THE PROTECTION OF COMMERCE.

Although the question of how our commerce is to be protected in time of war is perhaps the most important with which the naval administration of this country has to deal, it is a matter obscured by misconception, and for which no adequate provision has yet been made. Recent utterances abroad clearly show that in the event of war with any Power of tolerably maritime pretensions we must be prepared for a serious attack upon our commerce, which, if attended with only moderate success, would have serious consequences to our national prosperity. We say the matter is obscured by misconception, because there appears to be no general agreement of opinion as to the limit of such operations and the measures it may be lawful to take for their prevention. We therefore propose to consider first the international or political aspect before dealing with the means we should adopt to counteract the schemes of a future enemy. This is the more necessary as the utterances alluded to are at variance with the tendency of modern civilisation to mitigate the rigour of maritime warfare, and confine the operations as far as possible to the belligerents themselves, leaving the trade of neutrals undisturbed, even with an enemy, provided they do not supply her with contraband of war. Thus we find that on the outbreak of the Crimean War the Queen issued a proclamation conceding privileges to neutral States which they had not before enjoyed. After that war these were extended by the Declaration of Paris, which abolished privateering, exempted the merchandise of an enemy—except contraband of war—from capture when in the ship of a neutral State, and likewise exempted from capture the goods of a neutral, with the same exception, in the enemy's ships. At the same time it was agreed that only an effectual blockade should be recognised. It detracted not a little from the value of this international treaty that the United States did not subscribe to it, that nation wishing to go even further and exempt all private property from capture. We do not desire here to enter into the argument whether we are gainers or losers by the Declaration; but it is desirable to see how the clauses it contains will affect our commerce in time of war, and especially in reference to its protection. Advocates for freeing ourselves from the obligations of this Treaty have gone so far as to assert that to arm a merchant ship is to convert her into a privateer; and therefore, in view of privateering being abolished, she would on capture be liable to be treated as a pirate. But a privateer in the old days was, as the name signifies, a vessel equipped at the cost of a private individual for the purpose of carrying on hostilities on his own account, though under the sanction of the State to which he belonged. Plunder was his object, and his reward a large portion of the property he captured. It was no doubt due to the excesses of these auxiliaries that this mode of warfare became discredited, and eventually abolished. We are unable therefore to apply the term privateer to any vessel ordinarily employed in trade, but which during war is given some means of self-defence to be used solely for that purpose. The right to buy or hire any trading vessel and equip her as a *bonâ fide* war ship is, of course, unquestioned. By the second clause of the Declaration the merchandise of an enemy — except contraband of war — is not liable to capture in the ship of a neutral State. Before any merchant vessel could be taken the captain of a cruiser has first to ascertain her nationality, and, if belonging to a neutral, whether she carries contraband of war. If, for example, France and Germany were at war their cruisers could stop all merchant vessels on the high seas to discover these points, and would doubtless subject them to more or less vexatious treatment. In these cases the captain of the cruiser has a very delicate duty entrusted to him, because if the vessel has contraband of war it will be concealed, and on him rests the onus of discovery. But he has also to decide whether the contraband articles are for the use of the enemy, as it is permissible to carry warlike material to a neutral State; and in such cases an officer must judge whether the vessel is engaged upon this harmless occupation or one of a more hostile nature. Endless disputes may be expected to arise, and we are convinced neutral States would object strongly to their vessels being delayed, and trade interfered with, because two other countries chose to make war upon each other. The question is also complicated by the want of agreement as to what constitutes contraband of war. It was formerly held to include all descriptions of warlike stores, and other articles capable of being used for a hostile purpose, such as horses, and timber for building ships. Provisions for an enemy's port, in which a hostile armament is in preparation, have in some instances also been prohibited. But food, in the general sense of the word, has not hitherto been considered a contraband article; or coal, though the latter certainly is an indispensable munition of war. The French, however, in their late operations against the Chinese prohibited the import of rice into China, and found this the most effectual method of bringing their adversaries to terms. We believe our Government protested against this act, as it rendered our vessels carrying rice to any of the ports on the coast of China liable to detention; but we are not aware whether any attention was paid to our representations. Diplomatic protests are of little value unless it is evident that if not attended to stronger measures will be taken. The circumstance shows that the law of nations is binding only so long and so far as expediency may dictate. A powerful combination against England might declare wheat to be contraband of war, and we must be prepared accordingly. Under these conditions we should find the annoyances to which ships of neutral countries were subjected react in our favour, and most likely gain us several allies. The right of search would be strongly resisted by the United States, who might also object to her trade being impeded because other people were at variance. Although the merchant shipping of Great Britain is far larger than that of any other nation, in no part of the world will it be exclusively found; so that a hostile cruiser must be prepared to exercise or give up his right of search with neutral vessels, though it will be necessary to board them to verify their nationality. Even this operation, involving some detention as it must, will not be received with favour by trading vessels now accustomed for so many years to pursue their avocation without interference. National susceptibilities must, in fact, be taken into account. During the late blockade of the Greek coast, the allied fleets were most careful not to interfere with any vessels except those under the Greek flag, though steamers of other countries were daily passing through with munitions of war. The exemption from capture of a neutral State's merchandise in an enemy's ship also creates some difficulty for those who advocate a vigorous onslaught upon our commerce; and it will require very careful discrimination to prevent such neutrality becoming open hostility if rights of this description are rigorously enforced.

The case of the Alabama is often cited as an instance of the damage a single cruiser can inflict. But that vessel started on her course of depredations under exceptional advantages, and her pursuit by the cruisers of the Northern States was not, at the first onset, of a diligent or systematic nature. The undoubted sympathy also of a large section of the British nation with the Confederates was in her favour, or we certainly should have resented the wholesale destruction of English property in many of her captures. Although the gist of these remarks is to reassure those who predict the annihilation of our commerce if we should be involved in war with a powerful maritime nation, we are quite aware that at the commencement of hostilities we may have to deal with several Alabamas. We know this was the intention some years ago of Russia when war between the two countries was imminent. Steamers were purchased in the United States to be equipped as cruisers, and on the declaration of war despatched against our commerce. A dash was to be made to some point on the track of merchant vessels, as much damage done as possible in a short time, and then the process repeated in another locality. A communicative captain of one of these vessels stated this as the course he should pursue, though he owned that he expected eventually to be sunk. It is evident that whatever special means we adopt to frustrate these designs must be applicable at an exceedingly short notice. That is to say, a supplementary force of cruisers, whether obtained from our reserve of unarmoured war ships, or by the equipment of merchant steamers, should be at sea within a week after the order for their mobilisation was given. Owing to the vast extent of our colonial possessions, and the necessity for maintaining an adequate naval force on different stations, the normal condition of affairs entails a large peace establishment, but dispersed over an area of great magnitude. On the outbreak of war this force will have to be reinforced chiefly for the purpose we have indicated, and we will now see how this can be carried out with the resources at our command.

At the present moment we have in commission, and ready for immediate service, twenty vessels of war suitable for this work, with a speed of fourteen knots and upwards. It seems undesirable to include any with a less speed. Some might assert that sixteen knots should be the minimum, in which case our twenty ships are reduced to ten. It is obvious this number is quite insufficient to patrol the various ocean routes, even if we include all the ships building, and which will doubtless be ready within the next two years. In addition to these we require at least ten more corvettes of about 2000 tons, carrying a light armament, and having a speed of not less than eighteen knots. The Archer class, of which we have eight completing, are a useful type on which to improve. But whatever increase be made, we could not rely entirely upon the regular war ships to protect our commerce, and should have to equip temporarily several of the fine steamers of our mercantile marine. They form, in fact, a reserve of enormous value if arrangements are made for their being available when required.

A little over ten years ago the Admiralty instituted inquiries among the principal shipowners as to the capacity in speed and construction of their steamers for this service. Certain requirements in the above respects were laid down, and a list was made of the vessels suitable for cruisers. In 1878 the First Lord of the Admiralty stated in Parliament that in the event of war it was intended to arm thirty of these steamers. That number of armaments, consisting of inferior 64-pounders and obsolete 40-pounder Armstrong guns, were with difficulty scraped together, and have, we believe, been distributed to the different stations, so that vessels can be equipped abroad. Again, when war seemed imminent last year, sixteen steamers were hired by the Government, and in one or two instances armed. The Oregon took part in the operations of the evolutionary squadron, the chief of which reported highly of her useful qualities. The defect of the present system is that there is nothing to bind shipowners to reserve their vessels for Government use if required. It is notorious that some of the finest have only been retained in this country by the patriotism of their owners. We cannot expect this to continue in the future unless some return is made. An annual retaining fee is paid to every man of the Royal Naval Reserve on condition of his undergoing a certain amount of drill per annum and giving the Government his services when demanded. The same principle should be carried out with our reserve of steamers. They might be divided into two classes—the first class to include steamers of fifteen knots and upwards, the second class those between twelve and fifteen knots. Certain conditions as to subdivision by water-tight compartments and protection by fuel should be imposed. Positions for guns should be selected, and fitted to receive them, so as to prevent delay when desired to equip the vessel. No steamers on this list to be sold without permission of the Government, who should have the right to purchase or hire when an emergency arose. An annual subsidy to be paid to the owners of every vessel placed on the Admiralty list. Instead of the hybrid armament now prepared, we should recommend six, eight, or ten 5in. breech-loading guns, according to the size of the vessel, mounted on central-pivot carriages. Also a few quick-firing guns, throwing a 3-lb. projectile. The 5in. gun is an excellent weapon, light, but of considerable range and power, and would necessitate only slight modifications in the hull where it was placed. These vessels, not being intended to cope with ironclads or armoured cruisers, need not carry armour-piercing guns, and to do so would entail much additional strengthening to the hull.

Neither do we advocate giving torpedoes, though in a vague sort of way it has been stated that this weapon would put them on terms of equality with a man-of-war. But in the event of her being able to get within torpedo range without being previously disabled by the guns of the man-of-war, we must also credit the latter with the ability to torpedo her adversary, and with a better chance of success, owing to the larger target presented by the cruiser. The fittings necessary for the efficient discharge of locomotive torpedoes are not so simple as many people suppose, and they cannot be improvised in a hurry. As stated some time back, it is most essential that these auxiliaries should be at sea before an enemy could begin his ravages, and this will not be the case if too elaborate an armament is provided for them.

Thus equipped, and manned with crews from the Royal Navy and Naval Reserve, these steamers would be *bonâ fide* ships of war, capable of rendering a good account of similar vessels acquired by the enemy to harass our commerce. It will be observed that these suggestions deal only with the question of supplementing our navy with a certain number of armed merchant steamers withdrawn from their ordinary work. Probably twenty would be as many as could be spared, because we may anticipate a great demand in time of war for fast steamers to carry the merchandise now transported in sailing vessels and steamers of slow speed. The question then arises, should we not give the more important of our steamers trading at that time some means of self-defence, so that they should not be at the mercy of any small cruiser or torpedo-boat. We think this can be done to a limited extent, especially as in most cases they would, if our suggestions were followed, be on the Admiralty list. Two or four 5in. guns could be placed on board without inconvenience and worked by the crews. It is impossible with the space at our command to enter fully into details, as the subject is one of great magnitude. Our main object has been generally to show the broad lines upon which it should be treated, and the necessity of a more thorough organisation than now exists. When this has been accomplished we shall not be subject to these periodical scares respecting the protection of our commerce which the earliest threatenings of war now invariably produce. Already a cloud no bigger than a man's hand appears on the horizon; the political barometer is falling, and a few months may see an old struggle renewed, from which we may not be able to hold aloof. Preparations to maintain our maritime supremacy should therefore no longer be delayed.

THE ORIGIN OF THE BOGIE AND EQUALISING BEAM.

It appears that not only the bogie, but the equalising beam or lever can be clearly proved to be English inventions, though an American origin is often claimed for both of these useful adjuncts to rolling stock for rough permanent way. An account of the origin of the bogie, contained in a recent issue of the *Railroad Gazette*, states that the first bogie used in America was placed in 1829 under some granite cars used on the Quincy Granite Railway, near Boston. A man named Gridley Bryant testified in 1853, at a trial arising out of a patent suit on the question, that in the spring of 1829 he made some eight-wheeled cars for the Quincy Granite Railway. These cars had two four-wheeled trucks or bogies free to swivel round a centre pin or king bolt, and side-bearings or friction plates. The wheels revolved on the axles. The curves on the various branches varied from 150ft. to 400ft. radius. The cars were permanent, and not temporary structures. The line was visited by engineers from the Albany and Schenectady, and Charleston and Columbia, two lines then projected on which bogies were, it is claimed, first introduced.

Several witnesses testified that Conduce Gatch, a foreman on the Baltimore and Ohio Railway—then worked by horses—built some temporary cars for carrying firewood in April or May, 1830. These temporary cars consisted each of two four-wheeled cars or trucks, each carrying a swiveling bolster, and connected by three longitudinal stringers. Conduce Gatch also claimed that he built the first passenger coach carried on two four-wheeled bogies in July, 1831. Contemporary newspapers contain accounts of the trial trip of this car on July 3rd, 1831, but it was asserted on the trial that the car was not successful.

The above are the earliest recorded uses of the bogie in the United States. It appears to have been first used there under a locomotive in 1832. In the patent suit referred to above, and known as the "Winans' eight-wheeled car case," Mr. John B. Jervis, one of the best known American civil engineers, gave evidence that he invented a truck or bogie in 1831, and that an engine with this bogie was put to work on the Mohawk and Hudson Railroad in 1832. A second engine on a similar plan was put in operation on the Saratoga and Schenectady Railroad early in 1833. The front end of the engine rested on the frame of a four-wheeled truck, so arranged that, by means of a centre-pin passing through a transom beam, the upper frame on which the engine rested could follow the guide of the lower frame without necessarily being parallel with it.

Messrs. Robert Stephenson and Co. built their first bogie engine in 1833. This engine was ordered, January 12th, 1833, for the line referred to above, by Mr. Jervis, the Saratoga and Schenectady. The engine was sent away from Newcastle April 6th, 1833, and was set to work in America July 2nd, 1833. It is often asserted that this engine, the "Davy Crockett," was the first locomotive with a bogie, but that is altogether a mistake, as shown above.

The bogie engine seems to have been little known to English railway men until 1839 or 1840. In the early part of the first-named year three bogie engines named respectively the England, Atlantic, and Columbia, were sent to this country by Norris, of Philadelphia, for the Birmingham and Gloucester line. They were tried in the first instance upon the Grand Junction, and were apparently not placed upon the railway for which they were intended until 1840. A notice of these engines is to be found in the "Proceedings" of the Institution of Civil Engineers for 1840, p. 46. In the "Proceedings" for 1843, p. 99, some particulars are given of another of Norris's bogie engines, the Philadelphia, which was used on the Lickey incline. It is quite evident from the tone of these papers, and the subsequent discussions, that the idea was new to most of those who took part in them.

George Stephenson, in his evidence before the House of Lords' Committee on the Tolls on Steam Carriages Bill, in 1836, said:—"There is a contrivance I saw the other day for passing round curves, but it is by having a centre to move on, so as to change the direction of the wheels to suit the curve like a gentleman's carriage; I thought it would not do." This might not have been a bogie, but Stephenson says not a word about the bogie engines made at Newcastle, although several questions were put to him about locomotives passing round curves. The word "bogie" is used round Newcastle to signify a sort of low four-wheeled wagon or truck without any sides, the axles being placed near together, so as to give a very short wheel base.

In a patent granted to W. Chapman, engineer, Newcastle-on-Tyne, and E. W. Chapman, rope maker, of Wallsend, on December 30th, 1812, there is a clear description of a four-wheeled truck. After describing various improvements in the rope-driving gear of a six-wheeled locomotive, in which one pair of wheels is connected rigidly with the main frame, the specification continues:—"The other two pair are fixed on axles parallel to each other to a separate frame, over which the body of the carriage shall be so poised that two-thirds of its weight should lie over the central point of the four wheels where the pivot is placed. . . . The two-thirds weight should rest on conical wheels or rollers bearing upon the curved lates so as to admit the ledgers of the wheels or those of the way to guide them on its curves or past its angles, by orcing the transome or frame to turn on the pivot and thus arrange the wheels to the course of the way similarly to the carriage of a coal wagon. And if the weight of the locomotive should require eight wheels, it is only requisite to substitute in place of the axis I I a transome such as described, laying the weight equally upon both, and then similarly to two coal wagons attached together, the whole four pair of wheels will arrange themselves to the curves of the railway."

Another patent, No. 5540, granted to William Chapman, of Newcastle-on-Tyne, civil engineer, on August 14th, 1827, contains the following description of an equalising lever. After quoting as follows from "Wood's Treatise on Railways:—"In the form of railway carriages placed upon four wheels, the weight upon any one of them is far from being regular. The frame of the carriage is necessarily made square, and the sides quite parallel to each other, and are kept permanently so by the sides being strongly bolted or fastened to each other. The bearing section of the wheels is therefore perfectly square, and parallel, and when the road is not similarly square and parallel—which in practice is seldom the case—the weight of the carriage will therefore be frequently resting on three wheels only, but chiefly on two in a diagonal direction; and from which cause, unless the rails be nearly twice as strong as otherwise necessary, a considerable breakage of them must take place." Chapman then states that his invention provides a remedy. Taking an existing four-wheeled coal wagon, he "equalises the pressure on the four wheels by placing under one of the side sills of the wagon a detached bar of wood or metal, moving upon a centre half way between the axles of the two wheels on that side of the carriage, and resting near the ends upon the journals of those axles, so that the carriage may always rest upon four wheels, notwithstanding any casual disparity of level that may exist between the two sides. This bar I call an equalising bar." Then follows a detail description of the equalising bar, and the method of securing and applying it, and strengthening the side of the wagon to which it is applied, so that the whole weight of one side of the wagon can come on the centre pin on which the equalising bar works. It will be observed that the wagon being four-wheeled Mr. Chapman applied the equaliser on one side only, the simplest method to ensure steadiness with a fair distribution of weight. The patent specification then continues:—"The above described improvement is not applicable to the side sill of a wagon of more than four wheels, because a lateral as well as a vertical motion then becomes requisite to every set of four wheels, and they of course require a transome resting upon a centre under the body of the carriage, without which a carriage of six or eight wheels could not move along any curve of railway." The patent then goes on to describe a method of lubricating axles by pressing a pad of tow, hemp, or folds of thick woollen cloth against the under side of the journal. In the wagon described the wheels were fixed to the axle and the latter revolved. The whole specification is evidently the work of a practical, clear-headed, and experienced engineer.

IRRIGATION IN EGYPT.

No. II.

THE Province of Behera is furrowed by a great number of small canals, which are supplied by the Mamoudieh and the Katatbeh, the latter fed by the Rayah at low tide; but it has an independent supply direct from the Nile, used only at the time of the river's flood. The Katatbeh runs parallel with the Nile for a great part of its course; it then branches off to the west, crosses the province, and empties itself into the Mamoudieh near the town of Damanhour. The Mamoudieh itself communicates with the Nile at the village of Atfeh, 24 kilometres to the south of Rosetta; it supplies the town of Alexandria, and waters also the northern region of the province. Both the Katatbeh and Mamoudieh canals only receive the waters of the Nile freely when at its flood; at low water they would be dry if it were not for the aid of the pumps. The Mamoudieh is nearly 80 kilometres long, and its average width is 20 metres; it is navigable, and before the construction of the railway was the only means of communication with Alexandria. The first machines set up at Atfeh thirty years ago raised 800,000 cubic metres of water in twenty-four hours to a maximum height of 2·60m., and were in work at the time of low water from February to the end of July—a period of about 180 days. They were, however, found quite inadequate to supply Alexandria and to water the river lands. The Government therefore determined not only to set up works at Katatbeh, but to increase the power of those already erected at Atfeh. Taking the average height of the Nile in a normal season, it was calculated that the machines at Katatbeh would have to be worked for 120 days, and those at Atfeh nearly six months; the two works would therefore be required to raise respectively 180 and 270 millions of cubic metres per year.

A concession was accordingly granted on the 26th of May, 1880, by S. E. Aly Pacha Moutarek, Minister of Public Works, to Mr. Easton, who, as soon as he obtained it, formed a company, under the title of the Joint Stock Irrigation Company of Behera. The construction of the machinery was entrusted to Messrs. Easton and Anderson, of Erith, and the work was to be completed the following year.

The system chosen for Katatbeh was that of immense Archimedean screws. These screws, ten in number, were ranged parallel with each other in an immense basin, 50 metres by 16·50, communicating directly with the Nile. The machines were set up in an especial building in a line with the screw basin, so as to accommodate the whole length of the screw beams; there were in all three machines. The revolutions of the screws were from five to six per minute, and the discharge was 25 cubic metres per revolution. These screws unfortunately, however, did not suceed; they were found unequal to resist the enormous weight of water they had to bear; they broke off at a joint at a third of their height. After various repairs and modifications, which were all found insufficient, a radical

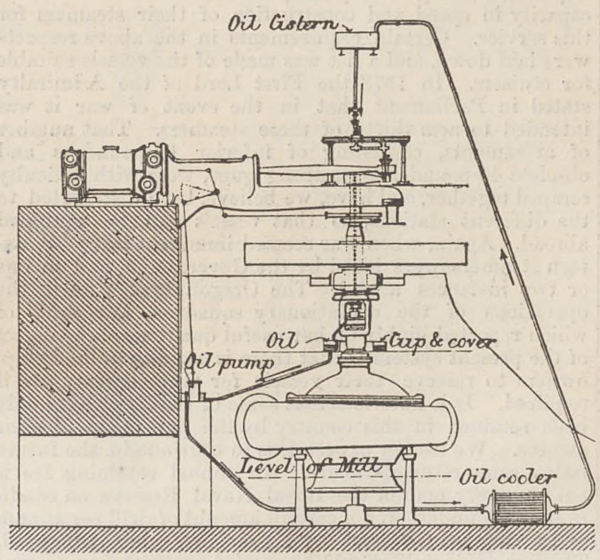


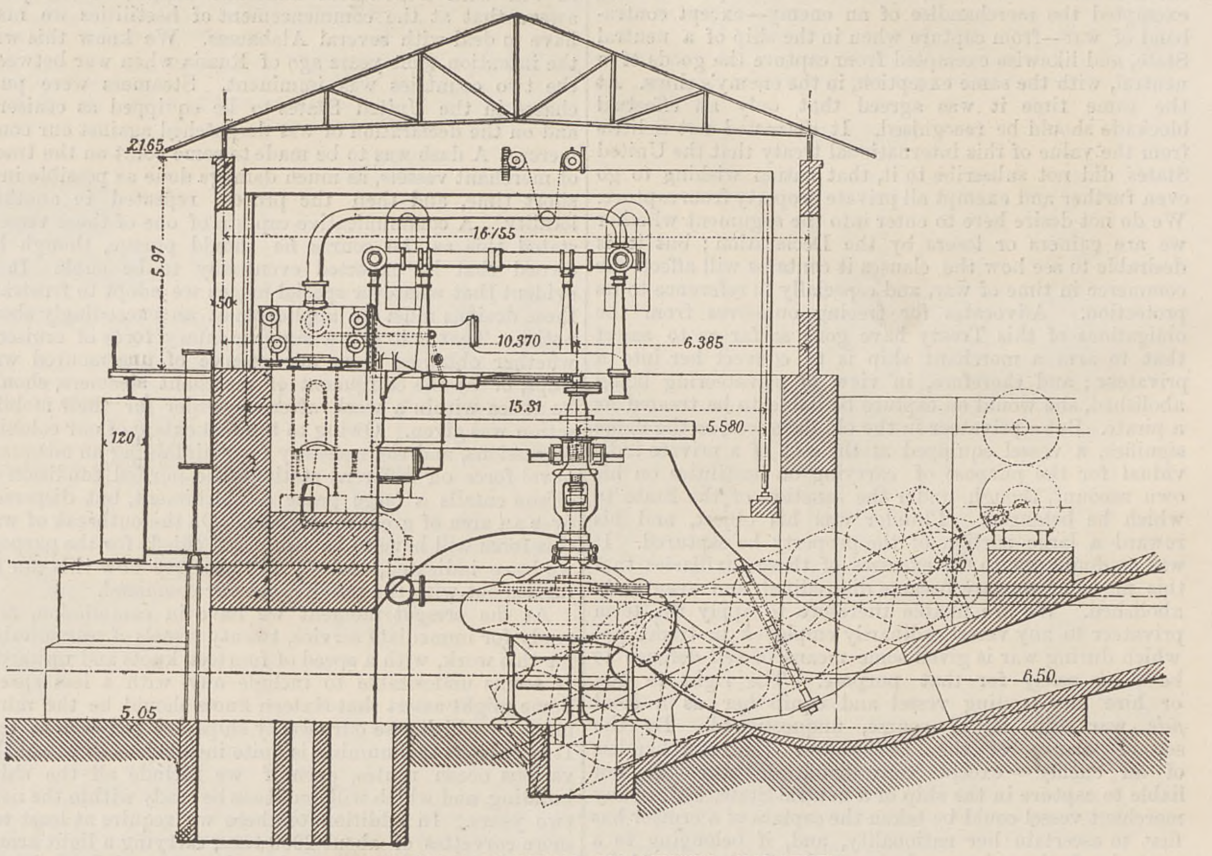
DIAGRAM ILLUSTRATING CIRCULATION OF OIL.

change was considered necessary as a protection against further accidents.

The company resolved then to condemn these screws, and to replace them by an apparatus of a type proved to be effective by experience. The Government having recognised the fact that the volume of 1,500,000 cubic metres per day was not sufficient for the irrigation of the province, a new contract was entered into with the company, under the ministry of S. Exc. Chérif Pacha, in January, 1883, whereby they undertook to set up new machinery at Katatbeh and Atfeh capable of discharging a volume of 3,000,000 cubic metres at Katatbeh, and 2,500,000 cubic metres at Atfeh. Meanwhile the company had separated itself from Mr. Ed. Easton, and the effective direction of the enterprise was entrusted to Egyptian engineers. Under these circumstances, they applied to M. L. Vigreux, Professor of Hydraulics at the Ecole Centrale, Paris, and to MM. Féray, constructors at Essomes, for the new works at Atfeh, and to M. J. Farcot, of St. Ouen, for those at Katatbeh. Some difficulties arose as regards the adjustment of the new machinery, on account of the necessity of utilising the old foundations as much as possible. The machines had to be placed at a sufficient height in order to be protected from the highest floods; it was therefore decided to use the works, which had been very solidly constructed on good foundations, as a base for the engines, and to place the pumps, which might without injury be submerged at high water, in the basin itself, which has been before mentioned as forming part of the works of 1880. The result of this was a vertical distance of 8·33m. between the level of the engines and that of the water mark.

For so small an elevation it was known that the use of suction pumps was disadvantageous; on the other hand, the utilisation of the foundations imposed the adoption of centrifugal pumps. To avoid the use of belts, which for such powerful works would have to be of vast dimensions, MM. Farcot conceived a bold solution of the difficulty by the use of vertical axle centrifugal pumps with a pivot out of the water. This had the advantage of great economy in the working—an important point in a country where the price of coal is 45f. per ton. The new works are now quite finished, and fully carried out during the last campaign the conditions of the programme. M. A. Porson, engineer of the Ecole Centrale of Paris, was at the head of the staff charged with the erection of the works at Katatbeh.

The difficulties the company had to surmount may be imagined when it is remembered that between the two campaigns, in less than eight months, the old apparatus had to be removed, the foundations transformed, an enormous block of



CENTRIFUGAL PUMPING MACHINERY, KATATBEH.

masonry constructed, and the new pumps and machinery of a weight of more than 1500 tons set up. The engraving above gives a transverse section of the engine-house, showing one of the engines with its centrifugal pump.

The building contains five engines, divided into two groups, separated from each other by three of the old screws, retained as a reserve apparatus. These screws have been modified and strengthened by the company, and were thus rendered serviceable during the late campaign. The wall in the centre not being very solid, it was not thought expedient to place the engines upon it, but judged better to fix them in two groups, divided by the three screws in the basin. The crank-shaft of each engine works directly a centrifugal vertical axle pump. The cylinders are 1 metre in diameter; the valve gear is on the Farcot system, of four slide valves for variable expansion, a centrifugal governor plant, and a condenser. The external diameter of the pumps is 6·90m.; the wheel, 3·80m. The vertical shaft carries a fly-wheel of a diameter of 6·70m., and 22 tons in weight, as well as the crank worked by the connecting-rod of the steam engine. The rotation is at an average speed of thirty-three, and a maximum of thirty-six revolutions per minute. A discharge of a volume of 600,000 cubic metres per day takes place; the whole, including the reserve screws, can discharge 3,500,000 cubic metres per day, and the water raised is equal to 2000-horse power.

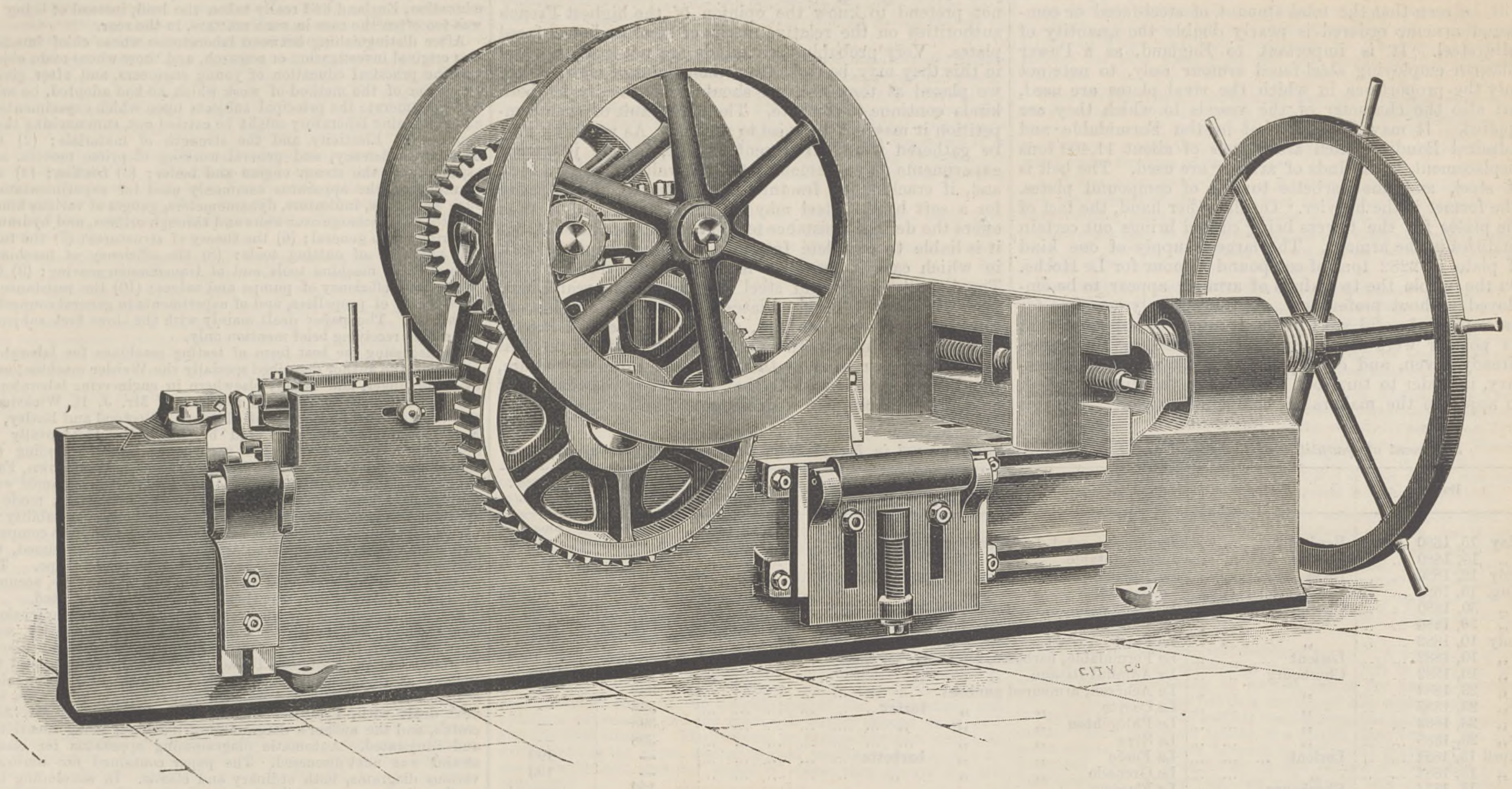
The steam is supplied by a battery of eleven boilers, three of which have a surface of 190 square metres; these were supplied by the Creusot Company, and the other eight by MM. Farcot. The effective pressure is 5 kilogrammes per square centimetre. Although these generators sufficed during the last campaign, experience has shown that it would be an advantage and an economy to increase the heating surface, and it has been decided to do so. The new establishment was inaugurated last June, and was in constant work until the time of the Nile flood. The quantity of coal consumed was kept below the prescribed limits, to the benefit of the company.

