composed of a strong cross-bar provided with means for connecting it to a suitable lifting apparatus.

1793. BOAT DISENGAGING GEAR, *N. Hamblin, jun., Poplar.*—9*th April*, 1883.—(*Void.*) 2*d.*
The gear consists of either eye bolts, switch bolts through stem and stern posts, or slings, and requires but one man to let it go.

1794. SECONDARY BATTERIES, *R. Tatham, Rochdale, and A. Hollings, Salford.*—10*th April*, 1883. 6*d.*
This consists essentially in constructing frames or supports of grooved or channelled strips or bars of lead or other suitable metal, preferably perforated and corrugated, combined together so as to surround and enclose the plate of active material.

1795. LAUNDRY PANS AND BOILERS, *T. Hartley and Z. Sugden, Halifax, and C. Parker, London.*—10*th April*, 1883.—(*Not proceeded with.*) 2*d.*
The copper or set pan is received within the hot water boiler, the latter being provided with necessary fire-box, smoke outlet, and usual pipe connection for surviving supply of hot water for laundry or other use.

1796. BRIDGES, *W. R. Kinipple, London.*—10*th April*, 1883.—(*Not proceeded with.*) 2*d.*
This relates to means for raising and lowering bridges.

1797. MACHINERY FOR STAMPING OR PULVERISING MINERALS OR OTHER MATERIALS, *J. H. Johnson, London.*—10*th April*, 1883.—(*A communication from N. W. Condict, jun., Jersey City, U.S.*) 8*d.*

The First part relates to improvements in that class of mechanism in which minerals and other materials are pulverised by power operated by stamp rods combined with motors; Secondly, to mechanism for the automatic operation of the valves of duplex steam stamps or pulverisers, in which the descent of the stamp rods is due to the pressure of steam on the piston of each cylinder, and their ascent to constant action of steam at low pressure against the underside of the pistons; Thirdly, to a valve operating mechanism for a steam stamping and pulverising machine, in which one motor, one stamp, and one cylinder is used.

1798. STOPPERS OR COVERS FOR BOTTLES, JARS, &c., *N. Thompson, London.*—10*th April*, 1883.—(*Not proceeded with.*) 4*d.*

This relates to means for securing caps or stoppers to bottles, jars, &c.

1799. TOOL FOR EXTRACTING INTERNAL STOPPERS FROM BOTTLES, *J. Hamer, Stalybridge.*—10*th April*, 1883. 6*d.*

This relates to a pair of pliers for extracting internal stoppers.

1800. APPARATUS FOR TIPPING VANS, &c., *C. Hill, London.*—10*th April*, 1883. 6*d.*

This relates to an arrangement of levers and spring for releasing the tail board.

1801. CONDUCTORS OF ELECTRICITY, *J. G. Parker, Plymouth.*—10*th April*, 1883.—(*Not proceeded with.*) 2*d.*

The object is to reduce the resistance encountered by an electric current while following a metallic conductor, and the loss of current resulting from such resistance.

1802. BRICK-MAKING MACHINERY, *P. M. Justice, London.*—10*th April*, 1883.—(*A communication from C. Chambers, jun., Philadelphia.*) 1*s.* 2*d.*

This relates to several improvements in that class of brick-making machines in which the clay is successively tempered in a case, forced out therefrom in a continuous bar through a forming die, sanded upon emerging from the die, cut into proper lengths by a severing mechanism, and finally delivered upon an endless off-bearing belt.

1804. MECHANISM FOR CUTTING OR SHEARING SHEET METAL INTO VARIOUS SHAPES, &c., *A. N. Hopkins, Birmingham.*—10*th April*, 1883. 8*d.*

This consists in a machine employed in cutting or shearing sheet metal into various shaped blanks, or trimming the edges of articles of various shapes made from sheet metal, or in performing both these operations, of the combination of a set of rotary shears or cutters with a "former" fixed and operated to produce, in conjunction with a weight or equivalent, a reciprocating movement of the cutter frame.