It may be stated, however, that great difficulties have had to be overcome; the machines ought to have been started after the campaign of 1885, but it was impossible to do this in consequence of serious accidents. The footstep discs of phosphor bronze which supported the weight of the crank shaft of the wheel and fly-wheel of the engine, that is to say, a total weight of 50 tons, broke up as if they had been fused.

Since then the defects have been completely remedied by two adaptations invented by MM. Vigreux and Farcot respectively. It was found, first, that the oil did not circulate between the discs; secondly, that the heat produced by the friction was not carried off with sufficient rapidity. It was therefore decided to force the circulation of oil and send it into the footstep by pressure; and to do this, a ring-shaped reservoir was placed round the shaft and above the pivot, filled with oil, and put into communication with the interior of the pivot, and a hole pierced in the axle of this pivot. In order also to produce

HORIZONTAL PUNCHING AND BENDING MACHINE.

MESSRS. FRANCIS BERRY AND SONS, SOWERBY BRIDGE ENGINEERS.



quicker cooling the division between the two compartments of the pump was removed, which established a circulation of cold water, drawn directly from the Nile, in the reservoir formed by the union of these two compartments.

The water then came into direct contact with the discs, and the oil running into the centre of the foot-step by high pressure entered the open spaces and prevented the metal from heating. Much of the oil, however, being lost by the constant flow of water, the process was not economic. M. Vigreux turned his attention to remedy this defect, and invented a new foot-step, which has been fitted to two of the machines with complete success. The system for the circulation of the oil is shown in the engraving. A pivot invented by MM. Farcot, after many experiments, has been applied to the other three engines, and has proved equally successful. Experience has proved that the quality of metal used for the discs has had great influence in bringing about a happy solution of the difficulty. The kind of oil used as a lubricant also has been found very important. Olive oil was not successful, being too fluid. Castor oil and vaseline have given the best results, and are now used exclusively.

HORIZONTAL PUNCHING AND BENDING MACHINE.

We illustrate by the engraving above a large horizontal punching, beam-bending, and straightening machine, made by Messrs. Francis Berry and Sons, of Sowerby Bridge, Yorkshire.

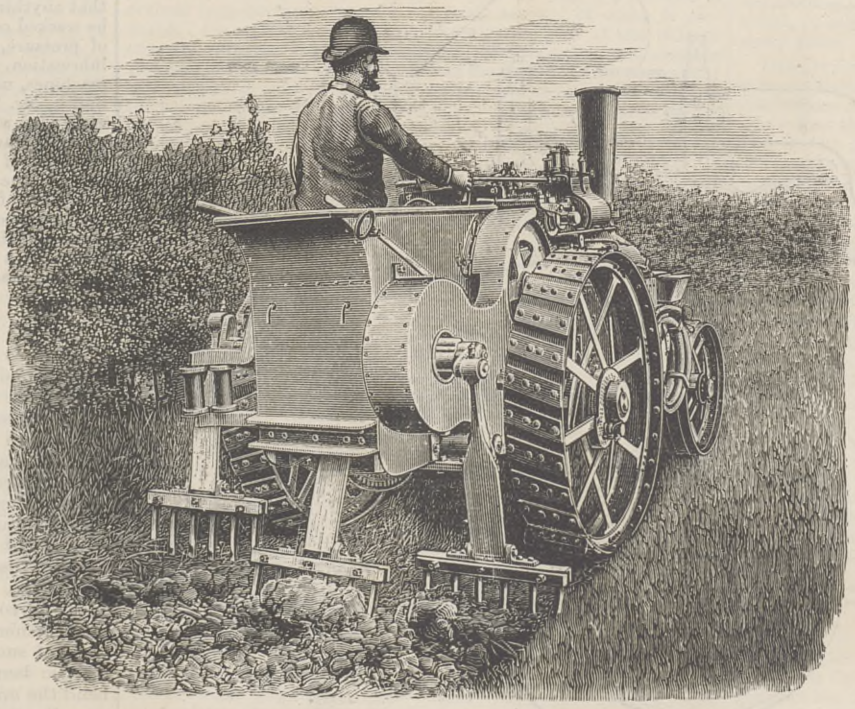
This machine is capable of punching holes one inch diameter through plates one inch thick, and is arranged to punch close and wide sections of channel and H iron. The other end of the machine is adapted for bending and straightening channel iron, H iron, joists, &c., up to 16in. by 6in. Both ends of the machine are fitted with improved disengaging motion and adjustable friction rollers, on which the iron to be operated upon can be easily moved. As will be seen from the illustration, the machine is powerfully geared and well adapted for the work for which it has been designed. This machine was made for Messrs. Stothert and Pitt, Bath.

PETROLEUM CARGOES.

In our last impression we pointed out that crude petroleum cannot be used as fuel at sea, although its use has been suggested. We have always inculcated the necessity for taking great precautions in attempting to use liquid fuel, and we regret to say that the soundness of our arguments has been disastrously proved by a dreadful explosion which took place on Sunday on board the steamship Petriana, of London, lying in Messrs. Clover's yard at Birkenhead, by which four lives were lost and several persons were seriously injured. The Petriana belongs to Messrs. Suart and Co., of London, and arrived at Liverpool from Batoum a few days ago with 2000 tons of petroleum, carried in tanks in bulk, which was discharged in the Herculaneum Dock. She encountered the recent storm on her way home, and suffered considerable damage thereby. A leakage was found in the tanks, and after the discharge of cargo she was taken to Birkenhead for repairs, which proceeded all Saturday and Sunday. There were six tanks, which extended from stem to stern. While the men were below with naked lights testing the tanks the gas ignited and an explosion took place. Five or six of the men managed to find their way to the deck. They were dreadfully burnt, and were removed to the hospital; but Captain Korkright, commander of the vessel; Mr. Fawcus, consulting engineer, Liverpool; Mr Mavor, manager to Messrs. Hawthorne, Leslie, and Co., of Newcastle—who built the steamer—and William Crawley, a labourer, were killed. Their bodies, which were recovered by a diver, were fearfully burnt. W. James, a fireman, who was dreadfully injured, was taken home. No damage was done to the vessel, and the fire was speedily extinguished by the fire brigade. The names of the injured men in the hospital are:—Robert William Corlett, Frederick James, John Ruth, Richard Hutton, John Allison, rivetters and boilermakers, and one more.

An inquest has been opened, but not concluded. One witness gave evidence to the effect that the petroleum vapour was drawn into the water ballast tanks when the latter were pumped out; a free communication existing between the two, as is often the case in ships carrying petroleum in bulk. The event will tell heavily against the carriage of petroleum in bulk; and although the prejudice will in time be got over, it is clear that special and extremely efficient arrangements must be adopted for ventilating the tanks. Safety lamps are not to be depended upon. The last word has not been said on the carriage of petroleum at sea.

PROCTOR'S STEAM DIGGER.



PROCTOR'S STEAM DIGGER.

The steam digger represented by the annexed engraving has been made by Messrs. Burrell and Sons, Thetford, from the designs of Mr. Frank Proctor. Those who have followed the modern phase of steam digger construction, including the Darby digger—illustrated in our pages—will readily understand the machine illustrated, and see that a departure from the beaten track has been made. The operation of the machine can be readily understood. We have not seen the new digger at work, but are assured that digging can be done by it whenever it is possible to do ploughing. The advantages of digging are undoubtedly numerous, and some of the very economical results attained have been sent us, but at present we need not publish these figures. The digger illustrated is one of those made for use in South America, where the first delivered has we understand proved very successful.

LONDON TRAMWAYS UNDER SNOW.

There is something assinine about the way in which the South of London tramway people proceed when the roads are under a few inches of snow. In the first place, they give it up, as they did last Monday, as a bad job, and attempt no service; another day comes, and they make a start by sending out several cars and sets of horses, to make their way somehow, if they can strugglingly manage it anyhow. Then they send out two or three men with shovels. After the cars have by great exertion been hauled over the snow-clogged road, the men clear the course a little by throwing the snow into everyone else's road, and by night the road is getting nearly clear for the tramcars, and nearly a block for anything that does not run on the track. Absolutely dangerous ridges of snow are left near cross-roads, and it seems to be nobody's business to see that the highways are not obstructed in this dangerous way. The tramway authorities are much to blame in this, for any agricultural implement maker would construct them a machine by which the track could be cleared by two passages of one horse over the route, and half-a-dozen of the machines would not cost as much as the companies lose by one snowstorm. After the track clearer had passed over the course, a few men could pile the snow in conveniently placed heaps, as they do in the City. The cars could by these means commence to run at their proper time and at proper intervals from the first, instead of losing hours of time as they do now, and pull horses to pieces too. The time lost by a dozen cars and the 100 horses they represent soon counts up, and the companies must take the whole of the horses for twelve cars, not simply the twenty-four in harness, in considering a matter of this kind.

It is not only the tramway authorities who are to blame, for roads within the jurisdiction of the Lambeth authorities are left in the most slushy, dirty condition, with crossings deep in slush, and with ponds of water at either end, except where the enterprising sweeper comes upon the scene. The piles of snow which the tramway men put anywhere out of their way remain until scattered by tradesmen's carts, and make traffic difficult and dangerous for every other vehicle which has to turn off the tramway line to stop at houses or pass other vehicles. People are kept at home by the disgraceful state in which the vestry and the vestry servants leave the streets and roads for which such high rates are paid. It may be said that clearing snow costs money, but it may be added that the rates at present paid if properly utilised provide the necessary funds and apparatus for keeping the streets clear of snow collections. Ratepayers should look to the accounts.

The Visit of the Iron and Steel Institute to Manchester.—A meeting of the local Reception Committee formed to make arrangements for the visit of the Iron and Steel Institute to Manchester, was held in the Town-hall, Manchester, last week, when it was announced that the Mayor of Manchester (Alderman Curtis) had consented to join the committee. Mr. S. Radcliffe Platt, of Oldham, was appointed chairman, and Mr. John Craven deputy-chairman of the Reception Committee; and Mr. T. R. Wilkinson, of the Manchester and Salford Bank, was appointed treasurer; and Messrs. James Johnston and Thomas Ashbury were appointed joint hon. secretaries. No date is yet fixed when the Institute will visit Manchester, but it is possible it may be the second or third week of September, 1887, when there is no doubt the members will receive a very cordial and hearty welcome to Manchester, and none the less so for having so distinguished a local man as Daniel Adamson for president.

STEEL-FACED AND STEEL ARMOUR FOR THE FRENCH NAVY.

WE give herewith an interesting table, showing the supply of steel-faced and steel plates to ships now in course of construction for the French Government By this it will be seen that the total amount of steel-faced or compound armour ordered is nearly double the quantity of solid steel. It is important to England, as a Power hitherto employing steel-faced armour only, to note not only the proportions in which the rival plates are used, but also the character of the vessels to which they are applied. It may be seen that in the Formidable and Admiral Baudin, which are vessels of about 11,400 tons displacement, both kinds of armour are used. The belt is of steel, and the barbette towers of compound plates. The former is the heavier. On the other hand, the fact of the plates for the towers being curved brings out certain qualities in the armour. The largest supply of one kind of plate is 2282 tons of compound armour for Le Hoche. On the whole the two kinds of armour appear to be employed without preference. As there is only one firm for the supply of solid steel plates, it might be supposed that its powers were fully engaged in meeting the orders already given, and consequently that it might be necessary, in order to turn out the ships in the time required, to apply to the makers of compound armour. If this were so, however, surely Messrs. Schneider would not be carrying out orders for foreign Powers. We are informed that the compound plates latterly have had better reports made on their proof trials than the steel, but we should require to see a complete list of the reports for the past year before giving weight to such a statement. We do not pretend to know the opinion of the highest French authorities on the relative merits of steel and steel-faced plates. Very probably their minds are not made up, and in this they may be right from their point of view. Were we placed as they are, we should undoubtedly let both kinds continue to compete. The final result of such competition it may not be wise to predict. As we think may be gathered from our recent articles, in our judgment experiments have demonstrated the value of a hard face, and, if cracking or fracture is objected to, the necessity for a soft back. Steel may be made hard, and it then offers the desired resistance to the entrance of the shot, but it is liable to complete fracture; or it may be made soft, in which case it more or less resembles wrought iron. The difficulty with solid steel is to combine a really hard face with a soft back. Plates compounded of different kinds of steel have, perhaps, a better prospect of success finally; but the experiments made at Sheffield in this direction appear to show that, to resist through fracture, the back must be so soft that it is very questionable if anything will compete with wrought iron for the purpose.

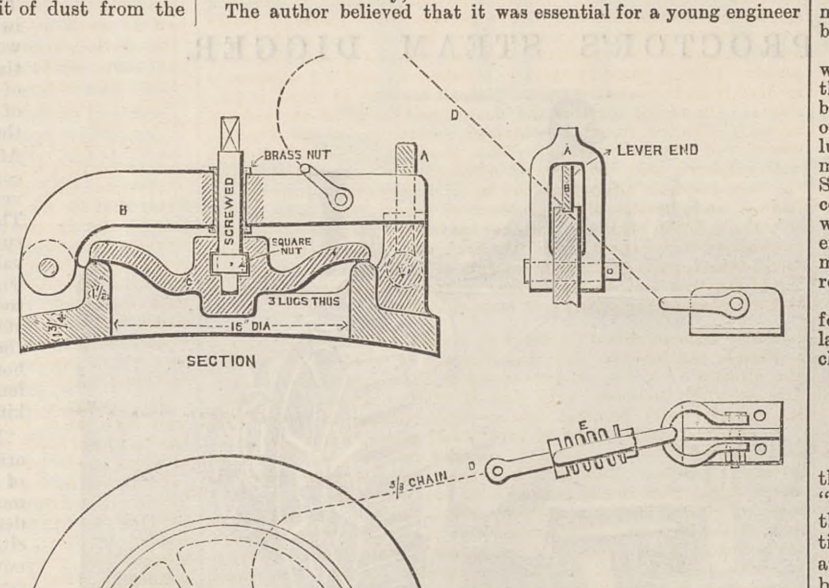
Statement of Quantities of Compound and Solid Steel Armour employed in French Ships in course of Construction.

Dates.	Ports.	Names of ships.	Compound metal.	Solid steel. Creusot.
			tons.	tons.
May 15, 1880	Bordeaux...	Le Requin, coast defender (barbette)	1716	—
,, 15, 1880	Lorient	L'Indomptable ,, ,, ...	1716	—
July 12, 1880	Brest...	Le Terrible ,, ,, ...	—	1716
Aug. 15, 1880	Rochefort	Le Caïman ,, ,, ...	1716	—
,, 30, 1880	Cherbourg	Le Duguesclin, barbette, sea-going...	394	—
,, 30, 1880	,, ...	Le Vauban ,, ,, ...	394	—
July 10, 1882	,, ...	Le Furieux, coast service barbette	—	993
,, 10, 1882.... ...	Lorient	Le Formidable, barbette, sea-going, 1st class	Tower, 944	Belt, 1829
,, 10, 1882	Cherbourg	Le Admiral Baudin ,, ,, ...	944	1829
,, 23, 1883	,, ...	Le Achéron, armoured gunboat	398	—
,, 23, 1883	,, ...	Le Cocyte ,, ,, turret...	398	—
,, 23, 1883	,, ...	Le Phlégéhton ,, ,, ,, ...	398	—
,, 23, 1883	,, ...	Le Styx ,, ,, ...	398	—
April 15, 1884	Lorient	La Fusée ,, ,, barbette	—	199
,, 15, 1884	,, ...	Le Grenade ,, ,, ,, ...	—	199
,, 15, 1884	Cherbourg	Le Flamme ,, ,, ,, ...	199	—
,, 15, 1884	Rochefort	Le Mitraille ,, ,, ,, ...	199	—
May 16, 1884	Lorient	Le Hoche, barbette, sea-going, 1st class	2282	—
Feb. 2, 1885	Toulon	Le Marceau ,, ,, ,, ...	1615	—
July 27, 1885	Cherbourg	Le Magenta ,, ,, ,, ...	—	1095
Nov. 9, 1885	Brest...	Le Neptune ,, ,, ,, ...	1246	—
		Total amount ordered	14,957	7860

LISTER'S HOT BLAST STOVE VALVE.

IN the manufacture of pig iron by the blast furnace, the tendency of late years has been to greatly increase the temperature of the blast, which is blown into the furnace through the tuyeres, saving thereby a substantial amount of coke; and in order to attain these high temperatures, fire-brick regenerative stoves of various types have been adopted. One of the drawbacks in the use of such stoves is the deposit of dust from the gas on the fire-bricks which form the regenerators; and unless this dust is frequently and thoroughly cleaned away, it becomes firmly affixed to, and forms a glazed coating over, the regenerator bricks, and thus prevents the proper absorption of heat by the bricks, destroying the efficiency of the stove to heat the air in its passage through the furnace. In many cases, especially where proper care has not been constantly taken to remove the dust, the stoves have had periodically to be laid off work, and mechanically cleaned by passing a scraper through the regenerator, or by some such means; and, indeed, when smelting an ore such as hematite, the gas from which contains a good deal of water, it is always somewhat difficult to keep the regenerator free from dust deposit.

In order to overcome this difficulty, Mr. Charles Lister, of Middlesbrough-on-Tees, has designed a valve which opens instantaneously by simply pulling a trigger and releasing the lid. This is done each time the stove is changed from blast to gas. The effect of this is that the air enclosed in the stove, which is usually slowly exhausted by a small valve made for that purpose, in this case being suddenly released through the opening of a large valve, rushes with great force down the regenerator, and drives out the dust through the valve opening, thoroughly cleaning the stove after each time of deposit, and thereby constantly keeping the stove in a clean and effective condition. There can be no doubt but that this simple means of cleaning the stoves, which are such an important factor in iron smelting, is well worth the notice and consideration of all employed in that process. In working, A is the trigger which releases the lever B and valve C. The valve is forced outwards, and is then checked by the chains D D, which are fitted with springs E E to relieve the jerk on the chains. The valve is then closed, and the gas turned on to re-heat the stove. In some cases two or more valves are fixed on the stove, so as to alternately blow the dust from different localities of the stove. The valves can be easily applied to existing stoves without stoppage of work, as they can be bolted on when the stove is working on gas. This valve has been adopted by several firms in the Cleveland district, the Clay Lane Iron Co., Messrs. W. Whitwell and Co., Messrs. Palmers, at Jarrow, and also in Cumberland, where it is found very efficacious and useful.



LISTER'S HOT BLAST STOVE DUST VALVE.

INSTITUTION OF CIVIL ENGINEERS.

THE USE AND EQUIPMENT OF ENGINEERING LABORATORIES.

AT the ordinary meeting on Tuesday, the 21st of December, Mr. Edward Woods, President, in the chair, the paper read was on "The Use and Equipment of Engineering Laboratories," by Prof. Alex. B. W. Kennedy, M. Inst. C.E.

The author believed that it was essential for a young engineer to obtain his practical training, in the ordinary sense of the expression, in a workshop. But the practical training of a workshop was incomplete, even on its own ground, and there appeared to be plenty of room for practical teaching such as might fairly fall within the scope of a scientific institution, and which should at the same time supplement and complete workshop experience without overlapping it. In an ordinary pupilage a young engineer did not have much opportunity of studying such things as the physical properties of the iron and steel with which he had to deal, nor the strength of those materials, nor the efficiency of the machines he used, nor the relative economy of the different types of engines, nor the evaporative power of boilers. He required such experience as might help him to determine for himself, or at least to see for himself how other people had determined, all the principal engineering constants, from the tenacity of wrought iron to the calorific value of coal, or the efficiency of a steam engine, or the accuracy of an indicator spring, or the discharge coefficient of an orifice. He thought that this kind of practical experience could be gained best in an engineering laboratory, in connection with some institution where technical instruction was given. He claimed that, in the matter of engineering laboratories, as a branch of technical education, England had really taken the lead, instead of being, as was too often the case in such matters, in the rear.

After distinguishing between laboratories whose chief function was original investigation or research, and those whose main object was the practical education of young engineers, and after giving an outline of the method of work which he had adopted, he went on to enumerate the principal subjects upon which experiments in an engineering laboratory might be carried out, summarising them thus:—(1) Elasticity and the strength of materials; (2) the economy, efficiency, and general working of prime movers, and especially of the steam engine and boiler; (3) friction; (4) the accuracy of the apparatus commonly used for experimentation, such as springs, indicators, dynamometers, gauges of various kinds, &c.; (5) the discharge over weirs and through orifices, and hydraulic experiments in general; (6) the theory of structures; (7) the form and efficiency of cutting tools; (8) the efficiency of machines, especially of machine tools and of transmission gearing; (9) the action and efficiency of pumps and valves; (10) the resistance of vessels and of propellers, and of experiments in general connected with both. The paper dealt mainly with the three first subjects, the others receiving brief mention only.

In discussing the best form of testing machines for laboratory purposes, the author described specially the Werder machine, used by Bauschinger, and largely elsewhere in engineering laboratories on the Continent, the vertical machine of Mr. J. H. Wicksteed, and the horizontal machine of Messrs. Greenwood and Batley, on Mr. Kirkaldy's principle, used by himself. Incidentally he described a number of other testing machines, including the Emery machine at the United States Arsenal at Watertown, Fairbanks' machine, and others. The three machines first named were compared in some detail in respect to their accuracy, mode of applying load, methods of making observations, adaptability for varied experiments, simplicity, and accessibility; and the comparative advantages and disadvantages of each were discussed, the author preferring, on the whole, the Greenwood type. The method of testing employed by the author, with pump, accumulator, and Davey motor, was then described and illustrated.

Different apparatus for the measurement of minute extensions, compressions, &c., occurring below the limit of elasticity, were next discussed, the instruments specially mentioned being those of Professor Unwin, Professor Bauschinger, Mr. Stromeyer, and the author, as representing micrometric, optical, and mechanical exaggeration of strains. Automatic test-recording apparatus was next dealt with, Professor Unwin's, Mr. Wicksteed's, Mr. Ashcroft's, and the author's diagramming machines being mentioned and illustrated. Automatic diagramming apparatus for elastic strains was next discussed. The paper contained *fac similes* of various diagrams, both ordinary and elastic. In concluding this section of the paper, brief references were made to machines for transverse tests, torsional tests, shearing tests, cement and wire tests, secular experiments, experiments on repeated loads, &c.

In discussing the design of an experimental engine for laboratory purposes, the author first enumerated the principal conditions under which such an engine should be capable of working, summarising them thus:—(1) Condensing or non-condensing; (2) simple or compound; (3) compound, with cranks at various angles; (4) with the greatest possible variation of steam pressure; (5) with the greatest possible variation of cut-off and other points in the steam distribution; (6) with the greatest possible variation of brake power; (7) with considerable variation in speed; (8) with or without throttling; (9) with or without jackets, and with varying conditions as to their use; (10) with variation of clearance spaces; (11) with variation of receiver volume; (12) with or without arrangements for intermediate heating; (13) with variation in the reciprocating masses. He then enumerated the principal quantities which had to be measured during an engine test, making remarks upon each important point in passing. A list was given of the principal experimental engines in existence, including those in London, Birmingham, Leeds, Munich, and Liége. This section was concluded by a description of the arrangement of an experimental boiler.

Under the head of "Friction Experiments," the principal points were summarised upon which experiments were required, in order that anything like a complete theory of friction in machines might be worked out. These included the variations of velocity, intensity of pressure, extent of contact, temperature, lubricant, method of lubrication, and nature of rubbing material. Friction measuring machines, used or proposed by Professor Thurston, Professor R. H. Smith, Mr. Tower, and himself, were briefly described. The paper concluded with a few remarks on laboratory experiments connected with hydraulic work, the theory of structures, the form and efficiency of cutting tools, the efficiency of machines and of transmission, the action and efficiency of pumps and valves, and the resistance of vessels and propellers.

In an appendix there were added:—(*a*) Forms used by the author for conducting engine trials. (*b*) Notes on the principal engineering laboratories in Europe and in America, with brief accounts of the chief apparatus used in each.

THE ROYAL INSTITUTION.

ON Tuesday, December 28th, Professor Dewar, F.R.S., delivered the first of six Christmas lectures at the Royal Institution, on "The Chemistry of Light and Photography." The first part of the lecture was devoted to experiments on light of an educational character. Towards the close he stated that the Chinese and Japanese knew certain peculiarities of mirrors before they became known to the Western World. In the "magic mirror" of the Japanese, the observer could see only his own face; yet, let a ray of sunlight fall upon the surface of that mirror, it will reflect a special image of its own upon the wall, which phenomenon the natives had long used as a part of their religion. Their mirrors were of polished metal, and he would imitate the phenomenon by means of an image filed by himself upon the back of such a mirror; it then reflected a beam from the electric lamp as usual, but when he applied strain to slightly bend the mirror in one direction, the image at its back appeared upon the wall in more luminous form than the surrounding ground. When he bent the same mirror in the opposite direction the image appeared dark upon a light ground; this was due to the production of an exceedingly slight convexity or concavity of the front surface, where he had filed away some of the back. Another way of causing the reflection from the front surface of a mirror of an image at its back was to apply a heated pattern behind; by applying the heated seal of the Royal Institution to the back of a mirror, a representation of the seal was thrown by the front surface upon the screen. In the course of his experiments he exhibited a hollow glass globe, about a yard in diameter, in which the air was so free from floating dust that it would not scatter a beam of light.

FRENCH TRIPLE EXPANSION ENGINES.

ON page 528 we illustrate triple expansion engines, patented and constructed by La Société des Ateliers et Chantiers de la Loire, for use in high-speed launches. In another impression we shall publish additional illustrations, and until then we shall reserve our description. Perhaps the most novel feature about these engines is the method adopted for working the pumps.

RAILWAY MATTERS.

CANSEAU, Nova Scotia, was on the 28th inst. put in direct circuit with New Westminster, British Columbia, an unbroken land line of 4600 miles, over the wires of the Canadian Pacific Railway.

THE Municipal Council of Paris has granted to the Committee of the Jubilee of Railways the free use of 900 acres of the most attractive portion of the Bois de Vincennes, including the lakes, and the works will be commenced immediately.

A NEW cable railway was opened to the public in New York on December 1st. The new road is a cross-town line, running from the East River to the North River on 125th-street. It is owned by the Third Avenue Railroad Company. The machinery was furnished by the Jonson Foundry and Machine Company, of New York.

AT present the aggregate length of railways open for traffic in Ceylon is 177⅜ miles. The gauge is 5ft. 6in. The construction of the main line from Colombo to Kandy—74½ miles—originally projected by a company in 1847, was not actually commenced until 1863, and was opened for traffic in 1867. The cost was 233,354 rupees per mile.

THE American "Consolidation" engine—so called from its being designed at a time when several railways were being united—appears to be the favourite engine in the States for work on long grades. Those on the Northern Pacific Railroad have a grate area of 30 square feet, and a heating surface of 2000 square feet, with four pairs coupled driving wheels of 4ft. 1in. diameter, and a four-wheeled bogie truck in front, the weight on the four driving axles being 45 tons, and that on the truck 6¼ tons.

THE *American Machinist* states that the Manhattan Elevated Company is adopting solid brass driving boxes for its locomotives. There being nothing to shake loose in the box, the cost of repairs is reduced, and slightly larger axles can be adopted without altering other parts. Iron cabs have been found to do well, and are replacing the wooden cabs. A Belpaire fire-box is soon to be tried on one of the locomotives. We have used solid brass boxes in this benighted country for very many years, and we have no wooden cabs.

THE style of fire-box invented by Mr. J. E. Wootten appears to be in increasing use, and the following figures show the number of locomotives with this fire-box built for the Philadelphia and Reading (P) and for other companies (O) by the Baldwin Locomotive Works. This firm built the first Wootten fire-box engine in 1880. 1880, P 18, O 5; 1881, P 30, O 10; 1882, P 30; 1883, P 28; 1884, P 24, O 2; 1885, O 3; 1886, to date, P 10, O 43; totals, P 140, O 63; whole total, 203. Of this number 24 were to burn bituminous coal, and the remainder anthracite.

A ROUGH average of dimensions and weights derived from the corresponding engines of those respective types as in use on the London and North-Western, the Midland, the Great Northern, the Great Western, the North-Eastern, the London and Brighton, the Caledonian, and the Lancashire and Yorkshire Railways, presents the following figures, given by Mr. Ed. Woods, as fairly representative of modern practice:—Express passenger engines: Weight of engine in working order, say 42 tons; greatest weight on a single axle, 15 tons; area of fire-grate, 19 square feet; heating surface, 1300 square feet; pressure of steam in boiler; 140 lb. per square inch. Tractive power, assuming an average effective pressure of steam in the cylinders of 90 lb., per square inch, 8900 lb.:—Merchandise or mineral engines not being tank engines: Weight in working order, 38¼ tons; greatest weight on an axle—N.B. axles coupled—14 tons; area of fire-grate, 18 square feet; heating surface, 1300 square feet; pressure of steam in boiler, 140 lb. per square inch; tractive power, assuming an average effective pressure of steam in the cylinders of 90 lb., per square inch, 12,690 lb.

THE Toronto (Ont.) *Globe* of September 20th, says:—"Engine No. 61 on the Northern and North-Western Railway was built at the Brooks Locomotive Works, at Dunkirk, N.Y., and without any general repairs has exceeded the best record by more than the ordinary life of a locomotive. Its total mileage, without any general repairs, has aggregated 190,554, and in running that distance has not had even a pin, a brass, a driving brass, or a flue taken out in that mileage. After she had run 45,179 miles she had a slight accident which necessitated her being taken off her wheels, and she then had her tires turned. Since that she has run 145,375 miles without being lifted off her wheels. She was used at first, and for some time, as a freight engine, but at the time of the accident was converted into a passenger engine. She has a 17 by 24 cylinder and 5ft. driver. She has now just come out of the shop with Clarke and Reid's new smoke-box and stack, and is working very successfully. Her driver, Mr. Robert Pearson, has been in the employ of the Northern Railway for thirty-one years, and has run very considerably over a million miles without an accident worthy of record. It is needless to add that he is proud of his engine, and more than pleased with the improvements which have been recently made."

A RECENT accident at Perkasie (Pa.), Tunnel shows, says the *Scientific American*, the importance of thorough ventilation. The above tunnel is about half a mile long. Repairs are being made therein. On the 3rd inst. some fifty men were at work near the centre of the tunnel when a freight engine, unable to draw its train through the tunnel, became "stalled" near the place where the men were at work. Fresh coal was put in the locomotive furnace, and the blast set in action. Soon the train started, when it acted as a piston in a cylinder, driving the gases from the furnace before it; and when the gases struck the men who were working in the tunnel, they nearly all fell as if dead. With no premonition, about forty of them became almost instantly unconscious, and fell as they stood. One of the men, only partially affected, made his way to the tunnel entrance, and gave the alarm. A gravel train, with flat cars, happened to be standing there. It was run in to the place of the accident, and the bodies of the fallen men were dragged upon the cars, and taken out to the fresh air. All were supposed to be dead, but to the surprise of the rescuers, the recently dead men soon began to show signs of life, and in a short time all were themselves again, except one poor fellow, who, in his fall, sank into a pool of water, and probably was drowned. One of the unconscious men was found hanging on a ladder, head downward, suspended by his feet.

THE Furness Railway has just experienced the benefit of an improvement in the hematite iron trade. Its receipts have decreased for many months, indeed for years. In the first half of 1886 the decrease was at the rate of £1200 weekly. That decrease continued for some months into the current half-year; and thus, at the end of September, there was a rather heavy decrease in the traffic receipts for the half-year so far. But in the last three months there has been an increase of the receipts until the whole of the decrease has been swept away, and there is for the half-year as a whole a slight—indeed, a substantial—increase, when the size of the company is borne in mind. The Furness Railway felt the decline in trade seriously—its dividend on the ordinary stock for the first half of 1886 was only at the rate of £2 per cent. per annum. It can only be hoped for the last half of the year that the long decrease in the rate of the dividend has now been stopped, for the increase is not large in itself. But the fact that there continues a very considerable increase in the demand for hematite iron gives ground for hope that the future of the Furness Railway—as one of the largest of mineral railways—is brighter; and as the number of furnaces lit has been increased, and as more than three-fourths of the revenue of the company is from the carriage of minerals, it may be believed that the increase in the traffic receipts, which set in as these furnaces began to be re-lighted, will continue. The Furness line is one which serves a district dependent on pleasure traffic and on minerals, and as the latter has decidedly turned for the present, the result will be that the next half-year will be one of greater prosperity than has been known for some time.

NOTES AND MEMORANDA.

IN London during the week ending the 18th inst., 2415 births and 1499 deaths were registered. The annual death-rate per 1000 from all causes, which had steadily increased in the four preceding weeks from 17·4 to 21·9, declined to 18·8 During the first eleven weeks of the current quarter the death-rate averaged 18·2 per 1000, and was 2·9 below the mean rate in the corresponding periods of the ten years 1876-85.

A PAPER was recently read before the Paris Academy of Sciences "On the Means of Reducing Momentary Accelerations of Velocity in Machines Fitted with Regulating Gear Acting Indirectly," by MM. A. Bérard and H. Léauté. The writers describeed what they consider a trustworthy governor, applicable especially to machinery used in the manufacture of gunpowder. For the apparatus it is claimed that, while giving the required uniformity of action, it checks all abnormal increase of speed, so dangerous in this industry.

AN "Account of the Hurricane of March 3rd-4th, 1886, over the Fiji Islands," was read at the Meteorological Society, last week, by Mr. R. L. Holmes, F. R. Met. Soc. This storm was the most destructive that has ever been known to occur in the Fiji group. The lowest barometer reading was 27·54in. at Vuna, in Taviuni. The storm was accompanied by a great wave from 18ft. to 30ft. in height, which swept over the land and caused an immense amount of damage. It was reported that fifty vessels were wrecked and sixty-four lives were lost during this hurricane.

THERE were 13 boiler explosions reported in Germany in 1885, against 14 in 1884 and 1883. The number of casualties to persons was 22, against 45 in 1884, and 55 in 1883, the number of fatalities being 11, against 12 and 23, while two persons were badly injured and nine slightly injured. Of the boilers which exploded, three were vertical, eight horizontal, and two tubular. The cause of explosion was in three cases local weakening of plates, in three cases want of water, in two cases defective construction, and in one case each excessive incrustation, high pressure, faulty action of tubes, weak and defective construction, and careless attendance. During recent years there has been a noticeable falling-off in Germany in the number of explosions, as in that of fatalities.

A PAPER was recently read before the Cambridge Philosophical Society entitled "An attempt to explain certain Geological Phenomena by the application to a Liquid Substratum of Henry's Law of the Absorption of Gases by Liquids," by Rev. O. Fisher. The author supposes that a liquid substratum exists beneath the earth's crust, and that this consists of fused rock holding gas, chiefly water above its critical temperature, in solution. This water is supposed to be that which is given off so largely in volcanic eruptions. If such be the constitution of the substratum, the reactions between it and the crust will largely depend on it, and also the tidal effects." The problem on this substratum notion is worked out in the paper, and numerical results, which are said to accord fairly with observed facts—of course they always do—are obtained.

AT a recent meeting of the Royal Society, a paper was read "On Jacobi's Figure of Equilibrium for a Rotating Mass of Fluid," by Professor G. H. Darwin, F.R.S. Jacobi was the first to prove that a mass of fluid in the form of an ellipsoid, with three unequal axes, is in equilibrium when rotating about the smallest of the three axes. The determination of the axes in terms of the angular velocity of the system has hitherto been left in an analytical form, not well adapted for numerical calculation. In the present paper the formulæ are brought into a shape involving elliptic integrals, and, by the aid of Legendre's tables, a table of solutions is calculated. If σ be the density of the fluid, ω the angular velocity, and $\frac{4}{3}\pi\sigma$ the mass, then, when $\omega^2/4\pi\sigma = {\cdot}09356$, the Jacobian ellipsoid is a revolutional figure with axes 1·1972, 1·1972, 0·6977. For smaller values of the angular velocity the first axis increases and the two latter diminish. For example, when $\omega^2/4\pi\sigma = {\cdot}07047$, the axes are 1·899, 0·811, 0·694.

AT a recent meeting of the Chemical Society, a preliminary note was read on "The Electrolysis of Ammonic Sulphate," by Herbert McLeod, F.R.S. When a neutral solution of ammonic sulphate is electrolysed in a U-tube provided with platinum plates as electrodes, nearly pure oxygen is evolved at the positive pole and hydrogen at the negative. For one volume of gas from the positive pole, a quantity varying between 4·7 and 5·4 volumes is evolved from the negative pole. A small amount of ozone is produced. On mixing together the electrolysed liquid at the poles a strongly alkaline liquid is obtained, containing a considerable quantity of "active" oxygen. When the liquid is first neutralised with sulphuric acid, then treated with excess of baric chloride, and the baric sulphate filtered off, the liquid deposits baric sulphate on boiling, an indication of the presence of persulphuric acid in the solution. When sulphuric acid that has been electrolysed is exactly neutralised with baric hydrate, the precipitate filtered off and the liquid boiled, baric sulphate is precipitated; at the same time the liquid becomes acid and a further quantity of baric sulphate is thrown down on the addition of baric chloride.

A NEW cement, called "cement de Paris," has been introduced in France, the inventor and manufacturer of which is M. Vallin, the director of a French cement works, the Gypserie de la Gare. The *Scientific American* says that M. Vallin, instead of crushing the material after burning, does so before placing it in the kiln. "A crushing mill breaks it into small pieces, which are automatically conveyed to a vertical cylinder mill, whence they issue ground to powder. This is in turn again automatically placed on sieves, which shift it into pans or kilns heated by gas. A series of inclined plates, having a gyratory motion, agitate the powder in each of the pans, and thus render every particle of it amenable to the action of heat. Finally, a mechanical arrangement conveys it to sacks, which a man fills as the powder arrives. The whole operation is thus continuous and automatic, which of itself is a great advantage. But still more important and appreciable is the fact that all the particles of the cement are thoroughly burnt. M. Vallin estimates that his method enables him to effect a saving of about 30 per cent. over those ordinarily adopted. Besides the homogeneity of the particles, the other advantages claimed for this cement are its greater whiteness of colour, durability, and freedom from liability to unequal shrinkage, which causes fire cracks."

HERR SCHUMANN has compared—*Deutsche Bauzeitung*, 1886—cement made from basic blast furnace slag, erroneously termed "Puzzolan cement," with Portland cement, and finds the latter preferable for all the usual purposes. Puzzolan cement hardens very slowly, and its final hardness is inferior to that of Portand cement, which latter also offers greater resistance to the passage of water through it. Cement made from slag may be used as an addition to lime mortar, the quality of which is thereby improved, but its admixture to Portland cement deteriorates the quality of the latter. Herr Tetmaier—*Schweizer Bauzeitung*, 1886—examined slag cement, as regards its formation and applicability. He finds that to increase its cohesive power it is very important to granulate the slag before mixing it with lime. This is probably owing to the change of position the molecules undergo when the hot slag is suddenly cooled by being thrown into water. The slag also loses thereby a small portion of its sulphur, and part of the silica is rendered soluble. Acid slag is not applicable for the manufacture of cement, and a slag in the thin white-hot state is most suitable for granulation, thus yielding a very uniform product. The percentage of lime in the slag must not exceed a certain limit, for, whereas a slag containing 47 to 48 per cent. lime is most suitable, a slag containing 51 per cent. lime is useless for the preparation of cement. If the proportion of lime to silica decreases to one, the slag cannot be used without an extra addition of lime to make up for the deficiency. No conclusive experiments exist about the influence of sulphur on the properties of the cement, but a large amount of sulphur must, at any rate, be avoided.

MISCELLANEA.

IN the paper by Mr. Thwaite, published in our last impression, on heliography, and in the description of the gallic acid, or the Shawcross process, for 110 parts of water 1100 parts should be read.

AT the last meeting of the Witham Commissioners Mr. J. E. Williams, M.I.C.E., reported the completion of the Steeping River and Wainfleet Haven Improvements. The works have been carried out with great expedition and within the Parliamentary estimate.

CIRCUMFERENTIALLY corrugated wrought iron and steel tubes for steam and water are being made by the Wainwright Manufacturing Company of Philadelphia, the flexibility of the pipes being claimed as a great advantage as against bending and other stresses which cause fracture of plain pipes.

SIR WILLIAM ARMSTRONG and several other gentlemen, and also the Council of the North-East Institution of Engineers and Shipbuilders, have been appointed a committee to make the inquiries essential to the establishment of a class of naval architecture and marine engineering in connection with the Durham College of Physical Science in Newcastle.

THE lately inaugurated Midland Counties Miners' Federation is making decided progress. Propagandist meetings in connection therewith are being held in North and South Staffordshire, the Cannock Chase, Shropshire, and Warwickshire. At a conference held in Wolverhampton on Monday, deputations were appointed to settle disputes at the Pelsall Hall and Brereton collieries.

MESSRS. ROBERT STEPHENSON AND CO., of Newcastle-on-Tyne, have now added to the business of locomotive and marine engineers—for so many years carried on at South-street, Newcastle-on-Tyne—that of iron and steel shipbuilders, lately carried on by Messrs. Macintyre and Co., at Hebburn, and are now in a position to undertake the building of iron and steel vessels, fitted complete with machinery, or the repairing of vessels and their machinery.

THE new colonial passenger paddle steamer Horatio, built by Messrs. C. S. Swan and Hunter, Wallsend-on-Tyne, for Messrs. Sproston, Son, and Co.'s service in British Guiana, and engined by Messrs. Black, Hawthorn, and Co., Gateshead, recently arrived safely out at Georgetown, and is highly spoken of in the *Colonial Gazette* of the 8th November, having attained a speed of over 13 knots on her first run, being the fastest passage on record of vessels on the station.

THE American *Mechanical Engineer* says;—"A new iron smoke-stack is in course of erection at the rolling mill in Paterson, and while a man was working on its top, one of the guy ropes broke, and the ponderous pipe fell over the top of the engine-house. As it toppled the workman lost his equilibrium, and fell feet foremost inside. He commenced falling at a terrific rate; but as the pipe came nearer and nearer towards a horizontal position his speed decreased, and he brought up in the bottom of the boiler much frightened and shaken up, but uninjured. He fell a distance of 65ft."

THE steamer Florence Richards, which has just been triple-compounded by Messrs. J. Jack and Co. Liverpool, went on trial on Friday, the 24th current. The compounding has been effected in this case by retaining the existing engines, and adding a new engine forward of them. The altered engines have pistons 18½in., 27in., and 48in. diameter, by 33in. stroke, each working on its own crank. Steam is supplied by one large steel boiler, working at 150 lb. pressure, with three corrugated furnaces 4ft. in external diameter. The improved machinery is contained within the original bulkheads and occupies considerably less space in the ship. The trial was eminently satisfactory, and the steamer immediately after proceeded to Newport to load.

"SECRETARY WHITNEY," says the *Army and Navy Register*, "has finally decided on giving the contract for building the machinery, boilers, and hull of the twin-screw vessel, of 1700 tons displacement and 3300 indicated horse-power, to Cramp and Sons. This is the craft usually designated as 'Gunboat No. 1.' Quite an important innovation is noted in the specification for condensers. Instead of the old-fashioned cast iron shell, weighing oftentimes half as much as the entire machinery, Gunboat No. 1 will have 'the shells of condensers cylindrical and made of brass.'" We have here another proof of the antiquated condition of marine engineering in the United States. Condenser shells of brass, gun metal, or copper, have been used in England and France for very many years.

THE Dudley Chamber of Commerce have just had before them a communication from their secretary on the working of the Boiler Explosions Act, 1882. The communication stated that it was likely that the Government would soon proceed to further legislation in the direction of compulsory supervision of boilers. The workmen were constantly clamouring for an extension of official supervision, forgetting that all increase of working expenses operated vigorously as to wages and trade. It was doubtful if such inspection would prevent many accidents, for the causes which led to explosion developed suddenly. There would be no inspection between the periods of official inspection. The secretary was of opinion that there was no need for further legislation, and the Chamber agreed in these remarks.

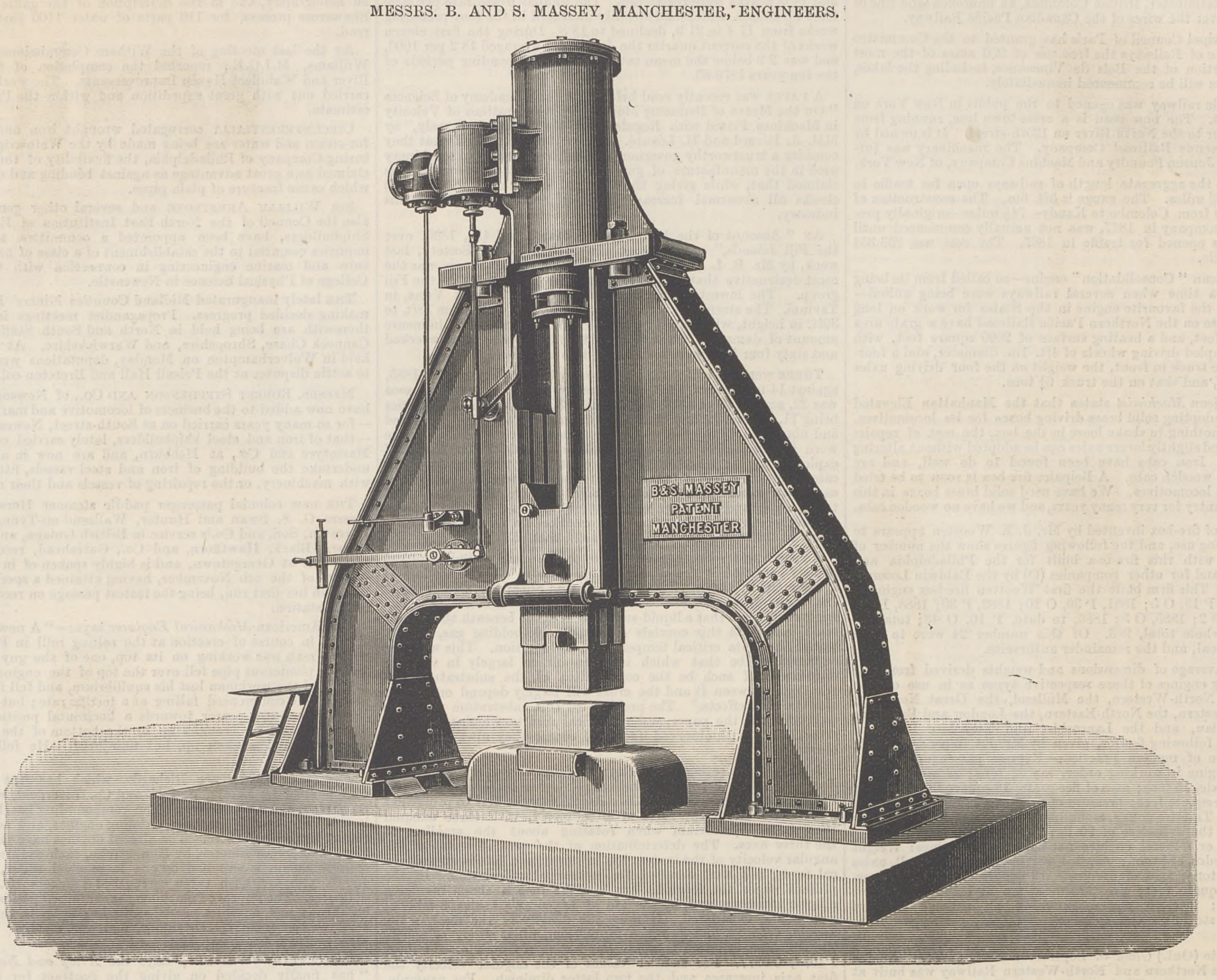
THE operative members of the Iron Trade Conciliation Board have been called together to consider in private a demand which has just been made by the Ironmasters' Association for a reduction of wages in the form of the abolition of certain "extras" of 6d. per ton, and so on, which are now paid to the men in the mills and forges. The masters have put before the men's agents a statement showing the difference which South Staffordshire occupies in this respect to other of the ironmaking districts, where the extras allowed are much fewer. The men's leaders will discuss the employers' claim at Wednesbury on Monday, and if they are unable to concede the terms demanded, the whole Conciliation Board will be called together, and the decision of the arbitrator will be sought. The standard rate of wages at date is 6s. 9d. per ton.

THE Secretary of the United States Navy has accepted the following bids for the construction of the new cruisers and gunboats:—Cruiser No. 2 (Charleston), Union Ironworks of San Francisco, at 1,017,500 dols.; cruiser No. 3 (Baltimore), Cramp and Sons, of Philadelphia, 1,325,000 dols.; gunboat No. 2, the Columbia Ironworks and Dry Dock Company, of Baltimore, at 247,000 dols. In the case of gunboat No. 2, no decision has yet been reached as between the bid of Reeder and Sons, of Baltimore, who propose to construct the vessel according to the plans of the Department, and the bid of Cramp and Sons, of Philadelphia, whose proposal contemplates the construction of the engines after their own designs. Although the Union Ironworks, of San Francisco, put in the lowest bid on cruiser No. 1 (the Newark), yet as the figures exceed the maximum amount fixed in the Appropriation Bill, the Secretary was unable to accept their bid.

THE main building now being constructed on the grounds of the American Exhibition of the Arts, Inventions, Manufactures, Resources, and Products of the United States, at Earl's Court, Kensington, is unique in several respects, and will in itself be a most interesting exhibit. The entire framework of the structure is composed of steel rails, such as are used in constructing railways. Two of these bolted back to back, with the T side out, make a very strong and really ornamental column. The only casting required is an angle piece and eye-bar, into which the ends of the rails are slipped. This frame will then be covered with plates of glass and sheets of corrugated iron. The advantages are many, including rapidity of construction—as an acre a week can be easily put up—and economy, no skilled labour being required to put it up or take it down; and when finished with, the material is as good and marketable as when first purchased. This invention permits the construction of large temporary structures, which can be quickly and cheaply built.

STEAM HAMMER WITH WROUGHT IRON STANDARDS.

MESSRS. B. AND S. MASSEY, MANCHESTER, ENGINEERS.



AN IMPROVED STEAM HAMMER.

In our "Lancashire Notes" of November 12th reference was made to an improved form of construction introduced by Messrs. B. and S. Massey, of Manchester, in their well-known steam hammers, and a short descriptive notice was given of several they have recently made for the Government of Russia, for the New Zealand State Railway Department, and for one or two private concerns. We now give an illustration of this type of hammer, which presents some important features. The so-called wrought iron framing which has usually been made for steam hammers is really a composite framing, with the lower part of wrought iron and the upper part of cast iron; but in the hammer illustrated there is no cast iron whatever in the framing, even the slides and flanges being made of wrought iron or forged steel, not steel castings. The slides, it may be added, are solid forged slabs, rivetted to the standards and braced together by binding bolts and distant pieces. The falling weight independent of steam pressure is 50 cwt., the stroke 51in., and the valves are so arranged that the hammer can be worked either single-acting or double-acting at the discretion of the attendant, the steam being either admitted to the top of the cylinder or shut off from it in a moment. The cylinder base is cast in one piece with the cylinder, so that the annoyance often caused by a leaky joint is avoided. The total weight exclusive of anvil blocks and base plates is about eleven tons, which is considerably lighter than in an ordinary hammer of very much less strength. This form of construction is more costly than the ordinary type of framing, but it secures two important advantages by giving greatly increased strength with a very considerable saving in weight.

It is not necessary that we should describe the valve gear of this hammer, as, with the exception of the valve itself, this is obvious from the engraving, and contrasts in a remarkable manner with the old form of gear of twenty-five years ago, when about six times the parts were necessary.

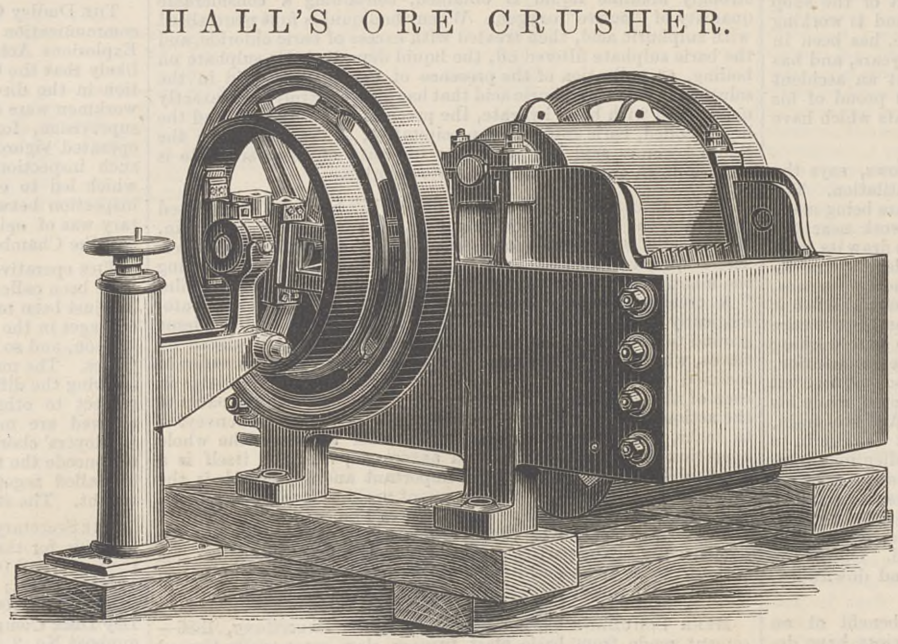
LARGE SECTIONAL ORE CRUSHER.

THE crusher illustrated above, manufactured by the Savile-street Foundry and Engineering Company, Sheffield, is of the Blake type, the opening at the mouth 30in. wide by 12in. depth, and is one of the largest ever made. It is the second crusher of the same size made, and in consequence of difficulty in transit and the great weight when together, it is made in sections, each section interlocking in a manner which Mr. Hall adopted some years ago. The whole is held together by eight through bolts, which, however, have no strain to bear. All the parts are planed together, and no part exceeds 2 tons 10 cwt., as many parts as possible being brought down to about a ton.

One of the noticeable features in the machine is that it is driven by friction, the frictional driving being effected by a pair of improved toggle-jointed friction blocks working against the inner periphery of the belt pulley. The belt speed for this class of machinery is over 2000ft. per minute, and the belt is 7in. wide, of double leather in the present instance, and to avoid a countershaft the belt drives from the fly-wheel of an engine working other machinery not necessarily dependent upon the crusher, so that it was necessary to arrange a means of stopping and starting without influencing other operations. This is a condition of things often existing, but hitherto the only available way was by a shifting belt—well enough in the case of small ore crushers, but totally unfit for such large machines as this. The special object of the machine is to prepare quartz and ores of all descriptions for the stamps or other subsequent reducing operations. Of the heavier ores it will crush from 300 to 350 tons per day. By a little modification the machine may be made to crush diamondiferous soil, fire-clay, and other materials less hard than ores, quartz, &c., and as such material is required to be reduced in large quantities to pay for the operation, a machine of large dimensions is necessary. The excentric shaft is of Swedish steel, and is fitted into Babbit metal journals of unusual length. The jaw and jaw bearings are bored, and a steel shaft turned all over secured therein. Adequate means of opening and closing the jaw to regulate the degree of fineness of product are provided. The various other parts are of great strength, and steel seatings, easily renewable, are fixed in the jaw, the connecting-rod, and block, wherein the toggles work. A massive fly-wheel is provided, and a special driving pulley; the belt is, of course, always running, but the attendant can stop and start the machine by a hand-wheel and screw at any moment with the greatest ease.

The method of operating the jaws, though not shown in the engraving, are very well understood, and consist of the excentric spindle and the toggle pieces.

HALL'S ORE CRUSHER.



THE PHYSICAL SOCIETY.

A PAPER on "The Influence of Change of Condition from the Liquid to the Solid State on Vapour Pressure," by Prof. W. Ramsay, Ph.D., and Sydney Young, D.Sc., was read at the last meeting. The authors refer to some experiments published in Wiedemann's *Annalen*, vol. xxviii., by W. Fischer, on the above subject, which show that the vapour pressure of ice and solid benzine are less than those of water and liquid benzine at the same temperatures. By using the formula $p = a + b\,t + c\,t^2$ to express the relation between the pressure and temperature of saturated vapours, Fischer arrives at the absurd result that the vapour pressure of liquid benzine is not identical with that of solid benzine at melting point. If the above formula be replaced by log. $p = a + b\,a^t$ it is shown that the anomaly disappears. The authors have measured the vapour pressures of solid and liquid benzine by the dynamical method, and obtain results agreeing closely with those of Fischer determined statically. They also calculate the vapour pressure of solid benzine from that of the liquid, using the formula

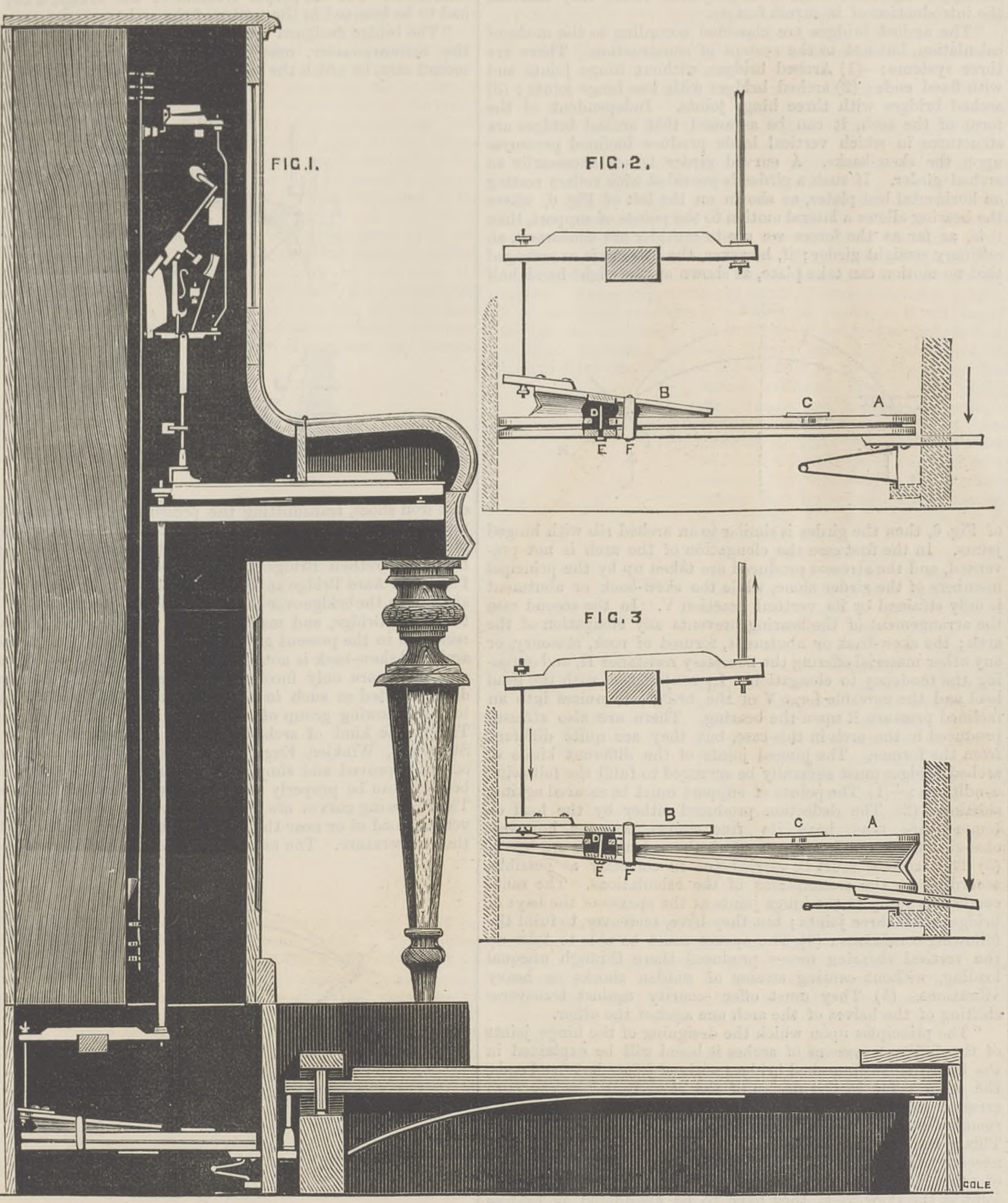
$$P_{t-1} = P_t - (P^1_t - P^1_{t-1}) \left(\frac{V_{t-\frac{1}{2}} + F_{t-\frac{1}{2}}}{V_{t-\frac{1}{2}}} \right)$$

where P_t and P^1_t are the vapour pressures of the solid and liquid at temperature t, $V_{t-\frac{1}{2}}$ = heat of vaporisation of liquid, and $F_{t-\frac{1}{2}}$ = heat of fusion of solid at temperature $t - \frac{1}{2}$. The numbers so obtained are in accordance with those determined experimentally.

Another paper, on "The Nature of Liquids as shown by the Thermal Properties of Stable and Dissociable Bodies," by the same authors, was read by Prof. Ramsay. From experiments on the vapour density and heat of vaporisation of stable and dissociable bodies, the authors arrive at two important results. (1) That for stable bodies such as alcohol and ether, the density of their saturated vapours increases with rise of temperature, whereas, for bodies such as acetic acid and nitric peroxide, the vapour density attains a minimum at a certain temperature, and increases with either rise or fall of temperature. (2) The heat of vaporisation of alcohol decreases with rise of temperature, but that of acetic acid attains a maximum at about 110 deg. C., and decreases with rise or fall of temperature. From these results the authors seek to prove that the difference between stable liquids and their vapours consists in the relative proximity of the molecules, this proximity being greater in liquids than gases, and that the molecules of stable liquids are not more complex than those of their gases. Professor Pickering dissented from this view, and thought that the molecules of liquids are aggregations or compounds of those of the gases.

THE GREAT EASTERN STEAMSHIP. — This vessel will be sold during the next month or two. Since her arrival in Dublin a large sum has been spent on her in cleaning, repairing, and painting and decorating her. Mr. De Mattos and his partners bought her for a coal hulk, as is well known, and have abandoned the idea of using her for exhibition purposes.

PIANOFORTE FITTED WITH PEDALS.



APPLYING ORGAN PEDALS TO PIANOFORTES.

Mr. H. T. Wedlake, of Berkley-road, Regents Park, exhibited last year at the Inventions Exhibition a pianoforte fitted with an arrangement of pedals, which attracted a good deal of attention at the time, and is, we believe, held to be a very complete solution of a neat mechanical problem. We illustrate the invention by the accompanying engraving.

The object of the invention is so to apply pedals to pianofortes that a small movement of the pedal shall cause the note corresponding to the same to sound, and that expression can be given as required to the said note.

The pedals are applied to enable organists to have pedal practice with a piano.

This object is attained by an apparatus somewhat similar to the pneumatic action in organs. The pedals formed in the usual manner are mounted in a frame near the base. It will be seen that the general arrangement for one key consists in a pedal and pair of bellows B, and the receiver, the receiver being much larger than the bellows. A is a fixed board constituting the upper portion of the receiver, at the back end of which is hinged a similar board the edges of which are joined by any flexible material to those of the upper board C. Upon the under side of the lower board is a projecting arm D, which is the means by which the movable part of the receiver is brought down corresponding with a similar movement of the pedal. Upon the fixed board, and at the end nearest to the back of the pianoforte, is a small bellows B hinged in a reverse position to the receiver below it; the reason for such relative position will be apparent. The upper board of the small bellows is joined at the edges by any flexible material to the lower board in a similar manner to the receiver just described. The free-board of the said small bellows carries a short arm, from which connection is made by suitable rods or levers to the keys or to a separate action as may be desired. At C is a small valve for the escape of air, in order to allow of the perfect return of the receiver. A passage of communication is also made between the bellows and receiver at D, through which air is either drawn or forced; thus when the receiver is inflated the bellows is collapsed, and when the small bellows is inflated the receiver is collapsed.

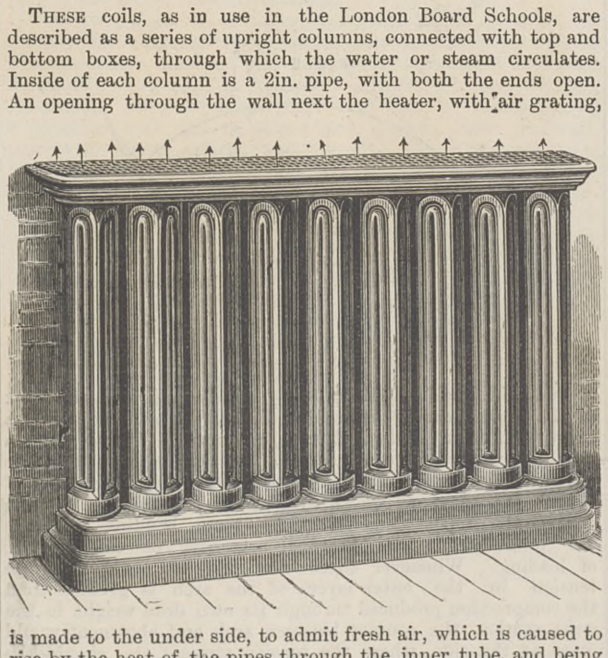
Upon the pedal being depressed the free board of the receiver, Fig. 3, is pressed down and the air which was inside the small bellows B being thereby suddenly drawn out, the said bellows immediately collapses and a note is struck as soon as the pedal has been depressed about one-third of the whole distance it has to travel. A loose strap F, which is made to surround both the bellows and receiver insures the small one remaining collapsed as long as the pedal is kept depressed in order to keep the damper off the strings during the same duration of depression. Upon the pedal being released the spring, which during the inflation of the large receiver has been compressed—see Fig. 3—is used for returning the lower board of the large receiver.

Upon the lower board of the feeder is a stud E which passes upwards through the passage of communication between the bellows and receiver, the top point of which stud presses upon the upper board of the bellows and pushes upwards the lower board of the receiver. This stud or pin simultaneously pushes up the top board of the bellows—see Fig. 2.