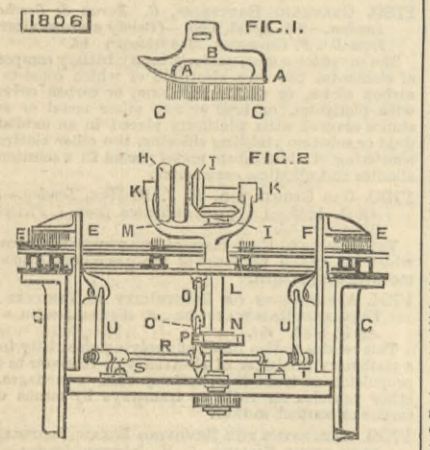
1805. ELECTRIC PILE, *J. C. Mewburn, London.*—10*th April*, 1883.—(*A communication from M. and P. Azapis, Paris.*) 4*d.*

The pile, which has a diameter of, say, 9 centimetres, and a height of, say, 24 centimetres, is composed of four porous diaphragms or vessels, into each of which is inserted a piece of carbon of a diameter one or two centimetres less than that of the diaphragms. Each of the diaphragms carries externally a semi-cylindrical piece of zinc of the same height as the porous vessels. The carbons are connected together by a single metallic piece, and the zinc pieces by another metallic piece. Into an outer vessel a solution of a suitable salt, by preference sea salt or salt of ammonia, is introduced. Lastly, into the porous vessels are placed sulphuric acid at 25 deg. to 45 deg., and 5 per cent. of ordinary nitre or nitric natron (natre nitrique) or nitric acid.

1806. COMBING MACHINES, *J. C. Walker, near Bradford.*—10*th April*, 1883. 6*d.*

The body of the dabbing brush A, shown in Fig. 1, is of metal, formed with the bridge B at the back of it, whereby it is attached to the mechanism for actuating the brush. C are the bristles which are held in the body A by wires in the ordinary manner. These wires are exposed at the back of the body A of the brush, and are consequently easy of access when the bristles are required to be removed or applied. From the general construction of this brush, the whole of the parts are readily got at by the attendant when required. Fig. 2 shows one arrangement for actuating the dabbing brushes, in which E are the dabbing brushes attached to a vertical slide F, fitted so as to work freely in guides or bearings on the framework G. In this arrangement the inventor dispenses with the ordinary pillars for carrying the driving shaft, and imparts the required motion to the machine through driving pulley H and bevel wheels I, carried on the horizontal shaft K and vertical shaft L, such shafts being supported by the bracket M attached to the framework G, and in order to impart the vertical reciprocating motion to the dabbing brushes he employs

1806



an excentric N, cam, or its equivalent on the vertical shaft L. This is coupled to a toggle arrangement of levers O O^1 by the short connecting link or rod P. It will be seen that on the vertical shaft being put in motion the excentric N imparts a radial movement to the toggle levers O O^1; the lower lever O^1 being attached to the short lever V keyed on the horizontal shaft R below the comb circles, imparts thereto a to-and-fro or rocking motion, such movement giving to the levers S and T a radial reciprocating action, whereby the desired vertical reciprocating movement is given to the slides F F carrying the dabbing brushes E, this being transmitted from the levers through the connecting rod U. The invention also relates to the application of porcelain, glazed earthenware, glass, or a vitreous enamel in the construction of and coating of the feed boxes, conductors, and feed rollers.

1807. MACHINERY FOR COMPRESSING THE MATERIALS USED IN MAKING ENSILAGE, *T. Potter, Alresford.*—10*th April*, 1883. 4*d.*

This consists in the means of compressing ensilage materials in pits or silos by the use of iron standards built or fixed into the walls of the said pits or silos, and to which irons are attached iron cogs or fangs for the purpose of counteracting the pressure obtained by the use of screw jacks, hydraulic jacks, or similar machines.

1809. VESSELS FOR CONTAINING WINE, &c., *R. Dunlop, Cardiff.*—10*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to the construction of the vessel and to the means of drawing off the wine.

1810. SIMULTANEOUSLY REMOVING THE CORES FROM, AND SLICING, OR CUTTING APPLES, PEARS, &c., *W. Downie and W. J. Sage, London.*—10*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to the arrangement of a series of cutters.

1811. ADJUSTING THE SHAFTS OF WHEEL CARRIAGES, *C. Healey, Gloucester.*—10*th April*, 1883. 6*d.*

The object is to permit the shafts of wheel carriages to be raised and lowered and virtually lengthened at pleasure so as to suit them to horses of different sizes.

1812. ELECTRIC LAMPS, &c., *H. Edmonds, jun., New York.*—10*th April*, 1883. 10*d.*

One part of the invention relates to a peculiar arrangement of spring terminals for incandescent electric lamps which are adapted to be brought in contact with terminal studs, and open or close the circuit when a partial rotation is given to the base of the lamp, and to means for enabling the lamp to be readily disconnected from the bracket to which it is fitted. A Second part relates to an improved construction of switch. A Third part relates to the wiring and the forming of circuit connections upon chandeliers, electroliers, and other fixtures. Several other improvements are described.