It is claimed that the application of this improved pneumatic lever in conjunction with the organ pedals to pianofortes give a perfect imitation of the pedals used in organs, and facility of touch in the practice of organ music, as in a pipe or reed instrument, is thus obtained.

CRANE'S VENTILATING WARMING COILS.

These coils, as in use in the London Board Schools, are described as a series of upright columns, connected with top and bottom boxes, through which the water or steam circulates. Inside of each column is a 2in. pipe, with both the ends open. An opening through the wall next the heater, with air grating,

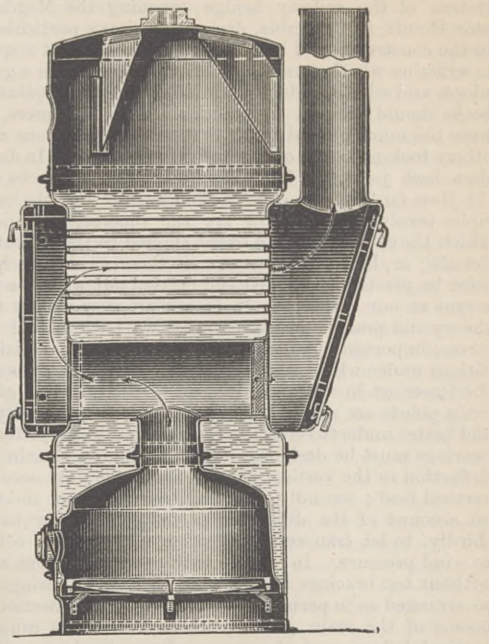


is made to the under side, to admit fresh air, which is caused to rise by the heat of the pipes through the inner tube, and being warmed on its way, passes out of the top grating and thus enters the room. The room is thus supplied with clean warmed air. The apparatus is made by Mr. Robert Crane, 3, Stockwell Park-road, London, S.W.

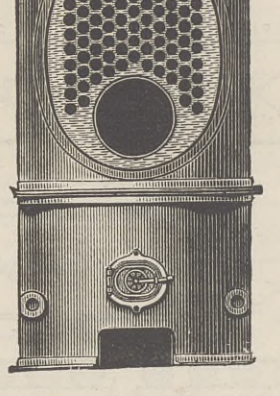
Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—W. H. C. Gale, chief engineer, to the Helicon, reappointed, on promotion, to date from December 1st, 1886; Frederick Mitchell, engineer, to the Australia; Walter Coleman, engineer, to the Pembroke, additional; Henry Humphrey, assistant engineer, to the Mersey; Edward Matthews, chief engineer, to the Northumberland; George A. Haddy, chief engineer, to the Arethusa.

THE HYDE DUPLEX BOILER.

The accompanying engravings illustrate a boiler the construction of which is so simple and so clearly shown that no description is necessary. It is of that description in which cross



fire tubes are fitted to a vertical boiler, and is in many respects a result of the development which has taken place of late years in the art of stamping and welding iron and steel plates. We are informed by the makers, Messrs. Tinker, Shenton, and Co.,



of Hyde, near Manchester, that it is capable of evaporating 11·3 lb. of water at a temperature of 160 deg. per lb. of coal, or 12·2 lb. of water at the temperature of 212 deg. per lb. of best coals.

THE STEAMSHIP HUDSON.

By Professor De Volson Wood.

In The Engineer for October 6th, 1876, is a worthy mention of the three steamships of the Cromwell Line—New Orleans, Knickerbocker, and Hudson—running regularly between New York and New Orleans, special mention being made of the Hudson. The most remarkable, and at the some time interesting feature in regard to the machinery is the fact that the propeller is driven by a single cylinder engine in which the steam expands from twelve to eighteen times. It may be interesting to your readers to know the condition of the engines after twelve years of service. During the month of May of this year, 1886, Messrs. C. D. Blanvelt and W. L. Haynes, students in the senior class of Stevens' Institute of Technology, Hoboken, N.J., made a round trip on this steamer, making tests of the boilers and engines, and from their thesis I extract the following:—"The engines were built by Pusey, Jones, and Co., in 1874. On this trip they were run continuously from port to port without heating boxes or other cause for stopping. Three ten-hour, one sixteen, and one twenty-hour test were made during the trip, with the following average results at full speed:—Revolutions per minute, 57·65; absolute boiler pressure, 81·27 lb.; condenser pressure, 3·2 lb.; horse-power, 801·64; cut-off, $\frac{1}{10}$ to $\frac{1}{12}$; condensation, 4 per cent. Although full tests were made of the boilers yet it is not advisable to give the results in this place, because their evaporative power was known to be inferior on account of their age and condition; but when we consider that there was no special preparation for the trial, that the coal was of ordinary quality, and that it was an everyday performance, there was determined the fact that an average of only 3·1 lb. of coal was used per horse-power per hour. The average piston speed for the seventy hours observed was 690ft. per second."

The engineer of the company, in an article in the *Mechanical Engineer*, New York, for October 13th, 1886, says:—"These engines are superior in economy to any compound engine, using the same boiler pressure, known to the writer. When the expansion exceeds, say, sixteen volumes, compound engines are to be preferred." The amount of cylinder condensation was remarkably low. The writers stated that "it was noticed that when the indicator fittings were permitted to be open for the entire stroke, the escaping jet appeared of a bluish colour for a distance of two or three inches from the outlet." It is scarcely necessary to say that the cylinders were steam-jacketted. At one time, at slow speed, the cut-off was $\frac{1}{18}$, during which the computed condensation was 12 per cent.

THE CONSTRUCTION OF HINGE-JOINTS OF ARCHED IRON BRIDGES.

The following is an abstract of a paper in the *Zeitschrift des Vereines Deutscher Ingeneure* of the 21st August last, by Herr L. Backhaus, of Duisbourg:—"The novelty in the system of the railway bridge spanning the Magdalena river near Honda, in Columbia, drew the writer's particular attention to the construction of hinged-joints. He made it a special study to examine whether an arch with five joints was a good type to adopt, and whether hinge joints simply resting against the skew-backs should be used in practice. Some designers, he found, were too much guided by theoretical considerations alone, while others took no notice of theoretical principles. In designing the skew-back joint, the following questions have to be considered. (1) How far does the construction answer the theoretical principles involved? (2) How are the theoretical principles upon which the calculations are based applied to the execution of the details; or, how can the assumed theoretical principles of the joint be practically applied and carried out with the mechanical means at our disposal? It is not an easy matter to combine theory and practice in this case, for we have to deal with great forces, important conditions, and friction. To explain the conditions under which such structures work, let us consider how the forces act in a straight instead of in an arched girder. The main points are similar to one another, are more easily explained, and better understood in the former than in the latter case. The bearings must be designed, firstly, to allow a certain amount of deflection in the vertical plan of the girder, on account of the vertical load; secondly, to permit free expansion and contraction on account of the difference of temperature or to the load; thirdly, to let transverse deflection take its free course as due to wind pressure. In bridges with open permanent way, that is, without top bracings or top wind ties, the bearings should be so arranged as to permit a slight transverse deflection of the top booms of the main girders, whenever such is caused by the vertical deflection of the cross girders. Such open bridges are mostly of short spans, with the permanent way at the bottom of the girder, and especially parabolic girders, or of Schwedler's system.

"Short span bridges, however, do not require bearings of such refined construction; there the main girders are placed on cast iron bed plates, while the bridge is fastened to the bed plates and masonry on one side only. The bridges remain free on the other side, where the bed plates only are fixed to the masonry. In this case the bed plates form the joints of the bridge; but though they are not constructed as such, they have the same work to perform. The deflections, however, are so small that the arrangement answers the purpose. In bridges from 50ft. to 60ft. span and upwards the bearings must be so designed that a free deflection and a free expansion and contraction of the girders can take place. A simple and effective method of obtaining this consists in placing the girders on one side upon a fixed joint, which the author terms a tip bearing, as shown in Fig. 1, and

FIG. 1

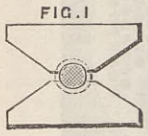


FIG. 2

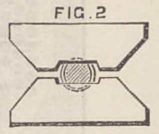


FIG. 3

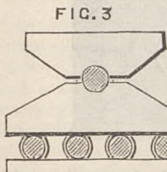
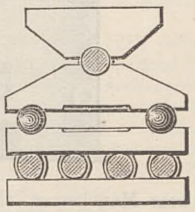
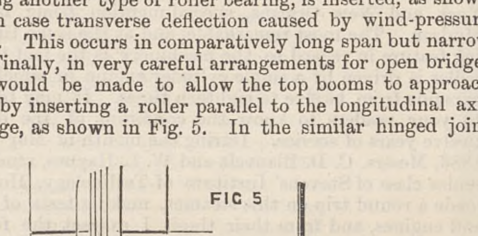


FIG. 4



on the other side on a roller bearing, as shown in Fig. 2. These simple bearings are very effective, and prevent any motion of the bridge; the friction caused by the deflection or expansion is small. These systems of roller bearings cannot, however, be used for large spans, as the only roller of the tip bearing would have to be made of too great a diameter. In still larger spans the tip bearing—Fig. 1—is then placed upon a series of rollers which run on a separate plate. This arrangement led to the construction of the standard tip-roller bearing now generally used, as shown in Fig. 3. An extra spherical roller or ball and disc, forming another type of roller bearing, is inserted, as shown in Fig. 4, in case transverse deflection caused by wind-pressure takes place. This occurs in comparatively long span but narrow bridges. Finally, in very careful arrangements for open bridges provision would be made to allow the top booms to approach each other by inserting a roller parallel to the longitudinal axis of the bridge, as shown in Fig. 5. In the similar hinged joint

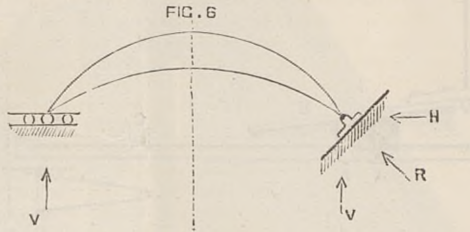
FIG. 5



with fixed bearing, the bottom rollers only would have to be taken out. To avoid the production of secondary stresses in the main girders which cannot be determined with certainty, it seems necessary to make use of such elaborated designs. Secondary stresses are to be understood as those caused through the work not being carried out in accordance with the theoretical principles; moreover, all those which are produced through known or unknown imperfections in the the execution of the work. It is not intended to examine how far the above designs of the bearings prevent secondary stresses, as they belong to bridges of statically determined systems. It will be important, however, in the following cases, as they belong to the class of arched bridges of statically undefined systems. In these cases it is most important that the theoretical principles and the practical execution of the work agree as much as possible; for, to find out the stresses, it is necessary to adopt assumptions which are more or less certain. This causes factors to be introduced in the calculations which are not correctly defined, and wrongly designed bearings or hinge joints would only increase the introduction of incorrect factors.

"The arched bridges are classified according to the mode of calculation, but not to the system of construction. There are three systems:—(1) Arched bridges, without hinge joints and with fixed ends; (2) arched bridges with two hinge joints; (3) arched bridges with three hinge joints. Independent of the form of the arch, it can be assumed that arched bridges are structures in which vertical loads produce inclined pressures upon the skew-backs. A curved girder is not necessarily an arched girder. If such a girder is provided with rollers resting on horizontal bed plates, as shown on the left of Fig. 6, where the bearing allows a lateral motion to the points of support, then it is, as far as the forces we are to consider are concerned, an ordinary straight girder; if, however, the bearing is so arranged that no motion can take place, as shown on the right-hand half

FIG. 6



of Fig. 6, then the girder is similar to an arched rib with hinged joints. In the first case the elongation of the arch is not prevented, and the stresses produced are taken up by the principal members of the girder alone, while the skew-back or abutment is only strained by its vertical reaction V. In the second case the arrangement of the bearing prevents any elongation of the arch; the skew-back or abutment, formed of rock, masonry, or any other material offering the necessary resistance H, and opposing the tendency to elongation. In conjunction with the dead load and the movable force V of the bridge, it unites into an inclined pressure R upon the bearing. There are also stresses produced in the arch in this case, but they are quite different from the former. The hinged joints of the different kinds of arched bridges must generally be arranged to fulfil the following conditions:—(1) The points of support must be secured against shifting. (2) The deflection produced either by the load or temperature must have its free course, without, however, changing the conditions upon which the calculations are based. (3) The erection must be carried out as correctly as possible, according to the assumptions of the calculations. The same conditions apply to the hinge joints at the apexes of the bays of bridges with three joints; but they have, moreover, to fulfil the following conditions: (4) The apexes must be able to take up the vertical shearing forces produced there through unequal loading, without causing strains of sudden shocks or heavy vibrations. (5) They must offer security against transverse shifting of the halves of the arch one against the other.

"The principles upon which the designing of the hinge joints of the different systems of arches is based will be explained in the following:—In arched bridges without joints but fixed ends, the main point in the design of the skew-back bearings is to arrange it so that the arch under all conditions of stress remains constantly in close contact with the masonry abutment. This is the only case in arched bridges where there is no absolute necessity for a hinge joint. If there are, nevertheless, bridges of other systems—of hinges and joints at apex—which have no joint at the skew-back, they have to be considered as bridges with joints imperfectly made. The flexure to which an arch with fixed ends is exposed through the load and the temperature indicates the effect it produces upon the bearings at the skew-back or abutments. The tangent of the arch at the point of support remains constantly at the same angle to the abutment. The temperature flattens the arch out, raises it, and has thus the tendency to form a curve with two points of flexure,

FIG. 7

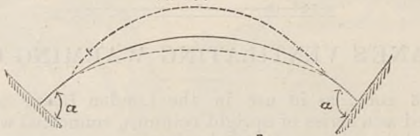


FIG. 8

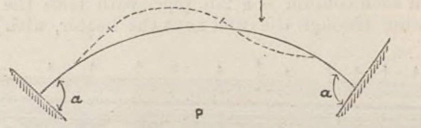
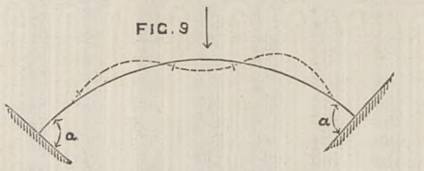


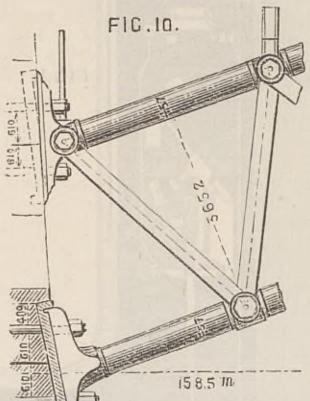
FIG. 9



as shown in Fig. 7. With a one-sided vertical load the apex of the curve shifts to the opposite side of the load and forms a curve with three points of flexure, as shown in Fig. 8. With a load at or near the centre of the bridge a depression of the centre of the curve takes place, and a curve with four points of flexure is formed, as shown in Fig. 9. The angle a between arch and support remaining the same, bending moments are produced at the bearings whatever be the manner of loading. Whenever those moments are such that the tension in the outer layers of the arch is greater than the compression produced through its own dead weight in the cross section, the contact between arch and abutment would cease at the side, where the tension stresses are, should the arrangement of the bearings not prevent it. If the compression through the dead weight of the arch is greater than the tension produced by the bending moments, there is no tendency then to prevent the contact of the arch with its bearing. These are the main points to be considered in the designing of the bearings. In the first case, bearing and skew-back, or abutment, must be as intimately connected as if they were of one casting; while, in the second case, support by contact is sufficient. A rigid connection between arch and abutment requires a rather full development of the arch at its base, in consequence of which this system is in exceptional cases only properly carried out. One of the best-known examples is the large bridge over the Mississippi at St. Louis, designed by Eads. Each arch of this bridge is composed of two braced tubes, as represented in Fig. 10, strongly bolted to the shoes, while the latter are well anchored into the masonry of the abutment or are bolted to the shoes of the next arch across the pier. These connections fulfil all the necessary conditions. For the proper erection of the bridge, a key piece had to be inserted in the centre of the arch.

"The bridge designed by Rothlisberger and Simons, built over the Schwarzwasser, near Bern, affords an example for our second case, in which the arch connections rest directly on the

FIG. 10.



cast iron shoes, transmitting the pressure to the masonry abutment by means of enlarged bed-plates. In books on bridges are enumerated, amongst arched bridges without hinge joints, the Margarethen Bridge at Buda-Pest, the Arcole Bridge in Paris, the Aare Bridge at Olten, the bridge over the Trankgasse at Cologne, the bridge over the Upper and Lower Rhine, near Basel, the Mosel Bridge, and many others. They cannot, however, be reckoned in the present group, as the immovable connection of arch and skew-back is not always used, and the bearings at the abutments are only incomplete hinge joints. They were no doubt treated as such in the calculations, and therefore belong to the following group of arched bridges with hinge joints:—This is the kind of arched bridges preferred, especially since Sternberg, Winkler, Eugesser, Weyrauch, Müller-Breslau, and others improved and simplified its theory. The action of the bearings can be properly seen in drawing the deflection curves. The following curves are obtained by taking into account the vertical load at or near the centre of the arch and the effect of the temperature. The expansion or contraction through change

FIG. 11

FIG. 12

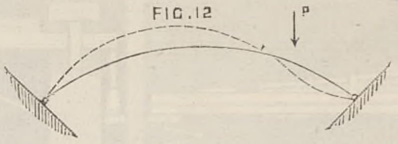
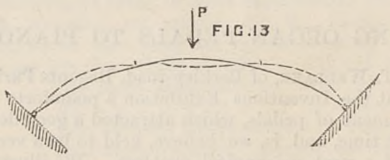


FIG. 13



of temperature produces a gentle raised or flattened curve, as represented in Fig. 11. The one-sided loading shifts the apex into the opposite direction, produces one point of flexure, and allows the change of the angle between the tangent of the arch and the bearing surface, as shown in Fig. 12. The load at centre flattens the arch, but produces only two points of flexures, as represented in Fig. 13. The dead weight of the bridge does not alter anything in the conditions. The curves of deflection being simpler, the calculations are accordingly simplified. It is quite understood that those curves are only mathematical lines, which do not occur in arches built. Especially in the latter case the radius of curvature only alters, as the curves will of course never pass from the positive through infinite into the negative sign, as the points of flexure would have to do. In all cases of different loading the arch swings in its plan round the abutment joint. Bending moments do not occur; at any rate, it is the principal duty of the joint to prevent the friction in the bearing which produces them, and which has to be arranged accordingly. The next most appropriate disposition consists of the insertion of a pivot d between the arch b and the bed-plates s, as shown in Fig. 14, similar to the bed-plates of a straight girder bridge. This kind of bearing is used at the bridge over the Lower Spree, near Berlin, at a road-bridge over the Arnheim-station, at several other road bridges at Strassbourg, Frankfort-on-the-Maine, Mainz, and at a number of other smaller arched bridges for road and railway traffic. To secure in large bridges the correct position of the bearings or bed-plates, and for the proper setting of the arch, a special bed-plate M is laid upon the skew-back, while between the saddle S at the bottom of the hinge joint and this ground plate a number of keys are placed, upon which the joint rests, as shown in Fig. 14. To fix sideways the position of the saddle-piece on the skew-plate bed four keys P^1 are inserted. This system of joints is subject to produce secondary bending moments in the arch through the friction in the different pivots. To reduce those stresses the bolts are usually made as small as the case may permit. Where pivots of large sizes are required they are formed out of the bearing. This simplifies the construction greatly, as shown in the general arrangement, Figs. 15 and 16. In the former it is the bottom part of the bearing which gears with its half cylindrical piece in the top half of the bearing fixed to the arch; in the latter it is reversed. The regulations of the height and its sideway positions is carried out as before. Any side motion of the bearing to each other is prevented by notches or corresponding connections. This system of arch-joints is used in a great number of bridges, as the Rubex Bridge near Mühlheim, the bridge over the Rhine in Coblentz and Hochfeld, the bridge over the Spree at the shipbuilding embankment near Berlin, the Tegetthof Bridge in Vienna, and the Douro Bridge at Oporto. Those bearings appear complicated in their details, especially on account of the arrangements necessary for correct erection; the principle of the bearing is, however, not altered. The moment of friction produced increases with the size of the pivot. The moments of friction in abutment hinge joints are less injurious than in link joints. Winkler proved that motion ceases as soon as a certain thickness of the pivots is reached, and the joint connection consequently gets rigid and acts more like a rivetted joint; he proved, moreover, that the sizes of the bolts can be proportionately enlarged without injuring the mobility of the joint, the more the moments of resistance of the connecting links increase. The latter circumstance takes place at the hinge-joints of the bearings of arched bridges, where the pulling link is composed of a powerful arched rib, which possesses a moment of resistance of great magnitude, and is often composed of the whole rigid arched framework. It is therefore not to be feared that the diameter of the bolt would become so great as to prevent the proper motion of the joint, and thus render it ineffective. It is of course sometimes necessary to determine the effect of the frictions in the joint, to calculate its influence upon the arch, and to take it into account in fixing the different sizes. In any case, the designer should take the frictional resistance into account, as otherwise the design of the joint may become very defective.

FIG 14

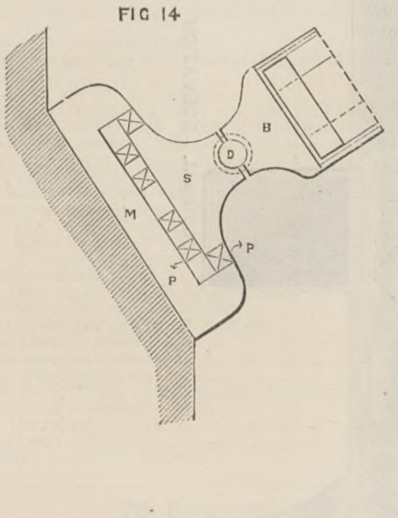


FIG. 15

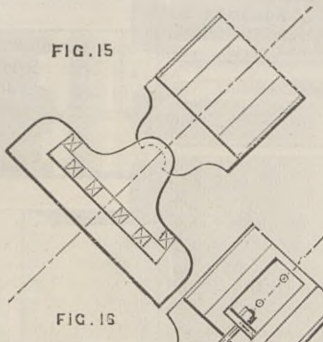
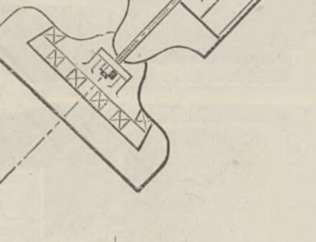


FIG. 16



"In reference to the last-named system of bearing, it will be observed that some difficulty will be experienced in the placing of the keys, and it will be found that some are tightly fitted on one side, while there is slackness at the other. To avoid this screws are used, as shown in Fig. 16, to draw both parts firmly together. After the erection is completed, the screws are taken out. One of the best methods of drawing the two parts of the bearing together, and to bring them into contact over the whole length of their bearing surface, by the bridge itself, consists in making the bottom part of the bearing to pivot round

FIG. 17

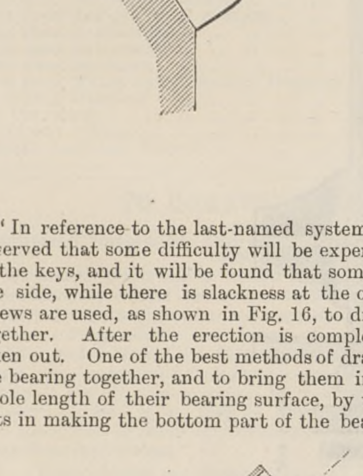
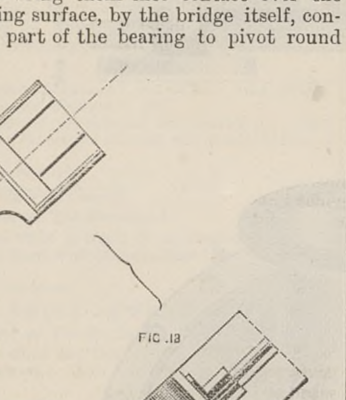


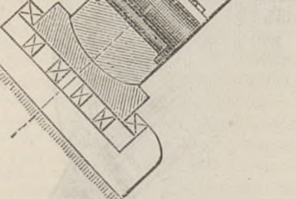
FIG. 18



an inverted axis, as shown in Figs. 17 and 18. Such a system has been applied in the "Lacture" design of the bridge over the Rhine at Mainz, and was recommended by Brennecke in 1884.

"Amongst this system of bridges, there are also some in which the bearings are without movable joints. The ends of the arch are simply planed and fitted into a cast iron wall-shoe, as shown in Fig. 19. This arrangement can, however, only be used in arches of such great rigidity that practically no deflection takes place, and especially for arches calculated upon the assumption to rest on bearings without joints. The fact proved by Winkler, that in using the largest size of diameter of bolts the motion in the joint practically ceases, and the connection becomes rigid, does not justify making it without a joint, even should the diameter of the required bolt exceed the limit allowed for it. The calculation assumes that the pressure in the bearing is transmitted to the skew-back or abutment in a point or in a certain line, which is the line of the centre of gravity of the cross sections of the arch, or the curve of bending moments. However small the deflections may be, the shifting of the centre of pressure at the bearing cannot be prevented. It lies sometimes above, sometimes below, the centre line of the arch; therefore secondary bending moments are produced, which it is far more difficult to determine correctly than those produced through friction in the joints. If the latter act irregularly, they assist in transferring the pressure to the abutment bearing at the point theoretically assumed. Even assuming the friction to be so great in the joint that motion ceases, the arch would have to be considered as one with fixed ends; but no one would base his calculations upon it as if it were a firmly secured arch. As example, it may be mentioned that the railway bridge of 215ft. span over the Mosel at Guls has no properly formed abutment hinge joints."

FIG. 19



PROSPECTIVE RAILWAY LEGISLATION.

THE railway Bills projected for next session are, as we have already stated, fewer in number than those of last year by five. This is only a slight falling off, but one rather looks for an increase than a decrease; and further, the schemes promoted are in no case on a large scale. They relate for the most part to small extensions, the acquisition of land, the stopping up of roadways and footpaths, and the settlement of financial arrangements. Nevertheless, the aggregate of contemplated operations is of sufficient magnitude to demand notice, as it will largely engage the attention and energies of numerous Select Committees. Speaking roundly, there is scarcely a corner of the United Kingdom which is not affected in some degree by these various measures, and to each locality the intended works are, of course, of considerable importance. As these schemes progress through Parliament we shall follow them in our customary manner, but a glance at their general nature in advance will be of interest, and possibly of some service to the people concerned.

Each of the two underground companies has a Bill of a very miscellaneous character. That of the Metropolitan District Company proposes to amend various existing Acts with a view, among other things, to the dissolution of the two separate Committees appointed in 1879 for the maintenance and management of the western and eastern joint lines and stations—that is, the lines between the stations at Gloucester-road, South Kensington, and High-street Kensington, and the substitution of one joint Committee for the management of these joint lines; to investing the Railway Commissioners with full powers for fixing the rates and regulating the traffic on the joint lines, if the two companies cannot agree. In view of the conflict that has been carried on for the last year or two between these companies on these matters, some such course as that proposed is urgently needed. The Bill further proposes to revive and extend the time and powers limited by the Metropolitan District Railway Acts of 1882 and 1883 for the completion of the Acton Junction Railway and the West Brompton Junction Railway respectively.

The Metropolitan Company's Bill is for the confirmation of a scheme adopted by the proprietors for separating the surplus lands of the company from their railway and works, and for the issue of a Surplus Lands Stock under their Act of 1885. It also seeks power to enable the South-Eastern Company to invest capital in the Metropolitan Railway; to secure the payment to the company by the South-Eastern Company of half of the loss incurred in working the Tower-hill, Trinity-square, extension prior to the District Company becoming joint owners with the Metropolitan Railway Company; and to acquire lands and other property adjoining the line, for improving the ventilation, stations, works, &c.

The Bill of the Latimer-road and Acton Railway Company is one for new lines of great importance to the metropolis. It proposes to construct a number of short lines to connect the Metropolitan system at or near Notting-hill-gate with the Latimer-road and Acton Railway now in course of construction, and thereby to establish a most useful new railway extension in a direction where it is much needed. The general clauses provide for the usual powers, including authority for working arrangements between the new line and the Metropolitan and Great Western Railways.

The Great Eastern Company has given notice of a general powers Bill covering works throughout its extensive system. The operations affecting the metropolis comprise a line from Stratford-le-Bow to West Ham by a junction with the Channelsea Branch Railway; a line from West Ham to Channelsea by a junction with the Stratford and Victoria Park Railway; powers to widen, enlarge, and improve the Liverpool-street Station, and the lines leading thereto, commencing near the bridge at Norton Folgate, and terminating near the Two Swan-yard, Bishopsgate. For these purposes the company asks power to reconstruct the bridges carrying Norton Folgate and Worship-street over its railway, and to stop up a number of thoroughfares, courts, alleys, and so forth, between the Liverpool-street Station on the west, Bishopsgate-street on the east, Worship-street on the north, and Liverpool-street on the south. The other provisions in the Bill relate to more distant parts of the system, none of them requiring special notice. Among other proposals in its Bill, the South-Eastern Company asks leave to abandon the authorised Cranbrook and Paddock Wood Railway, and to construct another in lieu thereof, commencing in Brenchley by a junction with the South-Eastern line near its junction with the Maidstone Branch Railway and terminating in Cranbrook. It also seeks power to enable it and the conservators of the Medway to make and carry out agreements with respect to the construction of works on the bed, shore, and soil of that river; to enable them and the Eltham Valley Railway Company, or either of them, to carry the Eltham Light Railway, authorised in 1881, across and on the level of a public carriage road; and to purchase from time to time land, and to erect thereon dwellings for its workmen. Other clauses will provide that so much of the capital authorised to be raised and applied by the Act of 1885 as may be required for and in connection with the construction of the harbour works authorised at Folkestone may be raised as a separate capital; and that these works, either alone or together with the works now forming the existing harbour at Folkestone, may be constituted a separate undertaking as to outlay, working expenses, tolls, and revenue, and enabling the Corporation of Folkestone to subscribe to the said separate capital.

As might be expected, the great lines running north have presented the most important of the railway Bills, both in regard to character and extent. The London and North-Western proposal, in the first place, is to make and maintain three railways, to be called the Bamfurlong Junction Railways in Ince-in-Makerfield, Wigan; and in the subsequent clauses of the measure, to abandon the construction of a portion of the railway from Colborne to Spring's Branch Junction (authorised by the Company's Act of 1883), to construct a railway to be called the Morecambe South Junction Railway, commencing in Slyne-with-Hest, Bolton-le-Moors, and terminating in Skerton, Lancaster; to widen a part of the Lancashire Union Railway, and to deviate a part of the Lancaster and Carlisle Railway. Further, the company seek to revive and extend the powers conferred in 1874, and subsequently, for the purchase of land for the construction and completion of the Buxton and High Peak Junction Railway; and by other clauses powers are sought for on behalf of the London and North-Western Company and the Lancashire and Yorkshire Company as to certain works in Lancaster, and on behalf of the company and the Great Western Company as to certain works and additional land in Chester.

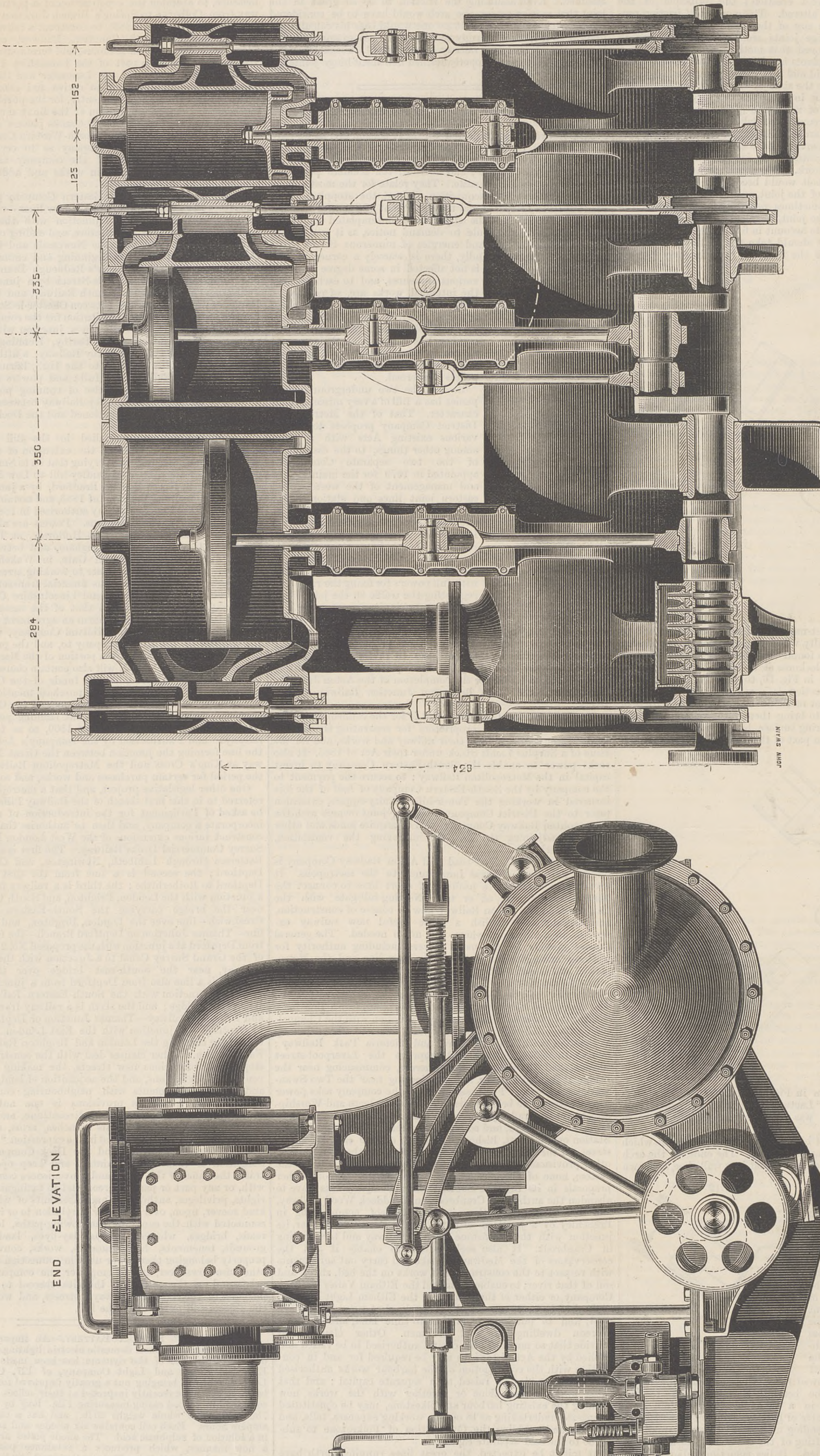
In like manner the North-Eastern Company purpose asking Parliament to sanction a number of new lines—viz., a line commencing in Gateshead by a junction with the Team Valley Railway, near the Low Fell Station, and ending on the southern foreshore of the Tyne, near the Newcastle and Gateshead Gas Company's jetty; a railway beginning and ending in Wickham by junctions with the company's Redheugh Branch Railway; a line commencing in Chester-le-Street by a junction with the Pontop and South Shields Branch Railway, and terminating in Harratan; another railway between Chester-le-Street and Keys, Lanchester; a fourth, in substitution for the company's existing railway, commencing in Selby, by a junction with the existing railway, and terminating in Barlby, Henningbrough, by a junction with the Hull and Selby Railway; a fifth line, from the Victoria Dock Railway, Hull, to the Hull, Barnsley, and West Riding Junction Railway, in Hull; and powers are also asked for with respect to the exercise of running powers over the portion of the Hull and Barnsley Railway between the termination of the extension last mentioned and the Docks of the Hull and Barnsley Company.

Among the schemes embodied in the Bill of the Great Northern Company are these: the extension of the authorised line to Heanon, Derbyshire, carrying that on to Smalley, Mouley; a deviation of the line from Dudley-hill to Low Moor, the line commencing in North Bierley, Bradford, by a junction with the company's line under their Act of 1883, and terminating with the extension of the Pudsey Railway authorised in 1885; a short line in Tong; and various deviations. Powers are also proposed to be taken to widen the railway at Holloway, at Three Counties Station at Grantham, at Nottingham, and between Lofthouse North Junction and Lingwell Gate, in Wakefield and East Ardsley. Other provisions relate to working arrangements with other companies, and to various financial transactions.

The Manchester, Sheffield, and Lincolnshire Company's Bill is of a different character from that of the measures last dealt with. Its first object is to confirm an agreement made between the Great Northern and the Midland Company, which involves the transfer by the latter company to, and the purchase by the Cheshire Lines Committee of a portion of the Manchester South District Railway. This Bill will also contain clauses empowering the company to subscribe to the funds of the Cheshire Lines Committee for the purpose of the purchase mentioned; confirming an agreement between the company and the Great Northern company; extending the contingent running powers of those companies under the agreement of 1860, so as to include the railways 1 and 2 authorised by the company's Act in 1886, and the line forming the junction between the Great Northern Railway at King's Cross and the Metropolitan Railway; enlarging the period for certain purchases and works, and so on.

One other legislative project, and that a metropolitan, may be referred to in this first sketch of the Railway Bills. Leave is to be asked of Parliament for the introduction of a Bill, first to incorporate a company, and then to authorise that company to construct various extensions of the West London Extension and Surrey Commercial Docks Railway. The first is a railway from Battersea through Lambeth, Newington, and Camberwell, to Deptford; the second is a line from the first extension at Deptford to Rotherhithe; the third is a railway from No. 1 to a junction with the London, Brighton, and South Coast Railway, near the bridge carrying the South-Eastern—London and Greenwich—line over the London, Brighton, and South Coast line—Thames Junction on Deptford Branch—the fourth is a line from Deptford at a junction with the proposed No. 2 line in the bed of the Grand Surrey Canal to a Junction with the East London Railway, near the south-east bridge over that railway; the fifth is a line also from Deptford from a junction with line No. 2 to a junction with the South-Eastern Railway near the Rolt-street bridge; and the sixth is a railway from the London and Brighton Railway—Thames Junction or Deptford branch—in Deptford to a junction with the East London Railway near the bridge carrying the London and Brighton Railway over the East London. Other clauses deal with the construction or the stopping-up of various new streets, the making of shafts for ventilation, deviations, and the acquisition of land, &c., working and other arrangements with neighbouring companies, and among these numerous provisions is one authorising the company to abandon, relinquish, discontinue, and stop up the Grand Surrey Canal and all its branches, arms, and collateral cuts—all of which are included in the expression "the canal"—and to relieve the company and the Dock Company from any obligation or liability to maintain and keep open for public traffic the canal or the works and conveniences connected therewith, or any part or parts thereof, and to extinguish all powers, rights, privileges, authorities, and easements of what nature or kind soever, upon, over, along, or in relation to or in any manner connected with the canal, or the towing-paths, locks, feeders, roads, bridges, wharves, quays, lay-byes, lands, buildings, grounds, tenements, hereditaments, works, conveniences and property belonging thereto, or used in connection therewith, or otherwise howsoever, and to empower the company to appropriate and use the same, and the site thereof to and for the purposes of the intended railways, streets, and works, or other the objects and purposes of the Bill.

THE "UNION" STORAGE BATTERY.—An important advance towards rendering general domestic electric lighting possible without the direct use of the dynamo has been made by the Union Electrical Power and Light Company, of 127, Cannon-street, London, who are bringing out a greatly improved form of storage battery, which we recently inspected at their offices. Each cell is contained in a wood casing measuring 11in. long by 6in. wide and 7in. deep. The whole weighs 20 lb., and has a capacity of 115 ampère hours. Each cell contains six anodes and seven cathodes in a solution of sulphuric acid. The anode plates are prepared in a new manner, which produces a substance possessing great porosity and conductivity, will bear transport, and can be stored dry for use at any time. The conductor is so protected as to prevent its oxidation, thus avoiding loss of capacity by the buckling of the electrodes, and the active material cannot become detached or disintegrated. The cathode is spongy lead.



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W. W.—*Wilson's treatise on "Factory Chimneys" can be had from Messrs. Crosby Lockwood and Co., Stationers' Hall-court, E.C.*

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WATERPROOF HOSE.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers state if there is an English maker of "American" double cotton hose lined with india-rubber?

London, December 29th. ENGINEER.

PIPE AND BRICK SEWERS.

To the Editor of The Engineer.)

SIR,—Will any reader tell me what are the advantages and the disadvantages of pipe and brick sewers? How can the objection to pipe sewers be overcome? W. E. C.

Neath, December 23rd.

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MEETINGS NEXT WEEK.

GEOLOGISTS' ASSOCIATION.—Friday, January 7th, 1887, at University College, Gower-street, W.C.: Election of auditors and lecture "On Crinoids and Blastoids," by D. P. H. Carpenter, F.R.S., &c.

ROYAL INSTITUTION OF GREAT BRITAIN.—Afternoon lectures next week, at 3 p.m.: On Tuesday, January 4th; on Thursday, January 6th; and on Saturday, January 8th. Professor Dewar, M.A., F.R.S., M.R.I.: "The Chemistry of Light and Photography," adapted to a Juvenile Auditory.

DEATH.

MR. WILLIAM E. RICH, C.E., son of Mr. EDMUND RICH, of Willesley, Gloucestershire, at St. George's-square, S.W., aged 42, Dec. 22.

THE ENGINEER.

DECEMBER 31, 1886.

THE IMPERIAL INSTITUTE.

IT will be remembered that not long after the scheme for forming an Imperial Institute was broached, an influential committee was formed to give the inchoate idea form and substance. The committee consisted of twenty, and it would, we believe, have been very difficult to suggest men better adapted to the work to be performed. We put their names on record here for future reference. We give them in the order in which they have signed a report published last Friday:—Herschell, Chairman; Carnarvon, Revelstoke, Rothschild, G. J. Goschen, Lyon Playfair, Henry James, Henry T. Holland, H. H. Fowler, C. T. Ritchie, Fred. Leighton, President of the Royal Academy; Ashley Eden, Owen T. Burne, Reginald Hanson, Lord Mayor; J. Pattison Currie, Governor of the Bank of England; John Staples, Frederick Abel, Vice-President of the Society of Arts; J. H. Tritton, Chairman of the London Chamber of Commerce; Nevile Lubbock, Henry Broadhurst.

The report in question is a lengthy document. Those who wish to peruse it will find it in all the daily papers. It is to us very unsatisfactory, in that it to all intents and purposes, leaves matters almost precisely where they were. We say almost, not altogether; for on certain points the committee obtained information not available before; and on others they have made recommendations. Perhaps the most noteworthy and the most comforting of the latter concerns the management of the Institute. It runs thus:—"The committee recommend that a new body, entirely independent of any existing organisation, should be created for the government of the Institute. This body should be thoroughly representative of the great commercial and industrial interests of the Empire. The colonies and India should have a fair share in the government of the Institute, and each colony should have special charge of its own particular department, subject, of course, to the general management of the entire institution. The method of carrying this out would be prescribed by the charter, after full consideration by her Majesty in Council."

We may take the foregoing as typical of the good and bad features of the report; with its typical aspect we shall deal presently. Meanwhile, it is necessary that we should note that the recommendation that an entirely new governing body should be appointed bears out all that we have already said weeks ago in this journal. Ostensibly the staff, officials, executive, under whatever name they are known, who have managed the South Kensington Exhibitions, and especially that of the present year, had a species of prescriptive right to take charge of the Imperial Institution. We find, however, that the twenty men, whose names we have given above, find that nothing connected with the old staff inclines them to regard their interference with the proposed Institute with favour. Practically they have condemned them; they have no doubt tried them, and found them wanting. No depreciative mention is made of the old executive or staff. The committee content themselves with the recommendation that a "new body entirely independent of any existing organisation," shall be appointed to govern the new Institute. This is just as it should be; and we may add that the old South Kensington men seem to have been aware of the fact long since, for we are informed that, throwing off the mask which it is now useless to wear, they are endeavouring to set on foot a scheme for converting the Horticultural Gardens into a species of Cremorne. The electric light machinery, the fountains, hydraulic work, the Chinese pavilion, &c., are to be bought, and the gardens are to be "run" during the summer of 1887 with bands, and concerts, and a variety entertainment. We have nothing to say against this scheme. It may be made to provide Londoners with plenty of innocent out-of-door enjoyment; but it is quite clear that the men of the variety-entertainment type are not indicated as the best men to manage the proposed Imperial Institute. It is, too, pleasant to see the myth that the exhibitions were held to instruct people, got rid of finally, and the fact broadly admitted that the later exhibitions, at all events, were merely pegs on which to hang the outdoor entertainments given nightly with such success in the Horticultural Gardens. No doubt one of the reasons which have led the committee to recommend the formation of an entirely new governing body is that those who managed the exhibitions have manifested as public servants no financial capacity whatever, as a glance at the imperfect accounts tardily furnished in response to the demands of the Press will prove.

We have said that the single recommendation we have quoted above is typical. It will be seen that it advises a certain thing to be done, but it supplies no information as to how it should be done. We find the same method working all through the report. Nothing can be more important than the governing body. On it in large measure will depend the success or failure of the Institute—at least this far, that it is certain to fail if the governing body is not what it ought to be, while there is a chance of success if it is. But the very influential committee we have named have nothing to suggest. They content themselves with the statement that all the details will be settled by the Royal Charter of Incorporation. Again, we have no fewer than five special conditions laid down which the Institute must they say fulfil, but not a syllable is said as to how these are to be secured. Take, for example, the first: "The display in an adequate manner of the best natural and manufactured products of the colonies and India, and in connection with this the circulation of typical collections throughout the United Kingdom."

Nothing on earth can be more vague than this. The word "adequate" admits of the widest latitude of interpretation. It may imply the necessity for a building at least as large as the Crystal Palace, or something akin to the Indian Museum in Whitehall. It would but weary our readers to go through the whole report *seriatim*, and point out its lack of practical tendency. No one man, or body of men, would be competent, enlightened by this report alone, to take a single step. Matters stand thus at the present moment:—It was suggested that an Imperial Institute was a fitting thing to establish during her Majesty's Jubilee year. Nobody knows with whom the idea originated. Unkind, and no doubt thoughtless, persons say that it was suggested by some person or persons at South Kensington, who felt that it was essential that some step should be taken to find them work as soon as the Indian and Colonial Exhibition closed. Be this as it may, the suggestion took root; but no one had any competent idea what an Imperial Institute was, or could be, or ought to be. Then a committee was appointed to settle this weighty question, and the committee have supplied instead of a direct answer, a host of additional suggestions. This, it will be seen, does not help to clear matters up. Very large sums of money will be wanted, but no one can really say for what. At the time of the South Sea Bubble, one speculator of more than ordinary audacity, asked for subscriptions for shares "to carry out a project the nature of which shall be subsequently disclosed;" and he got the money he wanted. There is, it seems to us, a very close analogy between this story and that which is now being told concerning the Imperial Institute.

Out of the obscurity comes, however, it is fair to admit, one ray of light. The Imperial Institute cannot have its home in or near the City. Concerning a site, the report is decided enough as to what cannot be done. Several places, it seems, are available. "The site of about five acres recently secured for the New Admiralty and War Offices is valued at £820,000, or rather over £160,000 per acre; that now vacant in Charles-street, opposite the India Office, is less than an acre, and would cost at least £125,000; probably another acre might be secured by private contract, so that the value of a limited site in this position would not be less than £250,000. It has been suggested that a single acre not far from Charing-cross might be obtained for £224,000. Two and a half acres on the Thames Embankment have been offered at £400,000; and it is stated that six acres might be procured from Christ's Hospital at £600,000. Another good central position has been suggested, consisting of two and a-half acres, which has been valued at £668,000." What this site is has not been stated. South Kensington is, after all, to have the Institute. "The attention of the committee was then drawn to the property at South Kensington belonging to the Commissioners for the Exhibition of 1851. This property was bought out of the profits of that Exhibition, with the express object of offering sites for any large public buildings which might be required for the promotion of science and art. Under these circumstances the committee submit to your Royal Highness that the Imperial Institute may well establish a claim for the grant of a site of sufficient magnitude on property bought and reserved for public institutions of this character. Though sensible of the objections that may be urged against the situation at South Kensington, the committee think that the advantage must be obvious of obtaining a sufficient site virtually free of cost, so that the whole of the subscriptions may be devoted to providing a building for and establishing and maintaining the Institute." We venture to make a suggestion to the committee. The Alexandra Palace, Muswell-hill, could be obtained for a comparatively moderate sum; it is of no use to anyone as it is. The situation is delightful, the building well adapted for exhibitions, conferences, and discussions. The train service is not bad, and might easily be made better. A busy City man could, under the improved conditions, get to Muswell Hill as quickly as he could get to South Kensington, and with much more comfort. Let the Alexandra Palace be purchased and converted into the Imperial Institute. It may be argued that however suitable for the purpose the building may be, the site is so far out of London that the Imperial Institute could not be of any use. Our answer is that it has yet to be proved that it would be of any use if established at South Kensington. It is, we think, too soon to say anything in detail concerning the suggestions made by the committee as to the work the Institute is to do. Already we find the hint that it is to travel outside its original purpose, as hitherto vaguely indicated, and to become a means of promoting technical education in our manufacturing towns. Here is the old South Kensington craze in full swing; but this, like a host of other ideas, really is not presented in a form to call for comment. The report is too indefinite for criticism. It will be time enough to deal with the functions of the Institute when we know at least a little as to what its functions will be.

THE COST OF LOCOMOTIVE POWER.

MR. JEANS, secretary of the Iron and Steel Institute, is about to publish a work on "Railway Problems," a portion of which is devoted to the cost of locomotive power on various railways at home and abroad. In this will be found a great many statistics, which at first sight appear likely to shed some light on the vexed question of the relative merits of English and American locomotives. It is to be feared, however, that this promise is not fulfilled. Indeed, Mr. Jeans is himself very careful to point out that several all but inexplicable puzzles are presented by his figures, and that they must in all cases be taken with such qualifications that they are necessarily very indefinite. It is, for example, well known that the cost of locomotive power is a large percentage of the whole cost of working a railway. Mr. Jeans gives a table dealing with ten first-rate British railways, from which it appears that the difference in total cost per train-mile is comparatively small. At the one end of the list is the North British Railway, with an expenditure of 2s. 2d. per train-mile; at the other end is the South-Western, with 3s. But we find that, while the cost of working the London and Brighton line, for example, is 2s. 4d., the cost of engine power per train-mile being 10·1d., the total for the Midland is the same as for the Brighton, but the cost of engine power is only 7·7d.

Here we have a curious unexplained compensating action, which is not confined to the cases named. The figures refer to 1884. Mr. Jean hardly attempts to supply any explanation of the apparent discrepancies, yet it may be possible to cast a little light on the matter. It would extend this article too much to deal in detail with these ten railways; we must confine our attention to two or three points.

The first thing which strikes us is that, although the work done by all the railways named varies, the total expenditure is remarkably constant. If we reject the London and South-Western line, with its exceptional 3s. per train mile, we find that the difference between the North British with 2s. 2d., and the North-Eastern with 2s. 7d., is only 5d., or say one-sixth. The relations between the cost of the locomotive power and the total cost are so obscure that they appear to have no relation to each other. Thus, as we have said, although the cost of the locomotive power on the London, Brighton, and South Coast system is 10·1d., while on the Midland it is 7·7d., the total cost per train mile is the same. Again, on the North British the cost of locomotive power is 6·5d., while the total expenses are 2s. 2d. On the London and North-Western the total cost is 2s. 7d., while locomotive charges amount to 7·9d. It appears, then, that the causes which determine the cost of locomotive power are largely distinct from those which determine the whole cost; and it will be found, further, that there are really no grounds for drawing any deductions as to the relative economy and efficiency of locomotive engines on British railways from such figures as those we have quoted. For example, let us take the cost of coal; we shall not be far wrong if we say that on the North-Eastern it costs about 7s. per ton, while on the London, Brighton, and South Coast it costs on the engine £1. If we reduce the total consumption to a dead level of 30 lb. per mile per engine, we shall have the cost of coal per mile on the first-mentioned railway in round numbers 1d., and on the latter 3d. Here, then, we have at one swoop 2d. a-mile against the Brighton engine. But this comparison is not fair, because the coal used on the Southern line is better than that burned on the Northern line, although of course nothing like 2d. a mile better; probably we shall be correct if we say that it is about a farthing a-mile better. The London and Brighton Company has a very large metropolitan traffic, which seriously affects the engine expenses; but of this Mr. Jeans takes no cognisance. Its goods traffic involves a great deal of shunting and standing about at stations, which means waste of fuel. Again we have to bear in mind that the total annual mileage of an engine has a very important effect. Now, on the Brighton Railway the mileage is 19,848, while on the North-Eastern it is 16,240. But the average annual expenditure on a Brighton engine is £742, while that on a North-Eastern is £728. The wages paid in the Brighton locomotive shops are higher than those paid in the North; and the cost of coal is, as we have said, nearly three times as much. It follows therefore that Mr. Stroudley's engines are, by comparison, kept up for less money by a good deal than are the North-Eastern engines, although the actual cost is considerably more. But further, the work done by the engines on the North-Eastern is very different from that done on the London and Brighton lines, so different that there is hardly any room for comparison. We have purposely taken two railways far removed from each other in this case. Turning now to two lines apparently worked under very similar conditions, namely the Great Western and the London and North-Western, we find the cost of locomotive power on the first-named is 7·7d., and on the latter 7·9d.; while the total cost per train mile is for the former 2s. 5d., and in the latter 2s. 7d. The cost of fuel will be about the same for both lines, probably about 6s. per ton. But Mr. Dean spends annually on each engine £617, while Mr. Webb manages with £505. Apparently the comparison here is all in favour of Mr. Webb. When, however, we turn to the mileage, we find that the opposite of this assumption is true; for the Great Western engines have an average mileage of 19,313, while Mr. Webb's engines only make 15,422—by far the lowest mileage in the kingdom. Mr. Dean's expenses per engine mile are, as we have seen, lower than Mr. Webb's, although his annual expenditure per engine is much higher.

The figures given by Mr. Jeans are to the effect that the profits earned by American locomotives are much greater than those earned by British engines; and this is attributed, in large measure, to the great annual mileage of American engines. It must not be forgotten, however, that this great mileage is attended with very heavy repairs. Thus, for example, while on the Pennsylvania Railroad, the annual engine mileage is 26,000, the cost per engine is no less than £1211 per annum; and as coal is very cheap, a large proportion of this outlay must be on repairs and renewals. We cannot now go fully into the question of engine mileage, but it may be stated to prevent misapprehension that the annual mileage of a locomotive does not represent its total economic efficiency. It may be assumed that every engine has a certain mileage which it can run without going into the shop for repairs. Let us say for the moment that this is 200,000 miles. Then if the annual run of the engine is 20,000 miles, it need not undergo any substantial repair for ten years. If the mileage were increased to 30,000 per annum, then the engine would be in a sense worn out in about seven years, and the cost of incidental expenses, coal, &c. &c., would in like proportion be augmented. Here the cost per annum would be increased, while the cost per train mile might remain the same. Again, the mileage depends to a large extent on the standard of repair which the locomotive superintendent sets up. Thus, some twenty years ago, the London and South-Western Railway had the reputation for getting more miles out of its engines than any other line in the kingdom. It was also held, however, that South-Western engines broke down and interrupted traffic more often than any other locomotives. The North-Eastern Railway, again, had once the proud pre-eminence of contributing more than five-sixths of all the locomotive boiler explosions of the year. We have already shown in a former article that American locomotives break down in a way that would not be tolerated in this country, and such facts must not be overlooked.

The general inevitable conclusion to be drawn from all or any figures dealing with locomotive engine expenses is that they are of little or no practical value as factors with which to estimate and determine the comparative merits of locomotive engines, because the conditions under which the engines work and the cost of the concomitants of their service are so variable. Take, for example, incidental expenses and general charges. What proportions of these are counted against the engines, and what do they amount to? These really have nothing whatever to do with the actual running of an engine any more than the preaching of sermons on Sunday has to do with firing the 100-ton Woolwich gun. But the gun stands charged in the gun-factory books with 15s. 4d. as its percentage of the stipend of the Military Chaplain, everything in the gun factory being charged against the guns. Nor will it do to draw deductions from such figures as to the relative merits, energy, skill, &c., of various locomotive superintendents, because these gentlemen have their policy shaped for them by conditions over which they have no control. For example, the annual mileage of a locomotive is not settled by its capacity for running, but the nature of the work, and by the wishes or powers of drivers and firemen. Thus, about 200 miles a-day may be regarded as the maximum for express drivers. This represents about five hours a-day actual work for the engine; but no engines can be kept in use at this rate, at least we have never heard of 60,000 miles being run in any one year, save under exceptional—we had almost said experimental—conditions, A difficulty lies in the circumstances of the trip. If, for example, an engine runs an express from London to Grantham—106 miles—in the morning, and takes it back in the evening, we have a total of 212. This engine could not take another express train out in the same day, because it could not leave its train until it had reached Peterborough, adding 76 miles to the 212 already run, which would be a great deal too much. It is the most difficult thing in the world to add on just a few miles a day to a locomotive, which has in most cases to be worked on the all or nothing system. To get more out of engines than is got now would entail a system under which relays of drivers would have to be provided. Thus, the Irish mail might be taken by one engine from Holyhead to London, or *vice versâ*. But it must be worked by a double gang of men. This method has been adopted in the United States, under the title of "the first in first out system." It has, we believe, been tried in this country, but has never taken root, and it remains to be seen whether it really means any economy. The most important result secured by its adoption would be that a smaller number of engines would suffice to conduct a given amount of traffic. This might or might not be a good thing. Legree held that it was better to use up and buy more than to spare his niggers. This policy is freely tried with locomotives in the United States. It is not liked here.

It is to be regretted, we think, that a general standard of efficiency for locomotives cannot be prepared; but the thing is really impossible. It is, however, possible to set up a number of standards, and try engines by one or some of these. Of such standards, however, we have always held that "cost per train mile of power" was the most misleading, and we find nothing advanced by Mr. Jeans to alter our views.

THE LOCAL GOVERNMENT BOARD.

The opening address recently delivered by Captain Douglas Galton, as Chairman of the Society of Arts, is calculated to tend to the glorification of that noble institution, the Local Government Board. When an authority on sanitary matters thinks himself justified to pronounce *ex cathedra* that England in matters sanitary has attained a kind of millennium, it is only natural to infer that the Local Government Board has justified its existence, and it is only right that the high praise it deserves for so great an achievement should be meted out to it. Before, however, we rush to cover with laurels an institution apparently so meritorious, it is our duty to make sure that the results with which it is credited have really been obtained; and here we shall be met with a serious difficulty. If, indeed, we content ourselves with the grandiloquent orations of sanitarians we shall arrive at a speedy and satisfactory conclusion. But when we turn from these flowery and airy performances to the more substantial domain of facts, we shall very probably find ourselves confronted with the question, "Where are these improvements?" and be quite unable to point to them.

Nothing is so safe in inquiries of this nature as a systematic procedure. It would be advisable first to inquire into the position of the Local Government Board, its will and powers, and then to proceed to discover the improvements, if any, which it has succeeded in introducing, and more important still, the instances on record when it has omitted or neglected to do its duty. For obvious reasons, however, such a course would be impracticable. In the space of a short article like this it would be impossible to give a full account of all this institution has done and left undone; nor could we easily compress into a small compass a full history of the origin and rise of the Local Government Board, though a complete history of these would probably serve to disabuse the public concerning its utility. We will, however, modestly content ourselves with raising only the hem, so to speak, of the golden veil of optimistic illusion through which our unfortunate, misgoverned countrymen are content to regard this beaureaucratic octopus before which sanitarians worship and bow down.

It is well known that the General Board of Health, a most excellent and energetic body, made itself disliked on account of its activity. People did not care to have the nakedness of the land too minutely spied out, and in those days sanitation was in its infancy, which, to believe modern authorities, can no longer be the case. Consequently, the duties of the Board of Health were very properly transferred to the Local Government Board, and nobody has ever accused that institution of sinning in the same direction. To further systematise our sanitation, an Act was passed in 1872 which divided the whole of England and Wales into rural and urban sanitary districts. The areas of the former comprised all parts of a union not forming part of an urban district, and the guardians of the union were to be the rural sanitary authority. The powers granted by the Sanitary Acts were to be transferred to the new bodies, and the appointment of inspectors of nuisances and medical officers of health was rendered compulsory. The Local Government Board, on condition of having a word in the appointment and dismissal of these officials, was to pay half their salaries. In 1875 another Public Health Act was passed extending the power of sanitary authorities, and enabling authorities in rural districts to supply water, and if, upon the report of the surveyor, any house within the district was found to be without a proper supply of water, the owner was to be compelled to furnish the same. It was further enacted that "When complaint is made to the Local Government Board that a Local Authority has made default in enforcing any provision of this Act which it is their duty to enforce, the Local Government Board, if satisfied after inquiry that the Authority has been guilty of alleged default, shall make an order limiting the time for the performance of their duty in the matter of such complaint. If such duty is not performed by the time limited in the order, such order may be enforced by Act of Parliament, or the Local Government Board may appoint some person to perform such duty, and shall by order direct that the expenses of performing the same, together with a reasonable remuneration to the person superintending the same, together with the costs of the proceedings, shall be paid by the Authority in default, and any order made for the payment of such expenses and costs may be removed into the Court of Queen's Bench, and be enforced in the same manner as if the same were an order of such Court."

It will therefore be seen that if the Local Government Board has done any good, this is not surprising, considering the powers it possesses; and when it has omitted to do good, this has not been for want of them. The fate of the General Board of Health, however, must have had a depressing and paralysing effect on the energies of its successor, for we do not find that the latter has ever been accused of using to the full the powers vested in it. We have thus briefly epitomised the theoretical position of the Board, so that our readers may see how powerful it is, and what it can do. In fact, whenever it finds sanitary defects it can practically enforce their remedy; and wherever a local official, either sanitary inspector or medical officer of health, has neglected his duty or shown himself inefficient, he can be dismissed. We will now proceed to see how far the Local Government Board has availed itself of the great powers thus placed at its disposal. We do not propose a complete survey of Local Government Board administration; for this purpose, even a hasty perusal of the "Supplement to the fifteenth Annual Report of the Local Government Board," containing the papers and reports on cholera will suffice. That will show how unsatisfactory is the state of things, and what appalling results the introduction of cholera into our rural districts would have. We will content ourselves with giving a few examples of Local Government Board activity in one or two rural districts. We have chosen these rural districts because we happen to possess authentic and trustworthy information respecting them, but we are not prepared to say that these are exceptions, nor would we have our readers suppose that urban districts are more fortunate. We know this is not so, and we can safely assure our readers that in this respect the old adage, *ex uno disce omnes*, holds good.

To begin with, there is the case of Birdbrook. Birdbrook is a smiling village near the town of Haverhill, in Suffolk. It would be a paradise on earth but for its water supply, which is drawn from wells and ponds situated in the close vicinity of farmyards. Cows and other useful beasts graze close to the wells and ponds, and as the habits of these animals have not yet felt the refining influences of education, the water in the wells and ponds is declared to be dark and muddy. Probably it would be found on analysis that this water possesses many wholesome and nourishing qualities, being replete with organic matter; but unfortunately the fastidious inhabitants of Birdbrook do not like its flavour. There is, however, an unpolluted well in the neighbourhood, and this is the private property of the rector. It is protected from the patronage of the vulgar by a chain and padlock, the key of which is in the careful keeping of the clerk of the parish. A favoured few are allowed access to this well, but they must in every case ask the clerk for the key; and if this functionary should be absent, or should have mislaid the key, chaos ensues. Even at Birdbrook there are truculent men who will not remain content with the existing order of things, and so powers to borrow £300 for the construction of a water supply were applied for, and an inquiry by the Local Government Board was held. The inquiry, which took place in October, 1884, was eminently satisfactory, but months elapsed before a definite official permission was vouchsafed. Nevertheless, Birdbrook is still without its water supply. The Board of Guardians, animated by a mistaken spirit of economy, have refused to vote the money. The agitation is being continually revived, but the Local Government Board will not exert its powers, and so things remain *in statu quo*.

From Birdbrook, which, as we stated, is in Suffolk, we will turn to Kingsbridge in Devonshire. Of this place the Local Government Board report for 1886 says: "Kingsbridge is in the same condition of bad drainage as when visited by Dr. Barnard in 1882, but a drainage scheme is said to be under consideration." This is hopeful. A correspondent of our contemporary, the *Plumber and Decorator*, in the number for November, 1886, says that he was engaged in assisting to prepare plans and a report for the drainage of Kingsbridge seven years ago; that the plan and report were adopted, paid for, and have been under consideration ever since; unfortunately, however, latest advices are to the effect that the plan has been lost. The Local Government Board evidently does not think Kingsbridge is worth making a fuss about.