1814. METER FOR ELECTRIC CURRENTS, *A. M. Clark, London.*—10*th April*, 1883.—(*A communication from G. Hochreutiner and A. Boucher, Lausanne.*) 8*d.*

This relates to a meter for electricity wherein the measure of the current which traverses the line is denoted by means of indications furnished by the gases resulting from the electrolysis of acidulated water or other suitable electrolytic solution; these gases acting mechanically on appropriate registering apparatus, such as ordinary or electrical machine counters or gas meters and the like.

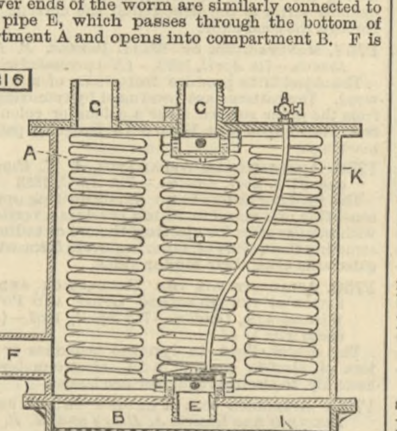
1815. BANDS OR HOOPS FOR HOOPING BALES, *A. A. Eichler, Alexandria, Egypt.*—10*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to the means of connecting the ends of the bands or hoops.

1816. APPARATUS FOR PRODUCING FRESH WATER BY DISTILLATION, *J. Kirkaldy, London.*—10*th April*, 1883. 6*d.*

In the drawing, A is the upper compartment of the casing; B the lower compartment; C the steam pipe led down through the cover of compartment A, and having nozzles projecting radially from it, to each of which is attached the upper end of a helical worm D. The lower ends of the worm are similarly connected to a short pipe E, which passes through the bottom of compartment A and opens into compartment B. F is

1816



a pipe by which a stream of water can be admitted to the lower part of the compartment A, and G is an outlet pipe by which water can flow off from this compartment. H is a filter bed resting on a perforated arched plate, which is supported by the bottom of the compartment B. I is a perforated plate placed above the top of the filter bed. J is an outlet pipe for carrying off filtered water from below the filter bed. K is a pipe by which air may be admitted to the chamber B.

1817. MANUFACTURE OR RECTIFICATION OF VASELINE, *W. P. Thompson, Liverpool.*—10*th April*, 1883.—(*A communication from H. and M. Bohm, Vienna.*—(*Not proceeded with.*) 2*d.*

The object is a new process of producing vaseline of a white and perfectly inodorous quality, and of any desired consistency, by which process perfectly colourless and inodorous lamp and grease oil are obtained at the same time.

1818. APPARATUS APPLICABLE FOR STEERING VESSELS IN CASE OF ACCIDENT, OR FOR A LIFE RAFT, *J. Philp and W. Forrester, Liverpool.*—10*th April*, 1883. 6*d.*

This relates to a floating rudder formed of a pontoon or float towed behind the ship by lines attached to it in such manner that when said lines are made of equal length the pontoon shall show very small resistance to the water; but when one line is lengthened relatively to the other the pontoon shall dart out to one side and present its broad surface obliquely to the water, thereby causing a great resistance tending to steer the ship round.

1820. BOATS WITH ADJUSTABLE KEELS, *S. R. Glyn, London.*—10*th April*, 1883.—(*Not proceeded with.*) 2*d.*

One feature of the arrangement is that the keel will yield automatically, should the same come in contact with the bottom, or with any obstruction, and thus prevent such accidents as might occur if the keel were rigid.

1821. CHIMNEY-TOPS AND VENTILATORS, *T. J. Baker, Newark.*—10*th April*, 1883. 6*d.*

This relates to improvements in chimney-tops or ventilators made with deflecting plates or parts having slits or openings formed or provided in or between the edges.

1822. MANUFACTURE OF HOSE PIPES, *J. C. Merryweather, Greenwich.*—10*th April*, 1883.—(*Void.*) 2*d.*

The hose is treated with hot solutions containing tannic acid.

1823. STEAM PUMP, *J. G. Joicey, Newcastle-on-Tyne.*—10*th April*, 1883. 6*d.*

The inventor claims, First, a pump having the suction and delivery passages surrounding a cylindrical piston valve. Secondly, a crosshead to connect a prime mover and a pump, to which the power is to be applied, with a crank controlling the stroke of the prime mover by a sliding block fitted with adjustable shoes.