We will give yet another instance of the apathy of our great central sanitary governing machine. Saltford is a parish five miles from Bath, and belongs to the rural sanitary district of Keynsham. The drainage and water supply of this village, which has a population of 421, are carried along opposite sides of a road, and, except for a very short distance, neither the drainage nor water supply is enclosed in pipes. At certain points the drainage passes over the water supply, and as the former is carried across in imperfect pipes, and the water supply is unenclosed, contamination of the water takes place. During the ten months ending in November last, twenty-four deaths of diphtheria had occurred out of a population of 421. For three years efforts have been made to secure a remedy, but to the credit of the reputation of the Local Government Board, be it said, without success. The inhabitants complained to their local sanitary authority, the local sanitary authority referred the matter to the Local Government Board, the Local Government Board referred it back to the local sanitary authority, and this august body came to the conclusion that the case of Saltford was not exceptional—and there they were right—and that the deaths had not occurred from diphtheria but only from diphtheritic sore throat. Of course this information must have been a great comfort to the people of Saltford. But with the base ingratitude characteristic of the vulgar mind, the people of Saltford got up an indignation meeting at which some very extraordinary facts were disclosed. The Rev. R. W. Fenwick stated that so long ago as the 6th March, 1884, he began to take action and had written to the local sanitary authority describing the state of things, but he was privately compelled to hold his peace. An inspector of nuisances was provided at the ratepayers' cost, but he was discouraged to make any reports of a sanitary character unless he was put forward to do so by somebody else. In other words, if he ventured to do his duty he would be discharged. He was censured for reporting diptheria. Mr. Fenwick then gave an exhaustive account of his ineffectual struggles to get the case of Saltford attended to. He was followed by Mr. George Mitchell, who informed the meeting that his doctor had ordered him not to use the water supplied to Saltford for drinking or even washing the floors with! We scarcely venture to hope that a time may come, not of course soon, but at least in the dim and distant future, when Saltford will have its drainage and water supply in a satisfactory condition, though it seems more than probable that the inhabitants will die out before the advent of that happy era.

One more instance. In last May the inhabitants of Brixham asked the Local Government Board to hold an inquiry with reference to some scheme the precise nature of which we cannot recal to our minds, though we know it was one connected with the public health. An inspector was appointed to go down, but we regret to state that this gentleman has not yet found time, owing to his numerous engagements, to give the matter his attention; nor have his arduous labours permitted him to spare sufficient leisure to inform the Brixhamites at what date it would best suit his convenience to go down. The inhabitants of Brixham are therefore still waiting patiently for the arrival of that great man before there is any hope for the adoption of their scheme. Even after the inquiry has been held, some time will elapse before the official sends in his report, and then the time between the sending in of the report and the granting of the permission by the Local Government Board must be added; but this last period no theory of probabilities will assist us in discovering.

The above instances are not isolated facts; we believe them to be fair examples of Local Government Board action. We will leave them to speak for themselves. An eloquent orator, or a popular agitator, could enlarge upon them and make possibly unpleasant deductions. This is not our object, but we think that when men like Captain Douglas Galton step forward to proclaim, *urbe et orbe* that the sanitary condition of England is perfect, the long-suffering and confiding British taxpayer should have a few facts placed before him, so that he may judge for himself. The Local Government Board is an expensive machine, and it is only right that the public should insist on its doing its duty. In one matter at least this duty is almost criminally neglected, and that is with reference to the exercise of a voice in the appointment of sanitary inspectors. It is notorious that these officials are recruited from all sorts of non-technical classes, such as butchers, bakers, and soldiers, and that they are completely under the thumb of the very people against whom they should report, and whose interest it is to pretend that everything is the colour of roses. If the Commission appointed to inquire into the working of the Civil Service succeeds in reforming the Local Government Board it will not have laboured in vain, and the country will owe it a debt of gratitude that nothing can repay.

Neglect on the part of the Local Government Board does not perhaps involve the waste of millions of the public money; it may, however, mean the waste of thousands of human lives. The Local Government Board exists primarily for the purpose of ensuring the satisfactory sanitation of the kingdom; in neglecting this important duty it deprives itself of the reason for its existence, and must fall to the ground. There are indeed critics not a few who would rejoice to see this institution completely abolished. We do not share this view, but we should like to see the besom of reform pretty briskly used in the comfortable offices at Whitehall, and the cobwebs of laziness and apathy completely swept away.

THE SEWAGE OF LONDON.

FORTIFIED by the approval of four eminent chemists, one of whom was a member of the recent Royal Commission on Metropolitan Sewage Discharge, the Metropolitan Board of Works are proceeding with their plans for the chemical treatment of the London sewage at the Barking and Crossness outfalls. The subject, however, is encompassed with a considerable amount of controversy, especially when contrasting the merits of the precipitation plan with the Canvey Island scheme propounded by Mr. Bailey-Denton and Lieutenant-Colonel Jones. These two gentlemen, whose views on such a topic must always command respect, have by no means abandoned their project, but still retain a hold upon Canvey Island, so as to render it available for the disposal of the London sewage, should the Metropolitan Board see fit to lay aside the purely chemical plan for treating the sewage at the outfalls, and enter upon the broader project of carrying all the sewage down to the estuary. The latter method, as a permanent plan, is in accordance with the recommendations of the Royal Commissioners; and Mr. Bailey-Denton and his colleague propose such a mode of dealing with the Metropolitan sewage in connection with Canvey Island as will fulfil the recommendations of the Royal Commissioners to the very letter. Precipitation by chemical methods at the existing outfalls, although aided by deodorisation, is evidently at variance with the views of the Royal Commissioners, except as a mere temporary arrangement. This gives, by comparison, a sort of *raison d'être* to the Canvey Island project, and Mr. Bailey-Denton is not disposed to let his scheme lapse into oblivion. Within the last few days he has addressed a letter to Sir James MacGarel-Hogg, the Chairman of the Metropolitan Board, in which the present aspect of affairs is discussed in a tone of remonstrance. Reference is made to the fact that in October last Mr. Bailey-Denton received a letter from Mr. Wakefield, the Clerk of the Board, to the effect that if he had any information in relation to his scheme in addition to that which had already been communicated, the Board would be prepared to consider "as to granting an interview." Five days afterwards Mr. Bailey-Denton replied on behalf of Colonel Jones and himself, stating that they were able to demonstrate, "with increased particularity, that what chemistry had failed to do could be done mechanically and automatically, with certainty and economy—without recourse to chemistry—at Canvey Island." At the same time "explanatory notes and details" were sent to each member of the Board, so that on the occasion of a personal interview the members might be in a position to ask any questions necessary to a clear understanding of the entire project. Time has passed on, and down to the present period nothing has been heard from the Board, nor has any notice been taken of the "explanatory notes and details." Mr. Bailey-Denton now expresses "great surprise" that although the Board still remain ignorant both of details and engineering facilities which should influence an ultimate decision, tenders have been invited for the construction of additional tank works at the outfalls. Any such expenditure, it is argued, will be "an entire waste of money if the Canvey Island scheme should be adopted." While this point is practically ignored, it appears, on the other hand, that Mr. Dibdin, the Board's chemist, has openly stated that if the Canvey Island scheme is adopted, the ratepayers would be burdened with a charge of £400,000 per annum, equivalent to a rate of threepence in the pound, or double the amount which the projectors of the plan have declared to be requisite. A strong protest is lodged against the course taken by Mr. Dibdin in thus, as it is considered, disregarding the character and competency of the two gentlemen in question. Some emphatic expressions are used in reference to this matter, and Mr. Bailey-Denton goes on to appeal to his past history, and that of Lieutenant-Colonel Jones, to show that they have a perfect claim to the confidence of the Board. The letter concludes by pointing out that if the present opportunity is not seized, Canvey Island will have to be purchased at some future time at a greatly enhanced cost, in addition to the unnecessary outlay at Barking and Crossness

THE AMENDMENT OF PATENT SPECIFICATIONS.

SINCE our article on this subject, a month ago, a new development has been reached which is manifested in a very peculiar announcement in the *Official Journal of the Patent Office*, of the 24th inst. The paragraph is headed, "Notice of Amendment of Specification," and sets forth that the amendment of a certain specification, which we need not particularise, "having been made through a misapprehension, the same has been cancelled, and the words struck out have been restored." A misapprehension by whom?—by the patentee or by the office? The administration of the Patent-office is rapidly becoming a serious scandal; and it is to be hoped that it will be brought to the notice of Parliament at the earliest possible opportunity, unless indeed the long-deferred report of the Inquiry Committee—which was constituted just a year ago—should prove to contain the only recommendations which can be regarded as satisfactory. It is a matter of intense surprise that the Comptroller should take upon himself to ignore—for he cannot be ignorant of—the provisions of subsection 9 of section 18 of the Patent Act, which is as follows:—"Leave to amend shall be conclusive as to the right of the party to make the amendment allowed, except in case of fraud; and the amendment shall in all Courts, and for all purposes, be deemed to form a part of the specification." Fraud is not imputed in the present case, unless "misapprehension" be the official euphuism for that ugly word. The amendment appears to have been made after a due observance of all the necessary formalities, and it must "*for all purposes* be deemed to form a part of the specification." The "cancelling" of the amendment is in itself an amendment, and this is admitted by the words "Notice of Amendment of Specification," which stand at the head of the announcement. The sooner the Patent-office is informed by those in authority that it is not at liberty to make alterations in specifications by a mere stroke of the pen the better it will be for all parties. There must be no more of these "misapprehensions," which have already been the cause of serious mischief.

LITERATURE.

Stresses in Bridge and Roof Trusses, Arched Ribs, and Suspension Bridges. By Professor W. H. BURR. New York: J. Wiley and Sons, 1886.

AMONG the series of technical works published by Messrs. Wiley and Sons, this book of Professor Burr's seems to be one of the, if not the, most important and useful. It is thorough-going in its treatment of its subject. The whole of it is devoted to the technical subject announced on the title-page; there is no padding, such as is so common in text-books composed of matter which ought to be studied in the elementary treatises on mechanics. A general knowledge of the principles of grapho-statics is assumed to be possessed by the reader, and thus the ground is cleared so that attention may be exclusively devoted to bridge and roof work. In fact, the matter is even more restricted than the title-page indicates, because although general methods of application of the constructions to roof work are explained, still, nearly the whole book is confined to bridge calculations; and what is written about roofs is so scanty as not in the least to constitute a technical treatise on that subject.

Extensive information is given as to the data on which bridge designs are founded, and detailed calculations from such data are given *in extenso* for a very considerable number of structures. These calculations are certainly not so complete and laborious as are actually required in practice for important designs; but they are very much more detailed than any we happen to have seen given in other books on this subject in the English language. A student of bridge engineering could not set himself any better exercise than to read carefully and critically through the whole of this book, checking off for himself the calculations. Adult as well as juvenile students might learn a good many things from doing so. The book deals with American practice in bridge building, and therefore it must find its chief usefulness on the other side of the water. But engineers on both sides of the Atlantic are now, we trust, alive to the fact that each can learn to improve his practice by watching what the other is doing; and this book affords us in England the opportunity of having a glimpse into the inner working of the brains of our American professional cousins.

The publisher's work is well done, the paper good, the type clear and easily readable, the diagrams neatly engraved. Regarding this latter point, we must remark that between many diagrams and the text relating to them there appear some confusing discrepancies in the lettering. It is especially confusing to find the same letter employed in different parts of the same diagram.

The first chapter gives general explanations, and solves algebraically the simplest cases of overhanging latticed girders, with parallel and non-parallel chords, and with vertical and diagonal bracing, or bracing "with two inclinations." Then for girders supported at both ends, the positions of the moving loads giving maximum web stresses and those giving maximum chord stresses are investigated. The ambiguity caused by counter-braces is carefully explained, the author seeming to have come to the conclusion that the amount of the ambiguity is so small as to be unimportant, and not at all to outweigh the unquestioned advantages derived from their insertion.

The system of analysing what is called a "compound" truss into two simple trusses, and relegating to each the duty of sustaining a definite proportion of the total load, is given and followed in several examples. It is stated that this is a legitimate method so long as the girder is one with parallel chords, but not for others. For the former, it is assumed that it is a convenient, and even necessary, method of procedure. We do not think this puts the matter on exactly the right footing. The process is legitimate—that is, it will give true results so long as the so-called "compound" truss is non-redundant in the number of its links, whatever may be the shape of its outline. If the truss be really redundant, then this proceeding is always liable to error, whether the chords be parallel or not, the amount of the possible error varying with circumstances. It should therefore not be used in the latter case. In the former case we cannot admit that it has any convenience at all about it. If the structure be really non-redundant, then in all cases it is possible to draw a single diagram for each given loading that will show all the stresses in all the members. But if the "compound" truss be split in two in this fashion, then it becomes necessary to draw two distinct diagrams, and one has besides the extra trouble of combining the results of the two diagrams. Even then the result is apt to have a fishy and doubtful aspect about it.

At page 89, *et seq.*, is given an extremely neat demonstration of a rule for the placing of the moving load so as to give maximum stress in any web member when the upper and lower chords have any inclinations to the horizontal.

The algebraic method of finding stresses is largely used throughout the book; but this is done a good deal in combination with help derived from graphic stress diagrams. These are called in to assist especially in dealing with bow-string and deck trusses with lower chord curved, as also for latticed arches.

In working out the stresses in a crane truss in Chapter III., we notice that no more is said about the effect of passing the chain along one of the chords than that it throws on that chord an amount of compression equal to the tension on the chain. Now this may be true, but it does not give the whole stress action of the chain. It would therefore seem better to take the resultant action of the chain at each joint it passes round as an "external force." Doing so leaves no doubt that the total stress-producing action of the chain is taken into the calculation.

In the same chapter wind stresses on roofs are dealt with. It is assumed that the wind pressure is normal to the surface of the roof. We suppose that there are no sufficiently reliable data to enable us to say exactly how much the tangential or frictional force of the wind is on the surface on which it impinges; but it should not be forgotten that this tangential component of pressure certainly exists, and is almost certainly of no negligible magnitude. In this section of the book we find a somewhat unnecessary assumption made, that one end of a roof rafter sometimes rests on rollers. "If neither foot rests on rollers, the horizontal reaction will be assumed to be equally divided between the points of support." This is a rather risky assumption to make. The actual share each wall takes of the horizontal wind thrust depends, of course, on the amount of yielding shown by the wall under a given horizontal force as compared with the elastic resistance of the roof truss to horizontal crushing or extension. The proper method of distributing this horizontal wind load between the two walls is evidently to investigate for each truss this horizontal "elastic modulus," as it may be called, and compare it with that of the walls. The proper mode of comparison will be understood by those who are familiar with this sort of work. Even if the above moduli can be approximated to only roughly, such an approximation is better than a pure fancy hypothesis such as that of equal sharing of the resistance by the two abutting walls.

A difficulty arising in connection with a roof truss on page 119 is got over by an awkward and unnecessary "assumption" that two stresses in two bars somewhat remote from each other are equal to each other. This can hardly be called a method of ascertaining the real stresses. The structure being non-redundant, the stresses are all determinate without any "assumptions" being made, and, in fact, it is easy to draw the complete stress diagram. It so happens that in the particular shape of truss shown the assumption made is correct, but the least alteration in the special relative inclinations chosen for the bracing bars would make it incorrect.

In Chapter IV. swing bridges are ably and thoroughly dealt with. But here again we must take exception to one part of the procedure. The theorem "of three moments" is used largely, but it is used in the form applicable only to the case of uniform section throughout the length of the bridge. In an appendix the complete general form of the theorem of three moments is most fully demonstrated, but then this general form is then made special and simple by assuming that "in the ordinary case of an engineer's experience I is constant, *i.e.*, the section is uniform." But is this so? On the contrary, in nearly all cases of sufficient importance to make it worth while to undertake the laborious calculations which the application of this theory in any form makes necessary, it is the fact that this section varies very largely at different points of the length. Indeed, in the chapter above referred to, after laborious calculations are made of moments by help of the simplified form of the "three-moment" formula for uniform section, and after determination of the stresses throughout the structure, it is assumed that the sections are to be made in proper proportion to those stresses, which of course vary largely. On the one hand, if the flange section is not to be varied, what is the use of making nice and laborious calculations of the variations of stress along it? On the other hand, if it is to be varied according to the calculated stresses, then the hypothesis on which these stresses have been found becomes entirely vitiated. It must not be supposed that the vitiation of the results is only slight; they are, on the contrary, made largely wrong. Thus there seems no practical—or theoretical—utility in spending so much trouble in using the theory of three moments in this shape. Of course this assumption of uniform section makes it comparatively easy to use the formula—its use becomes merely tedious, not difficult—but if the results have no practical value, this increased ease of manipulation is of no consequence. We are not arguing against the use of this formula. We only insist that, if it be used, it must be used in its truly applicable form in spite of the increased difficulty of doing so. The labour of the application can be immensely reduced by proper use of graphic methods, and with that help it actually comes well within the limits that can be profitably incurred in a design of any considerable magnitude and importance.

The same criticism applies to Mr. Burr's otherwise excellent treatment of metal arches. The horizontal thrust on the abutments is, of course, found by calculating the deflections due to the vertical loading, and those due to an assumed pair of horizontal abutment thrusts. These calculations depend upon the elasticity and the sections of the different portions of the arch. In order to make them simpler—the process is carried out graphically—the section is assumed to be uniform throughout the length of the arch. The results are applied to finding the different stresses on each section, and these sections are then supposed to be designed according to the stresses thus calculated to be brought upon them. It is evident that the same fallacy, as explained above, underlies this whole system of designing. Plainly, the correct procedure is to include the effect of variation of section in the calculations of the various kinds of deflection, an initial approximation to the needed sections being made by rough-and-ready reckoning, and the results being improved on by repeated approximations obtained by repetition of the whole process. Fortunately, the graphic method gives the means of making the variable-section calculations of deflection almost as easily as those for uniform section.

Evidently, swing bridges are a specially favourite subject with Prof. Burr, as he devotes 100 out of 450 pages to them. He treats them in three classes, viz., (1) those simply supported, (2) those latched down, and (3) those lifted up at their ends.

Fifty pages are devoted to arched ribs, and thirty-four to suspension bridges. All these chapters contain a great deal of important information to the student, and are decidedly interesting. We are inclined to object—especially in a text-book—to a good deal of tedious work being skipped over in the numerical examples, by means of making use of such purely accidental circumstances special to the particular data assumed, as "The numerical values are nearly enough equal, and therefore the line H K will be taken" (see page 242); or, "as the half intercepts at the distance $\frac{n}{4}$ from B and E are very small, and as their omission will lead to simplicity, and not cause much of an error, &c. &c." (see page 249). They may be small in this particular instance, but they are not generally so; and as the object of this book is to teach methods, the procedure in a standard example should not be shortened by taking advantage of such accidental circumstances, especially as the omission is of considerable, if not vital, importance in respect of method.

The subject of "Thermal Stresses," in arches with "ends fixed," and with "free" or hinged ends, is very fully illustrated. It seems a mistake to exaggerate these effects beyond their true proportions, by taking so enormous range of temperature as 165 deg. Fah.

On page 257 we notice an odd slip—which is repeated subsequently—in the statement that the dimensions of the quantity E I, viz., the product of elastic modulus by surface moment of inertia, is so many foot-pounds. It is really square feet × lbs. Again, I is in another place spoken of as so many foot-pounds, whereas it is so many fourth-power or quadric feet.

In Chapter X., "Details of Construction" are dealt with. Many useful hints are given, and we especially commend the author's insistency on the desirability of getting pin-connections as nearly as possible in the centre of gravity of the sections to which the stresses are transmitted. We think he over-estimates the bending moments produced by excentricity in the placing of these pin-joints, but nevertheless there can be no doubt about the existence of these bending moments under these conditions, and of their evil results. The weakest part of this chapter is the attempted analysis of the stresses arising round about pins and rivets; but this is confessedly a difficult problem, which we believe has never yet been accurately solved.

The calculations of "most economical depth" of girder are based on the assumption that the web thickness does not vary with the girder depth for a given loading. This is surely incorrect, and the reckoning on this basis must give a less than the true depth for maximum economy of material. It is difficult to say what rule should be followed in designing the web thickness of a solid girder, and how it should vary with the depth selected. The difficulty consists in making any reckoning of its tendency to buckle, and of the necessary strength of the side stiffeners employed to prevent this buckling. Professor Burr attempts to deduce a rule by considering the web as made up of independent parallel strips, taken along the lines of pure compression at 45 deg. to the neutral surface, and treating these strips as struts whose strength he finds by Gordon's formula. But the results of the rule so deduced are confessedly extravagant, although it is adhered to as the "basis for an empirical formula." But an obvious objection to this method of investigation is that the web might just as rationally be considered as a series of tension strips along the other diagonal at 45 deg.; and, if we were to do so, we would not only get an immensely smaller necessary thickness, but we would also find no tendency at all to buckle. As the tendency to buckle undoubtedly exists, it is very desirable that some rational method of taking it into account should be discovered.

As to the design of pins, Professor Burr very properly points out the immense importance of stiffness as distinguished from strength in these; but then he goes on to give a rule for calculating their diameters in accordance with the requirements of strength alone. We would suggest that he should alter this rule, so as to make it provide a certain standard amount of stiffness for all pins instead of a standard degree of strength.

The chapter on "Wind Stresses and Wind Bracing" will be found very useful, and is thoroughly sound.

In an appendix the strength of rollers is investigated by a legitimate approximate method. The safe load in lbs. per inch of length is found to be from 600 to 700 times the radius in inches, the roller being of wrought iron. For hard steel a considerably higher load may be taken. On page 446 in the formula for this load the factor $\frac{1}{4}$ has been omitted by inadvertence.

While making criticisms freely and frankly, we have said enough to indicate our high appreciation of the undoubted merits of this useful book. Throughout there is very considerable originality and vigour of thought displayed, as well as a thorough acquaintance with American practice in bridge building.

THE LATE MR. H. M. JENKINS.

WE announce with regret the death, at his residence, The Limes, New Barnet, on the morning of Friday, December 24th, of Mr. H. M. Jenkins, Secretary to the Royal Agricultural Society. When quite a youth Mr. Jenkins was connected with the Geological Society, first discharging the duties of assistant-secretary, and subsequently undertaking also the task of editing the society's quarterly journal. In 1868 he was elected from among a large number of candidates to the double appointment of Secretary to the Royal Agricultural Society of England and editor of its journal; and although, at the time, his lack of purely agricultural knowledge was by some regarded as an obstacle to his fitness for these important offices, as time wore away even the most doubtful were constrained to admit that the right man had been put in the right place.

Mr. Jenkins was ever ready to lend his advice and practical help almost whenever it was solicited. After the Franco-German War he threw himself heartily into co-operation with the late Lord Vernon and others in connection with the French Peasant Farmers' Seed Fund, which was, if we remember aright, suggested by Mr. James Howard; and in many another direction he rendered right worthy service, often in a way which escaped the public eye. His large acquaintance with European agriculture—for Mr. Jenkins was conspicuously one of those who availed himself of his opportunities to the fullest extent—resulted in his appointment as Assistant-Commissioner to the Royal Commission on the Depression in British Agriculture; and the bulky Blue-books issued by that body contain some hundreds of pages from his pen which are well worthy of the careful study they have received. Subsequently he joined the Royal Commission on Technical Instruction, at whose request he prepared a full and complete report upon agricultural education in the United Kingdom and on the Continent. The amount of work which he personally accomplished was a source of wonder to many, and especially to those with whom he was more immediately associated. In social life he was popular; in public life esteemed. Mr. Jenkins was an honorary member of the Royal Agricultural Academy of Sweden, and corresponding member of the Central Agricultural Society of France.

ON FLUTED CRATERLESS CARBONS FOR ARC LIGHTING.[1]

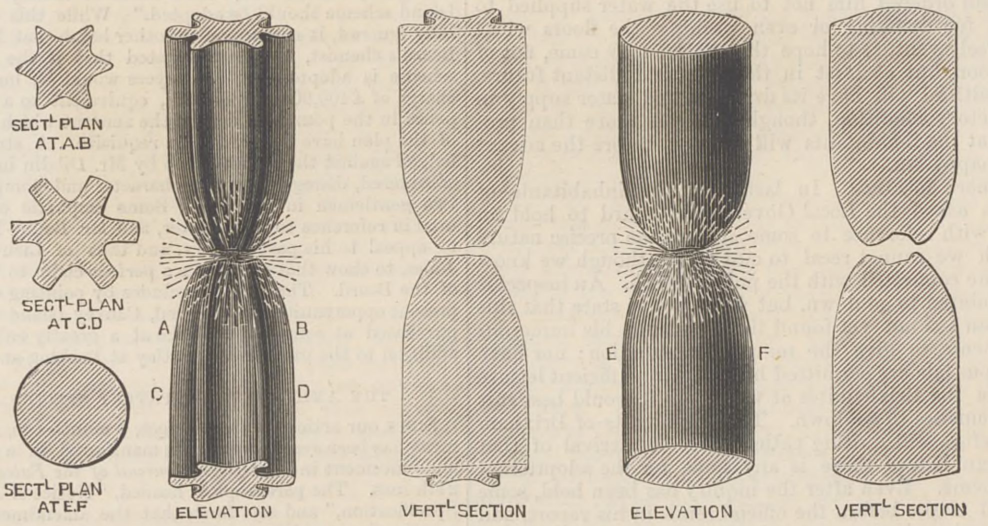
By SIR JAMES N. DOUGLASS.

ON the 8th December, 1858, at the South Foreland High Lighthouse, and with the direct current magneto machines of Holmes, the first important application of the electric arc light, as a rival to oil and gas for coast lighting, was carried out by the Trinity House, under the advice of Faraday. The carbons then used, and for several years afterwards, were sawn from the residuum carbon of gas retorts; they were square in section, $6\frac{1}{4} \times 6\frac{1}{4}$ mm., and the mean intensity of the arc, measured in the horizontal plane, was 670-candle units, being 17-candle units nearly per square millimetre of cross sectional area of the carbon. The crater formed at the point of the upper carbon of the "Holmes" lamp was so small that no appreciable loss of light was found to occur, and the arc proved to be very perfect in affording an exceptionally large vertical angle of radiant light for application with the optical apparatus as shown, one-third full size, in the engravings below.

The most reliable and efficient machine that has yet been tried for lighthouse purposes is the large size alternate current magneto machine of De Meritens. The average results with these machines are as follows, viz.:—

	One machine.	Two machines. supplying currents to one lamp.
E.M.F.	38 volts	48 volts.
Mean current..	206 ampères ..	372 ampères.
Diameter of carbons (cylindrical)	35 mm.	50 mm.
Diameter of crater in carbon..	13 mm.	18 mm.
Mean intensity of arc measured in the horizontal plane (candle units)	15,000	 30,000
Light per square millimetre of carbon section (candle units)	12	 12

It will be observed from this statement that the intensity of the arc in the horizontal plane per square millimetre of sectional area of carbon is about 35 per cent. less than it was with the small square carbons used by Holmes, although it might reasonably be expected that, with the improvements since effected in the manufacture of carbons, the efficiency of the old small carbons would at least be maintained. The relative efficiency of the large carbons used with the powerful currents now available appears to be due, first, to the loss of a large portion of the most intense part of the arc which is confined within the crater of each carbon; and secondly, to the fluctuations in the intensity of the arc caused by the current passing between various parts of the end of each carbon. For a new electric light installation, about to be made by the Trinity House at St. Catherine's Lighthouse, Isle of Wight, it is intended to utilise the large "De Meritens" machines that were used at the recent South Foreland experiments for determining the relative merits of electricity, gas, and oil as lighthouse illuminants. The electric light at St. Catherine's is intended to be "single flashing" at periods of 30 seconds. Each flash is to have a duration of $5\frac{1}{2}$ seconds, followed by an eclipse of $24\frac{1}{2}$ seconds. It is intended to use one "De Meritens" machine during clear weather, and two whenever the atmosphere is found to be so impaired for the transmission of light that the flashes are not reaching their advertised range. The defect here arose which is common to all electric flashing lights where a minimum and maximum intensity are adopted, viz., that the duration of the flashes of minimum and maximum intensity would vary in the ratio of the difference in the diameters of the carbons employed with one and two machines respectively, which in this case should be 50 mm. and 35 mm., this mean difference amounting to $36\frac{1}{2}$ per cent. nearly.



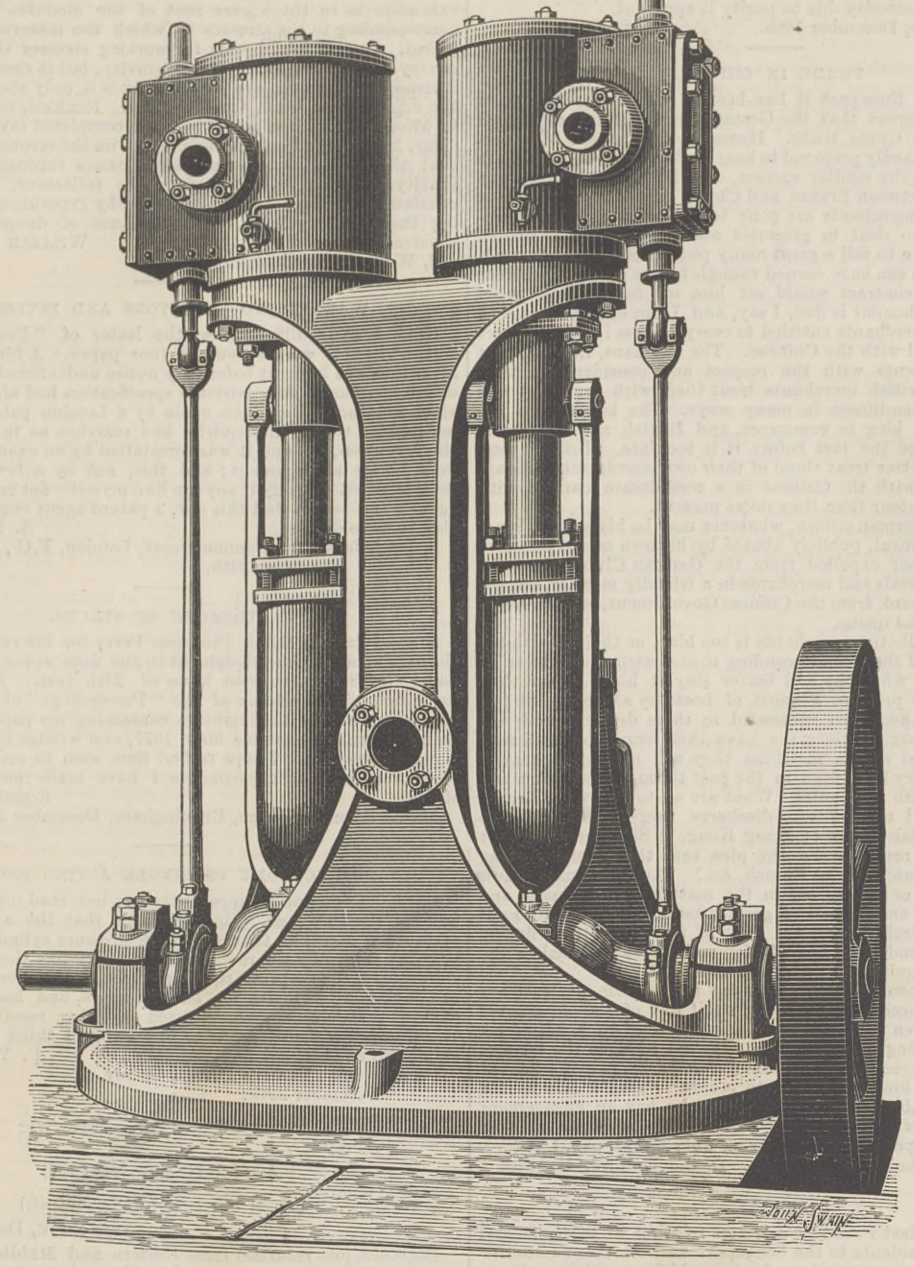
FLUTED CRATERLESS CARBONS FOR ARC LIGHTING.

It is evident that such a variation in the duration of flash would seriously impair the distinctive character of the signal. It occurred to me, however, that if carbons of a fluted section were employed for the arc of minimum intensity whose extreme diameter corresponded exactly with the diameter of the carbons used for the arc of maximum intensity, and of exactly half the sectional area of the latter, the defect referred to would be entirely obviated, and the flashes of maximum and minimum intensity would have exactly the same duration. As all carbons for electric arc lights are now made in moulds, I saw that such a form as shown in the accompanying sketch and model would not involve any more difficulty in manufacture than if cylindrical, while there would be less liability of fracture occurring in the process of drying and baking. Other advantages to be obtained with fluted carbons are, (1) a larger vertical angle of radiant light from the arc, and with a higher coefficient of intensity in consequence of the unobstructed radiance through the fluting at the points of each carbon; and (2) a steadier light is obtained, owing to the localising of the current at the central portion of each carbon.

The results of many experimental trials with fluted carbons 50 mm. diameter, as shown by the sketch and models submitted herewith, have entirely confirmed my expectations. It will be observed that no crater is formed, and the point of each carbon is all that can be desired for utilising fully the maximum light of the arc. My experiments have not been sufficient to determine accurately, but I am of opinion that the gain in intensity with fluted carbons is not less than 10 per cent.

1 "Proceedings" of the Royal Society, No. 245, 1886.

TANGYE'S VERTICAL RAM PUMP.

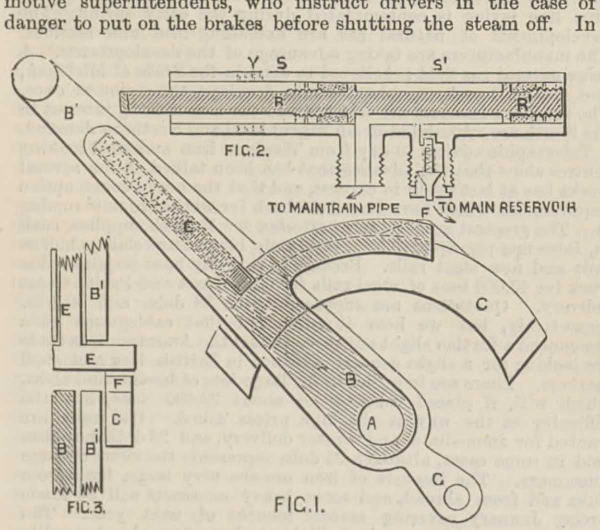


TANGYE'S VERTICAL RAM PUMP.