1824. SHIPS, AEROSTATS, PROJECTILES, AND OTHER VESSELS OR STRUCTURES INTENDED TO BE PROPELLED THROUGH WATER OR AIR, *N. de Teleschef, Paris.*—10*th April*, 1883.—(*Complete.*) 8*d.*

This consists in the application to the construction of ships, locomotive torpedoes, &c., of certain forms and arrangements by means of which the "*vis viva*" of the fluid displaced by the forepart of such vessels or structures is converted into mechanical work acting on the afterpart, and in the line of motion thereof, thus reducing to a minimum the resistance opposed thereto by the inertia of the fluid.

1826. TAPS OR LIQUIDS, *H. Cullabine, Sheffield.*—11*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This consists in the substitution of removable faces of india-rubber or other suitable material for the usual permanent metal faces of the valve, and in the general construction of the said parts.

1829. ELECTRICAL SIGNALLING APPARATUS, &c., *B. J. B. Mills, London.*—11*th April*, 1883.—(*A communication from J. U. Mackenzie, New York.*) 8*d.*

The inventor claims, First, in electrical signalling apparatus, two or more spindles arranged side by side, each carrying two or more series of contacts, and adapted to be adjusted axially, to bring into position any one of the series of contacts, in combination with two or more contact springs acting progressively upon the contact spindles; Secondly, the arrangement of one or more contact arms upon a revolving shaft, in combination with one or more adjustable spindles, each carrying two or more series of contacts; Thirdly, the combination of the adjustable spindle contacts for producing variable signals, and contacts for producing a fixed signal. Other improvements are claimed.

1830. APPARATUS FOR REGULATING THE DRAWING AND DELIVERY OF PAPER IN CIGARETTE MACHINES, *A. C. Henderson, London.*—11*th April*, 1883.—(*A communication from E. F. Leblond, Paris.*) 6*d.*

The object is to draw variable lengths of paper to suit the different sizes of cigarettes, by a modification of the rotary motion of the drawing rollers, without requiring any alteration in the mechanism for transmitting motion.

1831. MANUFACTURE OF PLUSH FABRICS, *J. H. Cunliffe, Rochdale.*—11*th April*, 1883.—(*Void.*) 2*d.*

This consists in weaving a plush fabric by means of tappets or their equivalents, so disposed that all the covering or facing picks are symmetrically arranged in pairs in suchwise that while one is designed to produce a cover or pile at one side of the fabric, the next is designed to produce a similar cover or pile at the other side of the fabric; hence the result is a double pile fabric, that is one having a pile at both sides of the cloth.

1832. INCANDESCENT ELECTRIC LAMPS, *J. W. Swan, Bromley.*—11*th April*, 1883. 4*d.*

This consists in the application of electro-deposition or coating or covering whereby copper or other suitable metal is deposited or coated around the outward projecting platinum terminals, whether they be in the form of loops or pins or in any other form, so as to strengthen and enlarge them, or give them such a shape as will facilitate the making of a firm attachment or electric contact to or with the lamp holders or conductors.

1833. BREECH-LOADING, HAMMERLESS, AND OTHER GUNS AND RIFLES, *W. Anson and J. Deeley, Birmingham.*—11*th April*, 1883. 6*d.*

The invention consists of an improved lifter, an improved method of forming and coupling together the top and bottom bolts, and certain improvements in the method of actuating such bolts.

1834. FOLDING BATH OR INVALID CHAIR, *O. Wolff, Dresden.*—11*th April*, 1883.—(*A communication from F. G. Leupold, Dresden.*) 6*d.*

This relates to improvements in folding bath and invalid chairs, and consists of the various constructive arrangements so that the parts of the said folding bath or invalid chair can be folded together into the smallest possible compass.

1836. APPARATUS FOR CLEANING LEAD AND OTHER METALLIC ORES, *T. Archer, Dunston.*—11*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to the employment of a revolving tube in which the ores are placed, and through which a blast of air passes, the tube being slightly inclined.

1837. RAILWAY SIGNALLING AND APPARATUS AND FITTINGS CONNECTED THEREWITH, *W. Lawson, Dumfries, and T. Forrest, Glasgow.*—11*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to an arrangement for detonating signals.

1838. PIANOS, *E. G. Brewer, London.*—11*th April*, 1883.—(*A communication from L. N. Letailleur and P. Scholtus, Paris.*) 6*d.*

This relates to the sounding board and to the means of stringing.

1839. APPARATUS FOR REMOVING THE ENDS OF EGGS, *R. H. Rowland and T. F. Stidolph, Woodbridge.*—11*th April*, 1883. 4*d.*

The egg opener consists of two rings or plates with openings attached to a handle, and with space between for a knife or cutter.