THE illustration of this pump is given not so much to show the details as the general design. This being so, the engraving describes itself, and is particularly to be commended to some of the makers of pumps who seem quite unable to combine the useful with the tasteful in design. The pump illustrated has an 8in. steam cylinder, 4in. rams, and 8in. stroke. The design is thoroughly good, and the pump is suitable for a great variety of applications where water has to be pumped against considerable pressure.

BULLEN'S REGULATOR FOR LOCOMOTIVE ENGINES.

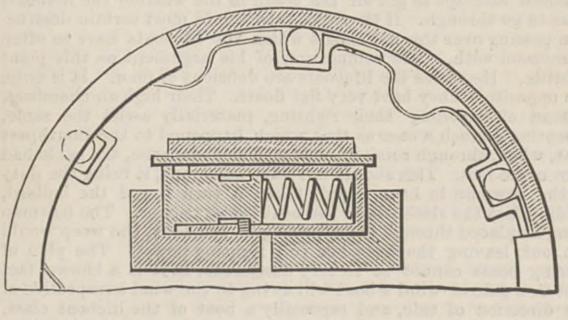
THE object of this invention, by Mr. Mark W. Bullen, of Barnard Castle, is to simplify the movements by which an engine is stopped, and thus prevent loss of time in an emergency. At present, in order to shut off the steam and put on the brakes, two handles must be used, and the impossibility of applying these at the same moment is recognised by many locomotive superintendents, who instruct drivers in the case of danger to put on the brakes before shutting the steam off. In

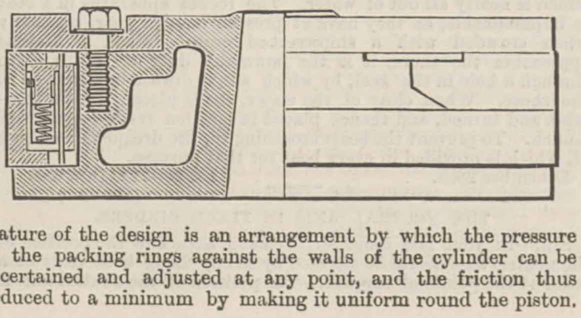


the arrangement illustrated both steam and brakes are controlled by one handle moving uninterruptedly from left to right. The Automatic Vacuum Brake Company and the Westinghouse Brake Company raise no objection to the use of this arrangement with their respective patents. A is the throttle valve spindle, B a short arm fixed to it. B^1 a handle of the general shape of the present driver's handle, but instead of being fixed to A, it works freely round the boss of the short arm B; E is a spring bolt fastened to B^1, it is hammer-headed, and part of this head passes through a slot B^1—not shown in Fig. 1—and overhangs the regulator guide C, and the other part rests in the notch in B; F is a cam fixed to the guide C. G is a continuation—beyond the centre of motion A—of the handle B^1, and to it the brake valves are connected. The throttle valve of the engine is so arranged that steam shall be full on when the handle is in the position shown, and off when it is vertical or nearly vertical. When steam is full on B B^1 form one handle, being joined by the bolt E, and they so remain during movements required for the regulation of steam, but if after the steam has been shut off the movement of B^1 is continued, E is lifted by the cam at F, and while B remains stationary the movement of B^1 can be continued to the right for the purpose of working the brakes. The position of the several parts when the cam has come into action is shown in section, in Fig. 3. If the brakes are worked by an ejector or by admitting air to a partial vacuum, the valves that put the brakes on are connected by rods to G, and they are taken off in the same way as at present. In the case of the Westinghouse brake the inventor advises the use of the valve shown in Fig. 2. The double piston R R^1 is so arranged that it shall, during the movement of B B^1, from the left to a vertical position, move to S S^1, and be inoperative, and a neutral position is provided by the cutting off of the 10 lb. valve by R^1 before the holes at Y are opened by R and the brakes put on. In order to take the Westinghouse brake off, direct communication is established by a branch pipe between the main reservoir and the train pipe, and a piston valve in this pipe is placed as far to the right as possible in order that the driver may conveniently have his left hand on the regulator and with his right recharge the train pipe and take the brake off.

SPURR AND SMITH'S PISTON PACKING RINGS AND SPRINGS.

THE piston illustrated by the accompanying engravings is made by Mr. W. C. Spurr, Finsbury-pavement, London. A

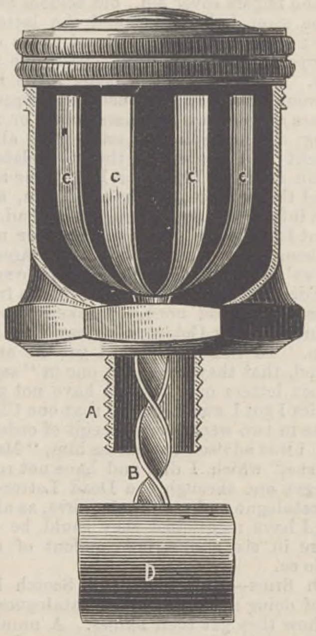




feature of the design is an arrangement by which the pressure of the packing rings against the walls of the cylinder can be ascertained and adjusted at any point, and the friction thus reduced to a minimum by making it uniform round the piston. A series of rollers containing springs are carried in the loops of the spring ring, which press the flange of the packing rings against the flat surfaces of the junk ring and piston flange; this action being independent of the spring that presses radially against the cylinder. The unique feature of the piston is the simple manner in which it can be adjusted, and the vertical and lateral pressure ascertained before it is put into the cylinder.

MAIN'S GREASE CUP LUBRICATOR.

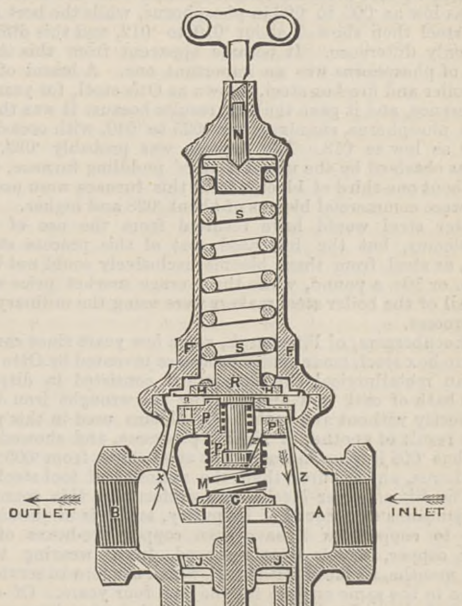
THE semi-solid lubricants, similar to vaseline, have several features that recommend them, not the least of which is their economy. Several lubricators or cups for using these solid lubricants have been brought out. That we illustrate is taken from the American *Mechanical Engineer*. It is simply a cup



with a spiral feeder B, connected with a sheet metal conductor C, inside the cup proper. This feeder rests upon the bearing as shown, and the lubricant is fed to it as the service demands—that is to say, as the slight warmth is conducted by the stem B, to the several arms C. It is made by Messrs. Main Bros., of South-street, New York.

THE MASON REDUCING VALVE.

THE reducing valve, of which the accompanying is a sectional view, is designed to reduce and maintain an even steam or water pressure in steam heating coils, water mains, steam laundry mangles, and in similar applications. The principle is that of an auxiliary valve which admits the initial pressure to operate a differential piston. The Mason reducing valve differs from other valves of this description in that the piston is steam actuated and the motion is positive. By referring to the cut, it will be seen that the high pressure enters the valve at the side



marked "inlet," and passing through the auxiliary valve K, which is held open by the tension of the spring S, passes down the passage marked "from auxiliary to cylinder," underneath the differential piston *d*. By raising the piston D, the valve C is opened against the initial pressure, and steam is admitted to take low-pressure side of the valve, whence it goes up the passage X, underneath the diaphragm O O, upon which the spring S bears. When the low pressure has risen to the required point, which is determined by the tension given by the key to the spring S, the diaphragm is forced upward, the valve K closes, and the valve C is forced on to its seat by the initial pressure, there being no steam then under the piston D to hold it up. This action is repeated as often as the pressure on the outlet side drops below the required amount. The piston H is fitted in the dashpot E E to prevent chattering or pounding when the high or low pressure suddenly changes. The *Steel Age* says it is manufactured by the Mason Regulator Company, Central-street, Boston, Mass.

IT is said that during the recent heavy gales the deep-sea harbour at Boulogne suffered considerably. The outlying works received the full brunt of the heavy seas, and massive blocks weighing several tons were torn up and swept off the main structure. The damage done is estimated at between 300,000f. and 400,000f.

LETTERS TO THE EDITOR.

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

MACHINES AND PARTS IN AUSTRALIA.

Sir,—Having been a subscriber to your valuable paper for a number of years, it has occurred to me that an opinion and a few facts from this part of the world may be of use to many of your readers. First, I think that either you, or the difficulties of the British Patent-office, are giving American inventors a great advantage over their British cousins, by illustrating their inventions and giving extracts of specifications, which do a great deal more towards making them known than merely notice of application. Another matter, and which has become a nuisance here, is the multiplicity of designs in various parts of harvesting and other machines, fingers, intersections, braces, connecting-rods, &c., things that could be reduced to at least half a dozen forms. Knife sections and fingers cover 3in., but seldom two makes of the former have the rivet holes alike; and, as a consequence of these differences, it is often hard or impossible to get extra ones if the particular make are out of stock. Such things not being made in the Colony, a great deal of trouble and loss is sustained, especially as certain sorts or makes are supplanted by others better or more popular.

The following are examples:—Last year I altered some old-fashioned wrought iron fingers to the steel-plated fingers of a popular American maker. This year I got some more to alter. I set to and drilled the bar, &c., for the alteration, and sent for the fingers, and was informed they were not to be had in Australia. I sent to the agent for some Hornsby fittings four months ago, and have not got them yet. I ordered some shares for Ransome, Sims, and Jeffries' Scotch grubber, and am informed they are not to be had. I ordered a pulsometer No. 1 pump from the agents, and was informed they had none. I asked him to get one from their branches in the other Colonies, or say how long until they would have one. To the first part, I got the answer, "None;" and to the second, that they could get one in "say four months." I have written six letters over it and have not got one yet. In some of the replies I got I was informed that one Clarke could make one in Melbourne in two weeks from receipt of order. The address was not given. I was advised to address him, "Maker Pulsometer Pumps, Melbourne," which I did, and have not received a reply. Perhaps I will get one through the Dead Letter-office. Did all manufacturers catalogue and code their wares, as all number them, in cases such as I have mentioned they could be telegraphed for and landed here in six weeks, independent of agents, who will not trouble to do so.

Some English firms—their Irish and Scotch brothers do not seem to think of doing so—send coded catalogues to persons that it is surprising how they get their names. A number come to this little town. David Beddie.

Blayney, N. S. W., November 6th.

STEEL FIRE-BOXES.

Sir,—There has been no little discussion in English mechanical papers on the relative merits of American and English locomotives, and on this subject I desire to call your attention to a point of superiority of the American engine that not only is superior, but is much cheaper. I refer to the fire-box. When open-hearth steel was first used for fire-boxes here it gave unlimited trouble from cracking, and it was some time before it was found that high carbon was responsible. In many cases a return to copper and iron was the result. The manufacture of steel became better understood, and with low carbon the cracking was largely prevented. But it was found that cracking was not wholly prevented by low carbon; it was found that phosphorus was largely responsible. An examination of a large number of fire-boxes which had been in service, and failed in from two months to eight and ten years, developed the fact that the long-lived ones were lowest in phosphorus provided the balance of the constituents were not abnormal —and this was rarely the case. It was known that for certain special uses in tool steel an English brand was the best known, running as low as ·006 to ·008 in phosphorus, while the best American tool steel then showed about ·010 to ·012, and this difference was the only difference. It became apparent from this that the question of phosphorus was an important one. A brand of open-hearth boiler and fire-box steel, known as Otis steel, for years held the preference, and it gave the best results because it was then the lowest in phosphorus, running from ·025 to ·040, with occasionally a sample as low as ·018. The average was probably ·033. This result was obtained by the use of Danks' puddling furnace, that is to say, about one-third of bloom from this furnace were used, the balance were commercial blooms of about ·028 and higher.

A better steel would have resulted from the use of all of Danks blooms, but the increased cost of this process stood in the way, as steel from these blooms exclusively could not be sold under 8c. or 10c. a pound, while the average market price was 5c. to 6c. All of the boiler steel makers were using the ordinary open-hearth process.

The Shoenbergers, of Pittsburgh, some few years since came out with a fire-box steel, made under processes invented by Otto Huth, a German metallurgical chemist, which consisted in dispensing with the bath of cast iron and melting the wrought iron blooms down directly without any bath. The blooms used in this process were the result of another of Huth's processes, and showed as an average but ·008 in phosphorus. The steel shows from ·009 to ·012 in phosphorus, and is purer than the majority of tool steel made here. The Shoenberger steel is now preferred in this country for fire-box purposes on account of its purity, and it is unquestionably superior to copper, as I have seen copper fire-boxes of Lake Superior copper, which were removed, from wearing thin in eighteen months, replaced with steel, which are now in service, and have been in the same engines for the past four years. Of course, the size of fire-box, kind of water, coal, and service, have much to do with the life of a steel fire-box; but, other things being equal, it has been shown that those having the lowest phosphorus give the longest life.

The complete analysis of steel from Huth's processes is as follows:—

Carbon	·10
Phosphorus	·010
Manganese	·30
Silicon	·015
Sulphur	None.

Considerable steel of English make has been sold here, but it does not begin to compare with the best American makes, as the following analyses show, which were made from pieces cut from English steel, from which a locomotive contract shop was building locomotive boilers and fire-boxes:—

Carbon	·16	·15	·16
Phosphorus	·039	·051	·046
Manganese	·45	·41	·39
Silicon	·031	·019	·022
Sulphur	·010	·022	·029

The English steel in question showed in the testing machine from 30 to 34 per cent. elongation in 2in. The Shoenberger steel shows from 50 to 57 per cent. in the same length. It is, therefore, quite evident that in this particular kind of steel this country is much in advance of Europe.

No little trouble has resulted from the sending out by some makers in this country of annealed steel for fire-box purposes. Such steel shows good physical qualities before being built into the fire-box; but after short use the blowing out of the boiler and sudden cooling resulting, dissipates the effect of the annealing, and the sheets return to their natural condition—which in all steel in which annealing is necessary by the maker is hard and soft spots and great unevenness.

The English steel referred to had, of course, higher tensile strength, showing from 60,000 lb. to 62,000 lb. per square inch, while the Shoenberger steel was lower, being 53,000 lb. to 55,000 lb. —as this shows better results than higher strengths in fire-boxes—which is partially accountable for the better ductility in the latter steel; but as the latter shows 48 per cent. with a strength of 61,000 lb., the superiority due to purity is apparent.

Cleveland, Ohio, December 10th. H. Southerland.

TRADE IN CHINA.

Sir,—For some time past it has been a very common thing to read in the newspapers that the Germans are cutting out British merchants in the China trade. However disagreeable that fact may be, we were hardly prepared to hear that the French merchants were likely to acquire similar success, especially so close upon the war just ended between France and China. It is nevertheless a fact, and British merchants are gone to the wall, with the exception of those who deal in groceries and draperies. A British merchant will have to sell a great many pounds of sugar and yards of calico before he can have earned enough to pay his way, whereas a single official contract would set him up for a whole year. Honour to whom honour is due, I say, and I am one of those who believe German merchants entitled to every success for the manner in which they deal with the Chinese. The Germans, in fact, treat their Chinese clients with the respect and consideration they deserve, whilst British merchants treat them with contempt and ill-disguised unfriendliness in many ways. The buyer who has ready money is a king in commerce, and British merchants had better acknowledge the fact before it is too late. British merchants had also better treat those of their own countrymen who are disposed to deal with the Chinese in a considerate manner, with less unnatural hauteur than they do at present.

A respectable German citizen, whatever may be his calling, is not despised by his Consul, publicly abused by his own countrymen in the newspapers, nor expelled from the German Club because he treats Chinese officials and merchants in a friendly manner, accepts an official title of rank from the Chinese Government, or even wears a Chinese dress and queue.

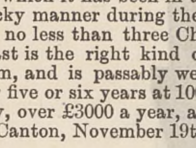
If the blood of British merchants is too blue, or their wealth too great, to permit of their condescending to deal with the Chinese on terms of equality, why they had better stay at home rather than come out here to provoke a spirit of hostility amongst the few who happen to have been successful in their dealings with the Chinese. Now that the Germans have their own subsidised mail boats and financial agents in China they will not be so heavily handicapped as they have been in the past through the whims and jealousies of English companies. What are we to believe of British ship captains and owners who discharge cargoes consigned to agents in the British colony of Hong Kong, at Singapore, or other places along the route, under the plea that they feared having their ships confiscated by the French, &c.? The Germans are now like the French, or nearly so, in the matter of mail boats and banking facilities, and I shall be greatly astonished if they do not gradually and entirely absorb the bulk of the China trade during the next decade, and leave the British merchants stranded on the shores of China, amidst all their pride and vanity.

It is but fair, however, to say that one British firm at least has awakened to the necessity of stirring itself out of the old grooves in which it has been in the habit of rolling along in a happy-go-lucky manner during the past. The firm has engaged the services of no less than three Chinese-speaking foreigners, one of whom at least is the right kind of a man to secure official orders for the firm, and is passably well payed—that is, he has an engagement for five or six years at 1000 taels of Shanghai currency per month; say, over £3000 a year, and one year off duty on full pay, I believe.

Canton, November 19th. W. Mesing.

LIFEBOATS.

Sir,—In your last I read two letters relating to lifeboats, and the distressing accidents to the Southport and St. Anne's boats—the first suggesting means of anchoring which would be quite as dangerous, and add equally to the chance of capsizing, as the present method, by preventing their righting power; for when a boat is alongside a vessel, the rope or chain being attached to the keel in the way named, it would be liable to get foul with the surrounding wreckage, rendering the boat so unmanageable that she could not be got clear of the wreck, or, if capsized, causing a repetition of accidents alluded to, and perhaps worse than we have already heard of. I would suggest having a hawse-pipe running through the fore air chamber on a level with the deck, so as to allow the cable to pass through—thus: and then worked on the present style, leaving the boat, if capsized, to right herself as if working upon a centre pin.



Referring to the second letter, starting with an extract from the *Times* that the lifeboats of the National Institution are a mockery, delusion, and a snare, "J. W." is evidently writing from inexperience, or without reference to the valuable work the boats have already rendered. I agree with "J. W." there are defects; but can we expect any boat which has to encounter the difficult work that is required from the lifeboats to be perfect? I do not doubt the Lowestoft boats having saved many lives without accident; but this is no criterion that they are safer and better boats than those of the Institution. Certainly a self-righting and clearing boat must be preferable to the Lowestoft boats. This can be carried out in all points, excepting when a boat is under sail, when, if she capsized, it would be impossible for her to right unless the sails and masts were cut away. The Institution are not satisfied with their boats, although they only capsize once in every hundred and twenty times they are out on service. "J. W." will find, on reference to the various lifeboat journals published by the Institution, that they are experimenting and daily expending large amounts to make their boats everything that should be. The alongshore boats alluded to would not in one case out of every hundred attempt to get off the beach in the weather the lifeboats have to go through. If they did, they would meet certain destruction passing over the flat shoals which the lifeboats have so often to contend with. The comparison of his argument on this point is futile. He states the lifeboats are deficient of floor. It is quite the opposite. They have very flat floors. Their high air chambers, instead of impeding their righting, materially assist the same, excepting in such a case as that which happened to the Southport boat, when, through some unexplained circumstance, the cable had been made fast. This should not have happened, it being the duty of the bowman to have simply taken a turn round the bollard, holding fast the slack whilst the boat lay at anchor. The bowman being displaced through the capsizing of the boat, the warp would run out, leaving the boat her full righting power. The plan of veering boats cannot be so very dangerous, as it is a known fact that in a gale of wind a boat will swing to the wind irrespective of the direction of tide, and especially a boat of the lifeboat class, which is nearly all out of water. The rocket apparatus in a boat is impracticable, as they have at present enough gear, especially when crowded with a shipwrecked crew. When a lifeboat approaches the shore, it is the bowman's duty to pass a chain through a hole in the keel, by which she is drawn bow first on to the shore. When clear of the water, she is placed upon a turntable and turned, and thence placed in position ready for another launch. To prevent the boats broaching to, the drogue is made use of, which is provided in every boat for that purpose.

December 28th. Lifeboat's Bowman.

THE NEUTRAL AXIS IN FIXED GIRDERS.

Sir,—In your last issue Mr. Pearson asks how the position of the neutral axis would be affected by firmly fixing both ends of a beam at the points of support. The position of the neutral axis is the same in a cantilever as in a beam, resting free on two supports, and depends solely on the nature of the materials of which the beam is made, and the intensity of the stresses to which it is subjected. In my book on "Solid Beams" I have demonstrated that the distance of the neutral axis from the top of the beam is to its distance from the bottom as the square root of the modulus of extension is to the square root of the modulus of compression corresponding to the stresses to which the material is being subjected. In cast iron beams for working stresses the neutral axis is very little above the centre of gravity, but it rises as the stresses increase, until on the eve of breaking it is only about one-sixth of the depth of the beam from the top. Rankine, and every writer to whose works I had access before I completed my own investigations, have worked out formulæ based on the erroneous assumption that the neutral axis in all cases passes through the centre of gravity. The results therefore are fallacious, and when the constants used have been determined by experimentally ascertaining the breaking loads, are the cause of dangerous errors in construction. William Donaldson.

2, Westminster-chambers.

WARNING TO INVENTORS AND INVESTORS.

Sir,—I can fully indorse the letter of "Provincial Patent Agent" in this week's issue of your paper. A few weeks ago an invention was brought before my notice and offered to me for sale or introduction. A provisional specification had already been filed after a "search" had been made by a London patent agent. On my making the usual inquiries and searches as to the validity of the invention, I found it was forestalled by an exactly similar and even better arrangement; and this, not by a few days, but by several years. Surely if anyone like myself—not engaged in patent agent work—could find this out, a patent agent ought to have been able to have done so. A. E. W. Gwyn.

9, Ducksfoot-lane, Cannon-street, London, E.C., December 24th.

STRENGTH OF STRUTS.

Sir,—I have to thank Professor Perry for his very friendly and thorough-going acknowledgment in the note appended to his last paper on Struts, in your issue of 24th inst. Professor Perry has now got the volume of the "Proceedings" of the Society of Edinburgh and Leith Engineers containing my paper on this subject. I think it was read May, 1877, and written in the autumn of the previous year. I hope to find time soon to send you notes of some very curious experiments I have made more recently on struts. Robert H. Smith.

Mason Science College, Birmingham, December 25th.

THE ECONOMY OF SINGLE ACTING ENGINES.

Sir,—"Compound" apparently has not read my letter in your issue of the 10th inst. He complains that the average receiver pressure is less than that of the low-pressure cylinder. The mean pressure shown by the receiver diagram is—like the mean pressure shown on the low-pressure diagram—the net pressure acting for the engine after deducting back pressure, and has nothing to do with the absolute pressures used in either receiver or cylinder. If "Compound" will refer to my letter, I think he will understand this at once. P. W. Willans.

Ferry Works, Thames Ditton, Surrey. December 29th.

AMERICAN NOTES.

(*From our own Correspondent,*)

New York, December 17th.

Brokers just returned from Eastern and Middle Pennsylvania report mills and furnaces so well sold up throughout the anthracite iron regions that the placing of new orders is almost impossible. The Thomas Iron Company has not yet fixed its prices for the coming year, but it is generally believed that 20 dols., 18 dols. 50c., and 17 dols. 50c. will be the ruling rates for the kind of iron that is in most request. The American Bessemer furnaces have booked some very heavy orders within a few days, amounting in all to 40,000 tons. The Pennsylvania rail mills have been doing very little this week in the way of new business, and have advanced quotations to 36 dols. The works at Troy, Buffalo, and Chicago have large orders on hand and under consideration. The works at Johnstown are running with natural gas. Work on two new Bessemer mills is being pushed. The indications are that next year's productive capacity will not be sufficient for the railway, bridge building, and other urgent requirements. Quotations at the Exchange to-day are 19 dols. 50c. for average No. 1 and 17 dols. for No. 2, with grey forge ranging from 15 dols. 50c. to 17 dols., according to quality. Better or poorer qualities are to be had. Muck bars are selling at 31 dols. 50c. to 32 dols. at mill. Manufactured iron is in active demand at 1 dol. 90c. for refined, 1 dol. 80c. for medium, and 1 dol. 70c. for common. Nails, 2 dols. to 2 dols. 15c.; plate iron, 2 dols. 10c. to 2 dols. 20c.; tank, 2 dols. 30c. to 2 dols. 40c.; angles, 2 dols. 15c.; channels, 3c. Skelp iron is so scarce that buyers are awaiting their turn for deliveries thirty to sixty days ahead. An enormous amount of pipe line laying is contemplated during the early spring. The developments of natural gas are extending into new sections. The manufacturers are taking advantage of the developments. A large natural gas field is believed to exist in the State of Michigan, and capital has been subscribed to develope the region at once. The southern furnaces are sold up, and the iron-making interest in the South are stimulated by an urgent local and Northern demand. Telegraphic advices to-day from Western iron and steel making centres show that the advance that has been talked of for several weeks has at last set in in earnest, and that the heavy consumptive requirements which have been held back for weeks are now coming in. The greatest anxiety is manifested for English supplies, such as, Bessemer pig, Spiegeleisen, steel rails, blooms and slabs, old iron rails and new steel rails. Brokers in this city have inquiries this week for 40,000 tons of steel rails for Gulf Coast and Pacific Coast delivery. Quotations are supposed to be 38 dols. and 40 dols. respectively, but we hear it rumoured that cablegrams have announced a further slight advance. In fact the American iron trade are looking for a slight general advance in British iron and steel markets. There are inquiries in for large lots of blooms and slabs, which will, if placed, amount to about 22,000 tons, but the difficulty in the way is the high prices asked. Old rails are wanted for immediate and winter delivery, and 25 dols. has been paid in some cases, although 24 dols. represents the views of large consumers. The imports of iron ore are very large, both from Cuba and from abroad, and some heavy contracts will be made during January covering several months of next year. The demand for merchant steel of all kinds has gone ahead steadily within a month, and during January the larger consumers will place orders to keep them for six months. Railroad building will take a fresh start next year, and some enthusiastic statisticians place the mileage for the coming year at 11,000 miles of main track. The figures for this year are 7000 main track, besides bewteen three and four thousand miles of side track and repairing. The demand for railway and general building material will be remarkably heavy during the winter. A ten-thousand ton lot of Bessemer pig sold this week at 20·25 dols. here. The Thomas Iron Co. has fixed prices for foundry iron at 20 dols. and 19 dols. They are operating twelve furnaces. Contracts will be placed in January for 800,000 tons of pig iron and probably more. There are buyers in this market to-day for large lots of English Bessemer when prices suit. Advices from Chicago and St. Louis show heavy orders for Southern and Ohio iron for winter and spring delivery. Advices from Alabama point to the extension of iron making capacity in that region, and to the erection of several iron consuming works, such as stove works, pipe works, and boiler-making establishments. Advices from Cincinnati and Louisville up to to-day show a very active condition of the iron trade. Nails are the only things that are drooping in price. Two months ago they reached 2·20 dols. base price, but now they are selling under 2 dols., and a meeting was held here a few days ago suggesting a four weeks' suspension, and calling for a conference of the nail makers of the United States to agree upon a general restriction. Inquiries were made this week from Western bridge builders for 5000 tons of angles, beams and channels, and the pipe makers of Western Pennsylvania are also in the market this week for material to supply the requirements for the coming spring. All through the iron trade there is a disposition to buy material two to four months in advance. This may not be wise, but the feeling is that prices will advance and that those who delay will pay the penalty. Plate iron is selling at from 2·25 dols. to 2·50 dols. per pound. Steel rails have sold this week in small lots at 36·50 dols.

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

(*From our own Correspondent.*)

THE ironmasters' meetings this week have been held under conditions much more favourable than those which marked the close of last December. Accounts brought to 'Change yesterday in Wolverhampton and to-day in Birmingham indicated a fair number of orders upon the books and the entertainment of brighter anticipations concerning the trade of the New Year. There is the existence of a cheerful tone, and 1887 is entered upon with the belief that a more abundant demand and better prices are certain to rule.

The market has declined to be much disturbed by the rumour of war or by the political surprises at home. Even should war not be avoided, the English iron and steel industries would probably benefit rather than otherwise. We might expect some repetition of the experience of 1872. The fact that the Ministerial crisis has been brought about by the resolution of the Cabinet to spend more money upon the naval and military services is construed as of hopeful augury to the iron and steel trades.

Operations at the mills and forges have been somewhat more generally resumed this week than is usual so soon after the Christmas holidays. The sheet mills have been the first to get to work, and here and there makers report that galvanisers and other buyers are pressing them to send in orders.

The trade is now looking forward to the quarterly meetings, which will come off in Wolverhampton on January 12th, and in Birmingham on the following day. Some speculation is indulged whether the marked bar firms will take any action in the matter of prices. The general impression is that prices will be declared for 1887 upon the basis which has ruled throughout the past nine or ten months—namely, £7 for bars, and 30s. to 40s. extra for sheets and plates rolled by the same houses.

In anticipation of the quarterly meetings, the following information, showing the course of marked bar prices during the last twenty years, possesses much interest:—1867, January, £7 10s. 1868, April, £7. 1869, November, £8. 1871, September, £8 10s.; October, £9. 1872, January, £11; February, £12; April, £12 10s.; May, £13; June, £14; July, £16; September, £14; November, £12. 1873, January, £13; February, £14; March, £16; July, £14. 1874, February, £12; July, £11. 1875, April, £10. 1876, January, £9. 1877, September, £8 10s. 1878, September, £7 10s. 1879, November, £8; December, £9. 1880, May, £8; October, £7 10s. 1881, April, £7; September, £7 10s.; 1882, September, £8. 1883, February, £7 10s. 1886, April, £7.

Until the quarterly meetings arrive the new business doing in manufactured iron will be only limited. Consumers of sheets, however, anticipate that prices will be stiffer a fortnight hence, and they are inclined to at once negotiate forward sales for next year.

Since the extent of supply is scarcely so large as some time ago, makers are acting with caution. Nothing less than £5 15s. to £6 will be accepted for singles, £6 10s. for doubles, and £7 5s. for lattens.

Galvanisers report good occupation and orders for some little distance ahead, but there is a temporary lull in the demand, which may continue until the orders for spring shipment come in. It is anticipated that these will be good. Prices of galvanised iron keep firm, and makers of position in the trade state that from the pressure for prompt execution of specifications, and from the abundance of orders coming to hand, it is evident that the demand has more than overtaken the supply, and they look for further rise. £10 2s. 6d. to £10 5s. is quoted for ordinary qualities of 24 w.g. in bundles delivered Liverpool. Packed in skeleton cases, £10 12s. 6d. to £10 15s. is quoted; and packed in felt, £11 to £11 5s. per ton. Best brands are quoted at higher prices than these.

Bar iron of common quality is unable to command any advance, but the makers of medium qualities are here and there insisting on 5s. rise on their late minimum to cover the increase in pig iron, which is now, on some brands of Northamptonshire and Derbyshire, as much as 4s. to 6s. above the summer quotations. Common bars are selling at £4 15s. to £5, merchant bars at £5 10s., and superior qualities are £5 15s. to £6.

Makers of tube strip strongly declare that they ought to be getting more money, since the position of the wrought iron tube makers is steadily improving. A new association has been formed among the tube makers, and the maximum discount on gas tubes has been fixed at 80 per cent. A few other strong firms outside the association declare that they will allow no discount above 77½ per cent. Quotations for tube strips are £4 17s. 6d. to £5. Hoop prices still range from £5 to £5 10s. for ordinary sorts.

The "levelling down" process, which during all this year has been noticeable in the matter of "extras" in the iron trade, is particularly apparent in angles and tees. Competition from the north and other districts has largely led to the extras of 10s. on angles and 20s. on tees above the price of bars being abandoned, except for superior qualities. Common angles can now be got at a little over £5 per ton, and tees are not much dearer.

The pig iron trade displays more activity than finished iron this week, since consumers are buying in anticipation of firmer rates at the quarterly meetings. For contracts over the first half of 1887, some sellers ask higher prices than buyers are prepared to concede. The circumstance that the stocks at the furnaces have largely declined is being used by Midland sellers as a strong point in their favour.