1848. ELECTRIC LAMPS, *A. Partz, London.*—12*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This consists essentially in the combination in an electric lamp of a copper-plated or otherwise metalised stick of carbon, an upright metallic tube holding the same, and being just wide enough to allow it freely to slide therein, and a piece of carbon in the shape of a cone, or presenting a plain or curved incline of about 45 deg., on which the stick of carbon stands, so that through its tendency to slip down the incline it is always kept sufficiently braced in the tube to preserve the necessary contact for the passage of the electric current, the positive conductor of which is made to communicate with the said tube and the negative with the said cone.

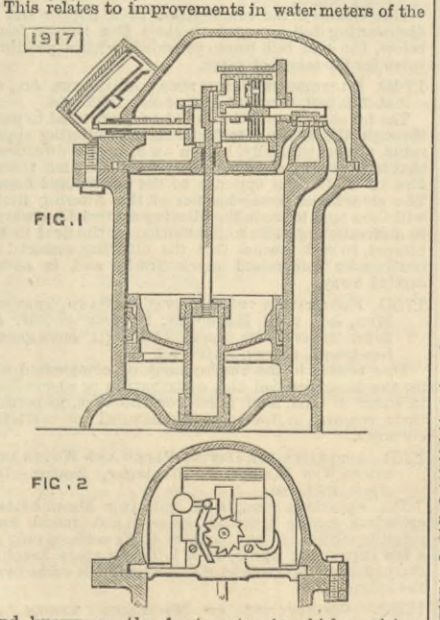
1879. APPARATUS FOR ELECTRIC SIGNALLING AND ALARM-GIVING, *J. H. Johnson, London.*—13*th April*, 1883.—(*A communication from A. Jeanjean and L. J. H. Eon, Paris.*) 6*d.*

According to the invention a thermometer is placed in connection with the circuit of the signalling apparatus, and this thermometer is so adjusted that when a given temperature is exceeded the circuit is automatically closed. Notice thereof is immediately given by means of the bell or communicator of the said signalling apparatus.

1917. WATER METERS, *C. Imray, London.*—16*th April*, 1883.—(*A communication from C. Michel and A. Frager, Paris.*) 6*d.*

This relates to improvements in water meters of the

1917



kind known as the frost meter, in which a piston moved by the water to and fro in a cylinder as it approaches the extremes of its stroke moves a rod, which by a pawl works the ratchet wheel of the counter and also moves a slide governing ports of a small subsidiary cylinder, the piston whereof works the slide of the main cylinder. According to the present invention the main cylinder is separated from the inflow cavity by a partition or cover making one joint with that of the external cover with the cylinder the subsidiary cylinder and its ports or passages are so combined as to form a single piece; and the pawl which works the ratchet of the counter is made with a tail piece, which prevents it from engaging more than one tooth at each stroke, and with a projection which, at each upstroke, meets a stop causing it to engage with a tooth of the ratchet.

1977. SELF-ADJUSTING SAW HANDLE, *B. Goulson, New Zealand.*—19*th April*, 1883. 4*d.*

This relates to means of attaching saw handles to the blades of cross-cut and other similar saws, and so that workmen can fix or detach the said handles with great facility.

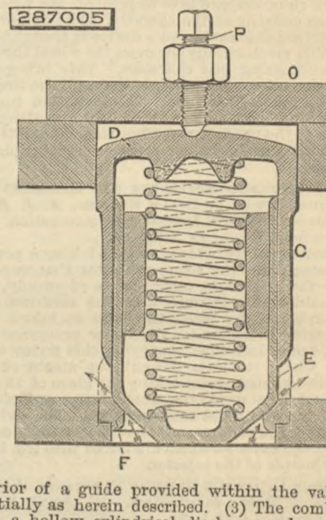
SELECTED AMERICAN PATENTS.

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

287,005. OUTLET VALVE FOR AIR COMPRESSORS, *George R. Cullingworth, New York, N.Y.*—*Filed January* 16*th*, 1883.

Claim.—(1) The valve casing composed of a hollow cylinder C, and a seat ring F, connected therewith by supporting wings E, so as to leave an annular space between them, the cap D, screw P, and bonnet O, with the inner and outer walls of the discharge air chamber, substantially as herein described. (2) The combination, with a hollow cylindrical discharge valve for an air compressor, of a closing spring placed within the said valve and guided externally by the

287005



interior of a guide provided within the valve, substantially as herein described. (3) The combination, with a hollow cylindrical discharge valve of an air compressor, and the casing containing the seat for said valve, and a cap or cover to said casing, of a spring guide bushing within the said valve and a spiral spring arranged within the said valve and said guide bushing, and having its ends fitted to bearings in the said valve and cap, substantially as and for the purpose herein described.

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