Prices of Northampton sorts are about 36s. to 36s. 6d. delivered to consumers here; Derbyshires, 37s. to 38s.; and Lincolnshires, 40s. to 40s. 6d. Hematites are strong in consequence of the excellent demand which is being experienced at the furnaces from the steel makers. 54s. to 56s. is quoted for good West Cumberland and Lancashire forge sorts delivered here. Native pigs keep in large demand, and some makers declare that they are busier than at any time since 1874. All mines are 52s. 6d. to 55s.; part mines, 37s. 6d. to 42s.; and common forge, 28s. 6d. to 30s.

The state of manufacturers' order books in the hardware trades is such as fairly gives rise to satisfaction, and the amount of unemployed skilled labour upon the market is decidedly less than has existed at the close of December for some years past. Necessity exists at only a minority of the works for prolonging the holidays over this week, and confidence is expressed on nearly all hands of a large and more remunerative trade next year.

The chainmakers who are on strike in the Cradley district, for an advance upon the excessively low wages which they have long been receiving, decided on Wednesday to furnish the Queen with particulars of their hardships through low wages and trucking, "as her Majesty had always showed practical sympathy towards the oppressed." It was stated that but for support received from distant towns numbers of children must have died.

The Wallsal Chamber of Commerce are endeavouring to secure samples of saddlery and other goods for China, Japan, and British Burmah. The Foreign-office have promised their assistance if the Chamber will disburse all expenses, and the co-operation of the secretaries of Chambers of Commerce with the countries named has been asked.

The recent heavy fall of snow impeded steam tramway traffic in Birmingham seriously on certain of the lines, but the South Staffordshire Company's trams were kept running much as usual. This was in a great measure attributable to a mechanical contrivance known as a rail cleaner. Two brackets, fixed rigidly on the engine, have fitted into each of them an adjustable pillar, which has at its end large eyelet-holes permitting the passage of a round shaft. The scrapers have projections to fit the groove of the rail, and wide enough to cover the head. A spiral shaft encircles the cross-shaft. One of its ends is fastened to the pillars through which the shaft passes, and the other is fixed in a brush which slides loosely along the shaft, but by means of a key fitting freely in a slot, is prevented from turning thereon.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE was but a small attendance at the Cleveland iron market held at Middlesbrough on Tuesday last, and scarcely any sales were effected. The general feeling was cheerful and confident, and although, owing to the holidays, little business was actually done, the advantage recently gained by sellers was maintained, and even higher prices than ruled last week were cheerfully paid. For delivery to the end of January the usual quotation for No. 3 g.m.b. is now 34s. per ton; but consumers do not readily give more than 33s. 9d. For delivery over the first half of 1887 34s. 6d. may be obtained for No. 3. Makers, however, being well provided with orders for the next two or three months, do not care to sell forward.

There is little or no demand for warrants at Middlesbrough, but at Glasgow speculation is active and prices have fluctuated considerably of late. On Tuesday the price current was 34s. 4½d. per ton, or 4½d. more than it was the previous week.

The holidays have interfered somewhat with shipments, but they are still fairly good. Up to the 24th inst. 49,927 tons of pig and 34,565 tons of manufactured iron and steel had been sent away during the month.

Steel manufacturers continue very busy, and are spending as little time as possible in holiday-making. Finished iron makers are not so well off, and most of them have closed their works for the entire week. Prices are as follows:—Steel ship plates, £6 5s. per ton; iron ship plates, £4 12s. 6d.; iron angles, £4 7s. 6d.; and common bars, £4 12s. 6d.—all free on trucks at makers' works. Payment by cash on the 10th of the month, less 2½ per cent. discount.

Mr. Charles Wood, of Middlesbrough, has received an order for four miles of light railway material for South Africa.

Messrs. Pearse and Co., of Stockton, have entered into a contract with a foreign customer for a vessel of 3000 tons burden. This, together with another large order they have on hand, will enable them to find employmont for a large number of men during the winter. Messrs. Raylton, Dixon and Co., of Middlesbrough, have, it is said, booked orders for no less than three large steamers during the last three weeks, and will shortly be able to double the number of hands they have recently employed.

It seems certain that shipbuilding is slowly reviving at the various yards on the north-east coast. The extremely low price at which cargo steamers can be built is tempting owners. Vessels of 3000 tons burden can be placed at as low a figure as £7 per ton of capacity. This price, however, is not enough to provide for anything whatever beyond labour and material. Profit for the builder cannot be expected, and scarcely even his dead charges. The workmen therefore have the best of it, and if they are only fully employed they have nothing whatever to complain of. The ships now being built are in almost every case of steel. Should any increase upon the present rate of building take place, there will be a dearth at once of that valuable material. The whole demand will fall upon the makers of Siemens-Martin qualities. Basic makers, both in England and Scotland, are confining their attention to rails, blooms, billets, and tin bars. For these miscellaneous products they seem to have got the market almost into their own hands. But from making shipbuilding steel of marketable quality they are as far off as ever. Lloyd's Committee professes to be ready to consider any proposal which may be made to use basic steel of a lower tensile strength than their rules at present permit. But as this would certainly involve increasing the scantlings, it would obviously be attended with more expense, and so no one desires to do it.

It is said that at certain continental shipyards basic steel from Germany has been tried somewhat extensively, and has not been liked. Consequently at these yards they have returned to the use of iron. It is not likely, however, that this will last longer than is necessary to extend the steel industry in this country sufficiently to supply these yards.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—After a long period of unprecedented depression, the year is closing with a more healthy tone than has characterised the market for a considerable time. The past week has been more or less a broken one, owing to the holidays, and there was not much actual business doing on the Manchester Iron Exchange on Tuesday. Right up to the commencement of the holidays, however, there were some fairly large transactions being put through in pig iron for delivery over the next six months, and in most cases makers are now so fully sold for as far forward as they are disposed to go, that they are very indifferent about booking further orders at present, and there is a decided hardening tendency in prices. Considering the course of trade during the past year, it is finishing with a surprisingly strong tone. Throughout the greater portion of the past twelve months, business has been of the slowest character. Consumers, taught by the experience of the persistent downward tendency of the market during the previous year, have bought only from hand to mouth, and in this way have found themselves fully justified by the continued contraction in values which ultimately brought prices down to the lowest point they had touched for thirty or forty years.

The basis of quoted prices for local and district brands—with outside brands, which will be amply covered in the reports for the Scotch and North of England districts, I shall deal only incidentally as they have materially affected this market—was at the commencement of the year about 39s. to 40s. per ton, less 2½, delivered equal to Manchester; but there was a general absence of inquiry, and almost at the outset the collapse in the Glasgow market, which brought warrants down to the lowest point they had touched since 1852, and the continued giving way in Middlesbrough iron had a most depressing effect upon the market here. Local and district makers had to follow in the downward movement, and all through the ensuing three months trade was dragging on very slowly with a falling market, until, at the end of March, there was a drop of quite 3s. per ton in the retail selling prices. Already some attempts had been made to arrest the downward movement by a restriction of the output; but this was only so partially carried out that it had no appreciable effect. Some temporary excitement was caused in the market by a sudden upward movement in Scotch warrants, based upon reports of a general combination for reducing the output; but as this died away, owing to the disbelief in the possibility of any sufficient combination amongst the makers to bring about a restriction of the output that could materially affect prices, trade relapsed into a condition of even still greater depression, and the second quarter of the year was probably one of the worst periods ever experienced in the iron trade. With stagnation throughout nearly all the principal iron-using branches of industry, the actual requirements which consumers had to place upon the market were of the most limited character possible, and the future was viewed with so little confidence, that even at the abnormally low prices—which did not cover the actual cost of production—that makers were prepared to accept to effect sales, consumers could not be induced to buy beyond their bare actual wants. Lancashire pig iron did not get down to quite so low a price as some of the district brands, local makers holding to about 35s. 6d. and 36s., less 2½; but Derbyshire was being offered at considerably under these figures, and Lincolnshire iron could be got at as low as 33s. 6d. and 34s., less 2½, delivered equal to Manchester. The market had now touched the lowest point. By sheer force of circumstances, which meant a serious loss on every ton of iron that was being sold, makers were driven to seek escape from their disastrous position by a further considerable reduction of the make. Not only in the large iron centres of Scotland and the North of England, but in other ironmaking districts, numbers of furnaces were either damped down or blown out; and at length it became evident to buyers that, whether trade improved or not, makers had at last been pushed to the lowest limit of price, and that with the widespread reduction of the make there was the possibility that prices might now take a turn in an upward direction. As this conviction gained ground, there was a gradual increased weight of buying, and a steady hardening of prices. At first the lowest sellers began by asking an advance of 1s. per ton upon the minimum prices they had been taking, which was followed by the Lancashire makers advancing their quotations 6d. and 1s. per ton. During September heavy buying went on, not because of any really increased requirements for actual consumption, but because consumers were frightened that prices had at length taken a permanent upward move, and having no stocks they were naturally anxious to get in supplies beyond their actual wants; merchants and dealers, actuated by much the same reason, also become somewhat anxious buyers, either on speculation or for uncovered sales; whilst in addition outside speculators came in and bought rather heavily on the prospect of a further rise in prices. All this weight of business coming upon the market had of course a stiffening effect upon prices, and before the end of October quotations for Lancashire pig iron had got up to 37s. 6d. and 38s.; for Lincolnshire, 36s. 6d. to 37s. 6d. and 38s.; and for Derbyshire foundry to 39s. 6d. and 40s., less 2½, delivered equal to Manchester. In the iron using branches of industry there was, however, no appreciable improvement to back up the heavy buying which had been going on, and this was an element of weakness which very soon made itself felt. Consumers having more than covered their requirements dropped out of the market, and merchants, perceiving the signs of reaction, were less anxious to buy. Some little weakening of prices naturally followed; speculative parcels began to make their appearance in the market at under current rates, and in some instances makers receded from the full prices they had been asking. Generally, however, there was no very serious giving way. In most cases makers were so fully sold that they were under no immediate necessity to force sales, and as the cheap second-hand lots were gradually worked out, a strong healthy tone returned to the market, bringing with the close of the year a renewed upward tendency and a considerable inquiry for forward delivery. The closing prices quoted by makers are about 38s. 6d. to 39s. 6d., less 2½ per cent., for Lancashire and 37s. 6d. to 38s. 6d., less 2½ per cent., for Lincolnshire forge and foundry, with Derbyshire foundry quoted at 41s. up to 43s. 6d., less 2½ per cent., delivered equal to Manchester. It can scarcely be said that business of any weight is practicable at these figures, but at a little under the above quotations there are buyers who are prepared to place out considerable orders for forward delivery. There is, however, still an absence of any real improvement in the iron-using branches of trade which is so essentially necessary to give permanent strength to the market, and it can scarcely be regarded as a healthy basis that the present upward movement is in great measure due to the very restricted output in all the iron-producing centres.

Very much the same course has been followed in hematites that has characterised the market for the commoner qualities of pig iron. Starting on the basis of about 53s. 6d. to 54s., less 2½ per cent., for No. 3 foundry, delivered into the Manchester district, prices gradually receded until they touched about 49s. to 50s., when the upward movement in August and September brought them back to about 51s. and 51s. 6d., and with the exception of some little underselling by merchants, a firm tone has since been maintained, which has developed with the close of the year a further steady advance that has brought prices up to about 54s. and in one or two instances to 55s. per ton for No. 3 foundry qualities delivered equal to Manchester.

A very depressed tone characterised the manufactured iron trade throughout the greater portion of the year. At the outset works generally were fairly off for orders, and prices were tolerably firm on the basis of £5 2s. 6d. to £5 5s. for bars delivered into the Manchester district, but there was an absence of new work of any weight coming forward. As the orders on the books ran off without being replaced forges had to go on short time, and there was a keen competition for any work offering that brought prices down to the lowest point ever touched in this market, makers being compelled to take the unprecedentedly low figure of £4 15s. per ton for bars delivered into the Manchester district. This remained about the basis of prices for several months, until towards the end of the year manufacturers began to experience an improvement in the demand, and prices got back to about £5 per ton. Makers are, however, again beginning to work off their specifications with comparatively little new business in prospect, and it can scarcely be said that in all cases prices are characterised by absolute firmness.

So far as the engineering trades are concerned, a year of exceptional depression has been the record for the past twelve months, and this has extended throughout nearly all the various branches of industry. At the very outset the employers felt themselves compelled to take a course of action with regard to wages that was in itself only too plain an indication of the discouraging condition and prospects of trade in the important branch of industry of which Manchester is so great a centre, On the 4th of January a circular was issued by the Iron Trades Employers' Association stating that it had been decided to post at the various works notices to the effect that in consequence of the depressed state of trade and the high cost of production the wages of the workmen would be reduced about 7½ per cent., or to the rate paid in the early part of 1879. This reduction was met with some show of opposition on the part of the men, but the resources of the principal trades union organisations had been so seriously drawn upon by the large expenditure in support of out-of-work members that they were practically powerless to offer any effective resistance; and, ultimately, with the proviso that at the reduced rate the men should not be allowed to work overtime, the reduction in wages was accepted. It can scarcely be said that the year has developed any improvement upon the depressed state of trade which at its commencement necessitated the reduction in wages. Where firms have been busy it has been either in work of a special character or upon orders taken at prices so low that not only have they left no margin for profit, but in some instances have been taken at an actual loss, as the more preferable alternative to allowing shops to stand idle. Tool makers have been fairly employed, and in one or two special departments they have been busy. Machinists have only had a moderate amount of work, some of the leading firms having experienced a greater scarcity of orders than they have known for years past. In the ordinary run of general engineering work trade has been extremely dull. Locomotive building has probably never before been in so depressed a condition, and although the close of the year has brought out some fairly large orders from the Lancashire and Yorkshire Railway Company, the whole of which have gone into the hands of local firms—an order for thirty locomotives having recently been secured by the Vulcan Ironworks, at Newton-le-Willows, and a further order for sixty locomotives having since been secured by Messrs. Beyer and Peacock, of Gorton—there is no general improvement to report in this branch of trade. In the shipbuilding trade the yards have turned out even less work than last year, and the few orders that are still in hand are being worked off with very little in prospect coming forward to take their place. As to employment, the returns of the principal trade union societies connected with the engineering branches of industry have shown an exceptionally large and, during the greater portion of the year, steadily increasing percentage of members in receipt of out-of-work support, and even this has only partially represented the general scarcity of employment, as to a large extent where the men have been kept at work it has only been on short time.

A year of exceptional depression summarises the record of the operations in the coal trade during the past twelve months, which has only been varied by the usual winter increased demand and advance in prices, that has been practically confined to the better qualities of round coal for house fire consumption. The lower classes of fuel for iron making, steam, and general manufacturing purposes have been in dull demand all through the year, with supplies largely in excess of requirements, and prices have shown comparatively little variation from an average basis at the pit mouth of 5s. per ton for steam and forge coals; 4s. 6d. to 5s. for burgy; and 2s. 6d. to 3s. for common, to 3s. 6d. and 4s. for the best qualities of slack.

Barrow.—There is a steady tone in the hematite pig iron market this week, although as a matter of fact buyers and sellers as well as workmen have more or less spent the last few days in holiday making. Most people are, however, agreed that the prospects of the new year in both iron and steel are good, and that the scarcity of new orders booked during the past few days has been more the desire to defer new business until the New Year than any show of evidence that heavy deliveries were not wanted. It is more than evident that there will be a need for further increase in the make of Bessemer iron early in the year, as the demand for this article on the part of steel makers will be greater than it is owing to the heavy and increasing deliveries which are to be made during 1887. The business doing in forge and foundry iron is better than it has been. Prices are steady for both descriptions of iron. Stocks are larger, but not when compared with the delivery engagements. Steel rails are in large demand and in full output, and the orders in hand are very considerable, embracing contracts from all parts of the world. Rails are quoted up to £4 per ton for ordinary heavy sections. Other descriptions of steel are in good demand, and the outlook is cheerful. The only department in which a quiet tone prevails is that of iron and steel shipbuilding; but those engaged in this trade are sanguine of a better year than the last has been. The engineering trade has a hopeful outlook so far as marine orders are concerned. Iron ore is in steady demand at from 9s. to 11s. per ton net at mines. Finished iron is in steady but not active request. Coal and coke in brisk demand.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

This is a week of holidays, which began on Christmas Eve and will extend into next week. Where the firms take advantage of the season for stock-taking and for having repairs done to machinery, a longer period will be apportioned for "play." One or two firms have intimated to their *employés* that they will have a month's holiday. This, however, means that the firms have latterly been making for stock, and do not feel disposed to add to the accumulations in the warehouses. Generally, the prospects for the New Year are more encouraging than at the corresponding period of last year. In the heavier trades several departments have had only a brief respite from labour, as heavy deliveries have to be made to the Admiralty and War Departments by the end of March.

Messrs. Thomas Firth and Sons, of the Norfolk Works, Savile-street, were asked about a month ago if they were not producing the "Firminy" shell at their establishment. The firm admitted they were making new steel projectiles, but desired no public mention of the fact. I notice, however, that a London paper stated the other day that Messrs. Firth and Sons had obtained an order from our Government for 200 of the Firminy shells at 2s. per lb., the cost being £20,000. Messrs. Firth very properly decline to publish the terms at which they supply their wares; but while admitting they have an order in course of execution for the Government, they declare that the price stated by the London paper, and reproduced locally, is far in excess of the actual amount. It is a singular fact that at Messrs. Firth's premises, which are fixed between Messrs. John Brown and Co.'s and Messrs. Charles Cammell and Co.'s—the two armour-plate manufacturers—should be produced the new shell which its inventor expects to smash the Sheffield plates. Both armour firms are experimenting, to meet any emergency which may arise; and while the Messrs. Firth, by acquiring the English patent rights in the Ferminy shell, are labouring to destroy compound and all-steel armour alike, the armour firms, on the other hand, are doing their best to defeat their neighbour's efforts; and thus the battle of projectiles *versus* plates goes bravely on.

During the year the armour for the five belted cruisers built by private shipbuilders, and the two belted cruisers built in Government yards, have been completed. Each of these seven cruisers has about 460 tons of armour. The side-belt armour is 10in. steel-faced, and bulkhead 16in. iron. Messrs. Charles Cammell and Co. have supplied two of the cruisers with "Wilson" compound—steel-faced—plates, and Messrs. John Brown and Co. have supplied the others with compound—steel-faced—"Ellis" type. Messrs. Cammell and Co. have also delivered a portion of the armour for the two large armour-clads Renown and Sans Pareil, and the belt armour of the Renown, by the Atlas Works. The latter firm are also busily engaged on the plates for the Nile and Trafalgar. The total weight of armour for these two ships is 4908 tons, plus bolt fastening. The order, as usual, is divided between the two Sheffield firms. The Cyclops Works have supplied Russia with armour for war-ships building on the Black Sea.

There is again some uneasiness here about the steel plant at Woolwich. Our leading firms have gone to an enormous expense in putting down new machinery—probably £300,000, certainly not less than £250,000—to meet all possible requirements on the part of the Government, and it was understood that their enterprise would render unnecessary any further extension at Woolwich. The great point has been to prevent Woolwich becoming a favoured rival of Sheffield in steel castings; and it is stated again that the Woolwich authorities have not ceased their extensions, but, on the contrary, are increasing their productive powers. The subject is again being put before certain parties with a view to action. It is probable that a satisfactory explanation may yet be forthcoming of what is being done at Woolwich. Sheffield has undoubtedly carried out its part of the undertaking with loyalty and enterprise.

Through the courtesy of Mr. Benjamin Folsom, the new Consul at Sheffield, I am enabled to give the return of Sheffield exports to the United States up to the last possible date—the 29th of December. The United States trading year ends on September 30th. The value of Sheffield exports for the year ended was £523,187, an increase of £73,841 on 1885. Steel increased by £37,334, and cutlery by £34,527. The total values of steel and cutlery were respectively £256,312 and £178,506, as compared with £218,977 and £143,979 for the year ending September, 1885. In October last, the total exports were £47,409, steel ranking for £23,788 and cutlery £15,378; November, £71,829, steel being £26,433 and cutlery £15,682. These figures show a large increase on October and November of 1885. Taking December as far as it has gone, the total promises to maintain the increase of October and November.

The Altofts Silkstone pit, where the explosion took place recently, resulting in the loss of twenty-two lives, was opened again on the 28th inst. Work in the pit has been suspended for about three months, causing a good deal of distress in the district. The careful inquiry made before the coroner will bring out more fully than has ever been done before the dangers of coal dust in causing explosions.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

Business in the iron market has been curtailed by the holidays and there will be little doing for another week. The ironmasters supplied their annual returns of the pig iron trade at the close of last week, and the Scottish Pig Iron Trade Association issued the complete statistics for the year on Tuesday. The warrant market had been firm before their issue, and it made a further advance as soon they appeared. The statistics are as follows:—

	1886. Tons.	1885. Tons.	1886. Dec.
Production	935,801	1,003,562	67,761
Consumption—In foundries, as per returns received	123,186	152,597	
In malleable and steel works, as per returns received	299,509	243,022	
Total	422,695	395,619	Inc. 27,076
Exports—Foreign, less 11,837 tons English iron transhipped	223,204	267,456	
Coastwise	147,596	162,299	
Railway to England	9,950	14,859	
Total	380,750	444,614	Dec. 63,864
Stocks—In Connal's stores	840,321	665,688	
In makers' hands	342,718	384,995	
Total	1,183,039	1,050,683	Inc. 132,356

	1886.	1885.
Number of furnace in blast on Dec. 25	72	91
Average number of furnaces in blast for the year	83	90
Average price of mixed numbers G.M.B. Warrants for the year	s. d. 39 11	s. d. 41 10
Highest price of mixed numbers G.M.B. Warrants	44 5	43 11½
Lowest price of mixed numbers G.M.B. Warrants	37 11	40 7½
	Tons.	Tons.
Quantity of malleable iron and steel made in Scotland, about	460,000	441,000
Consumption of Cleveland and Cumberland pig iron in Scotland—		
In foundries	268,500	270,000
In malleable iron and steel works	140,500	195,000
Total	409,000	465,000

It will be seen that the efforts of the ironmasters to restrict the output have resulted in a decrease of 67,761 tons as compared with the production of 1885. There is also a decrease of 42,277 tons in makers' stocks; but it is apparent that the decrease is the result of purchases made for the warrant stores, a fact which is borne out by the decrease of 63,864 tons in the exports of Scotch pig iron. Taking the stocks altogether, those held by makers and those in Messrs. Connal and Co.'s stores, they show an increase for the year of 132,356 tons. The increase of 27,076 in the home consumption is the result of the activity in the steel works and indicates an expansion in the use of hematite pig iron.

For g.m.b. at present there is a very poor demand, but the special brands of makers' pigs are reported to be in request for America at advancing rates.

The past week's shipments of pig iron were 5370 tons as compared with 4539 in the preceding week, and 4670 tons in the corresponding week of 1885.

Business was done in the warrant market on Tuesday forenoon at 44s. to 44s. 3d. and 44s. 2½d. cash. In the afternoon transactions occurred up to 44s. 6½d. cash, closing with buyers at 44s. 5d. cash. On Wednesday the cash price of warrants advanced to 44s. 7½d., coming back to 44s. 3d., and closing with buyers 1½d. more. To-day—Thursday—the market was quieter, with business down to 44s. 2½d., closing with buyers 44s. 3d. cash.

The values of makers' pigs, which had been well maintained for some time, are irregular this week, there being in some cases a substantial advance, whilst in others no improvement is quoted.

In the course of the week locomotive machinery worth £520 was shipped from Glasgow for Bombay; machinery, £8620 to different places; sewing machines, £4100; steel goods, £5500; and general iron manufactures, £23,330.

There have been good shipments of coals in the past week, but they include a large quantity which could have been sent away in the preceding week but for a strike of colliers. From Glasgow 29,563 tons were despatched; Greenock, 196; Ayr, 7069; Irvine, 1360; Troon, 6629; Burntisland, 15,698; Leith, 1226; Grangemouth, 6520; and Bo'ness, 5855; total, 74,356 tons, as compared with 63,128 in the corresponding week of last year.

Mr. William Small, secretary of the Lanarkshire Miners' Association, has addressed a letter to the coalmasters through their secretary, Mr. Baird, asking for an advance of wages, which he alleges has been given by certain individual firms, to be generally conceded. The request is not likely to be granted, at least at present, seeing that the shipping department of the trade has materially slackened.

A movement is in progress among the colliers of Fife for a general restriction of the hours of labour. They will have difficulty in carrying the proposal into effect, as the colliery rules require them to work at least eleven days a fortnight, and the local courts have virtually decided that the men must conform to the rules as a condition of their employment.

At a meeting of the Mining Institute of Scotland, a discussion has taken place on the merits of the blasting gelatine water cartridges of the Nobel's Explosives Company, which were recently tested at several Lanarkshire collieries in presence of members of the Institute. The general opinion expressed regarding the cartridges was that, while absolutely safe, they did not bring down the coal so completely or in such good condition as gunpowder.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The Monmouthshire coalowners, whose chief port is Newport, are closely watching the action of the Severn Tunnel on the Welsh coal trade. There can be little doubt but that a great diversion of coal traffic is taking place, and will steadily increase. Instances of Aberdare coal cut one day and loaded at Southampton the next morning are getting common, and the saving in labour, wages, and time must be great. The question is how far this will divert trade from the Rhondda Merthyr to the Monmouthshire coals. In matters of house coal, probably Newport would benefit, but the Ocean, Ferndale, Navigation, Coedcae, and similar coals must keep the lead, and if not shipped at Cardiff, will be taken by rail through the tunnel.

The storm has had its effect upon the shipping again. A Glasgow steamer got into difficulties in Penarth roads, and the total of Cardiff and Swansea vessels ashore or damaged is as usual an important one. Messrs. Wells, Telleffsen, and Co., of Cardiff, have a fine coal steamer, Cymro, unaccounted for. The crew for this vessel of large tonnage is, of course, numerous.

The graving dock question is still to the front at Swansea, and the alleged despatch of a vessel to Cardiff instead of Swansea, because the graving dock was too small, has led the Chamber of Commerce to carry a resolution suggesting the immediate construction of the graving dock in the Prince of Wales' Dock, to meet the requirements of the largest steamers that come to the port.

Latterly the harbour trustees of Swansea have made important concessions in tonnage rates, and the Chamber of Commerce are moving that the railways exhibit the same consideration.

Messrs. Nettlefolds' new works, near Newport, are busily importing bar iron, and Swansea has been urgent in requirements for delivery of pig and steel bar. Last week the imports coastwise included over 2000 tons pig and 388 tons bar.

There was a rumour of an explosion at the steelworks, Swansea, this week, but it turned out to be insignificant. Important modifications and extensions are going on at several of the large works, to which I shall further allude when completed. The aim chiefly lies in the same direction—increase of yield at diminished cost. The new year promises to give a good rail trade; the colonies will be well represented, New Zealand in particular.

Small coal is still in little demand, and generally stated, patent fuel sluggish.

Tin-plate continues to be the most vigorous industry, and promises well if the men do not spoil it. I am told of sinister movements in Monmouthshire, with a view to combination and intimidation in order to get increased wages. It is a pity that a movement is not started amicably by men and masters to secure a good working sliding scale.

Swansea is doing well, and prices are firm for all varieties. Little that is good can be had under 13s. 6d. ordinary cokes, and best brands are quoted as high as 14s. 6d.; ternes are in strong request about 13s. The shipment of tin-plates was unusually heavy last week, over 50,000 boxes being sent away, and as only 24,000 were received into stock, buyers, I need not add, are getting nervous, and brisk times may be expected. America continues to put in large demands.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The improved tone of the iron markets reported lately continues unabated, and if anything it extends with favourable indications all round. Almost all prices have a rising tendency, and buyers are more disposed than ever to make long contracts ahead, but as appearances indicate a good trade coming, sellers are naturally reluctant to bind themselves for long forward delivery. Whatever they may eventually do, one thing is clear, that the many Conventions lately created have had the effect for the time being of causing a more stable business, without attempts being made to force down prices on the one hand, or to compete unreasonably for orders on the other. That general confidence is shown in the reality of the industrial improvement may be gathered from the fact that, whilst the political atmosphere has been so overclouded that stocks, in ordinary cases, would have gone down in value, all industrial shares have held their own. Added to this, exports were more favourable this year, for in the last ten months iron goods, principally pig, bar iron, and wire rods, were sent abroad to the amount of 1,044,304 t., against 909,298 t. for the same period last year. In Silesia, too, especially in rolled iron, there is great improvement, and the Bessemer works are now well employed. Bar iron has gone up M. 2 p.t.; and, quite contrary to the usual mode of doing business in that district, just the finish of the year has brought a large number of buyers into the market. The wire drawers have also intimated to their customers that a rise in wire is about to take place. The neighbouring iron markets of Austria also become firmer from day to day. Returning to the west, the Belgian works are receiving an influx of orders, whilst the French market is about stationary, the price of merchant iron remaining at 130f. p.t. Only unimportant orders are reaching the works, but still they form sufficient to keep them going till the end of January next. The first tenders for constructive work in connection with the great Eiffel Tower have been given out. The term of four months for commencement of delivery, on April 1st, is considered a very short one, and there is some grumbling because the whole has only been divided into four lots whereas double the number of works might otherwise have had profitable employment upon it. Ores are still firm and rising, and in Rheinland-Westphalia red ore costs 6 to 6·20 p.t. Siegerland steel stone costs 8·50 to 9; roasted, 11 to 12; crown ore, 8·50 to 9; and glanz, 9 to 9·50 M. p.t. at mines. Pig iron of all sorts is rising more or less in price; the demand for forge descriptions is very brisk, and the Convention has raised its minimum M. 2 p.t. The stocks are so fast diminishing that again another rise is imminent. Spiegel has latterly been going up proportionately more slowly, and has not risen at all this week. Foundry is a little better called for, and a slight advance has been at last secured. The present minimum prices are—No. 1, M. 52; No. 2, 49; No. 3, 47·50 p.t. There is not sufficient demand for Bessemer sorts to warrant an increase of price, but the steel works are watching with interest the immense demand for steel of all kinds in the States, and are hoping that, sooner or later, orders from there will find their way here, where they will be so acceptable to this now almost stagnant industry. Luxemburg pigs are also slightly advanced in price. The pig iron production for November, including Luxemburg, was 274,057 t., against 308,106 t. in November, 1885. At the end of October there were 117 blast furnaces at work, against 133 at the same time last year. The bar iron branch has been progressively improving along with the raw materials, and both the heavy and light section mills are all very well employed, and the enhanced prices are maintained, a tacit agreement having been come to on all hands not to quote any lower figure than M. 100 p.t. as a base price at works. This step is justified by the continual small rises in puddle pig. There is no alteration for better or worse in heavy plates. Thin sheets are still as brisk as ever, and M. 130 is noted for them. Wire rods are even more favourably situated than when last reported, and from a trustworthy source it is related that a Telegraph Construction Company in London has just contracted at a small rise in price with firms in Westphalia to deliver 27,000 tons of wire for cables. The tin works which have taken the contract will have work for nearly a year on the order, which, of course, will tell favourably on other works. What a pity it is, in a case of this sort, that workmen and the goods managers of railways cannot see their road to work at such prices as would ensure such magnificent orders remaining in England. In railroad material there would be nothing particular to report were it not that it has been stated here a German firm took the order for 48,000 tons of rails and 2000 tons of fish-plates at Melbourne on the 20th inst. There is but one firm which can afford to compete with the cheaper English prices. It would really be a misfortune if this news becomes true, of which, however, there is every likelihood, as it would not be for the first time this firm has made rails for Australia. Not only is this loss of work for England, but her good money goes to pay the foreigner and help him to maintain the rivalry, besides giving his new Orient Line just the pretty little fillip it needs of 1000 tons of easy cargo per week for a whole year. Some small domestic tenders for rails have been given out, the prices ranging M. 115 to 118 p.t. When next tenders are given out, prices are expected to advance, but it is not easy to see the wherefore. The wagon works have orders enough in hand, but the prices are quite unremunerative, and the machine shops are, on the whole, poorly off for orders, though here and there a few new ones have come forward.

The cannons which Hsu-chin-Chêng, the Chinese Ambassador a Berlin, went to Essen to inspect, are of 42 c.m. calibre, two in number, for coast defences, and will now be shipped off at once for China. On closing this the news reaches me that, as was suspected, it is the firm of Krupp which has obtained the Melbourne order.

NEW COMPANIES.

The following companies have just been registered:—

Crouch and Jay, Limited.

This is the conversion to a company of the business of iron tank manufacturers, carried on by Robert Charles Jay, of Regent's Wharf, Maroon-street, Limehouse. It was registered on the 18th inst., with a capital of £20,000, in £10 shares. The purchase consideration is 450 fully paid shares. The vendor is appointed managing director and secretary, at a salary of £300 per annum, and Mr. Alfred Robinson is appointed assistant managing director, at a salary of £200 per annum. The subscribers are:—

	Shares.
*R. C. Jay, Regent's Wharf, Maroon-street, Limehouse, iron tank manufacturer	150
*G. Robinson, 17, Gloucester-place, Greenwich, iron merchant	100
*A. Robinson, 12, Quentin-road, Lee, clerk	50
H. G. Gastrill Wilkins, 1, Windsor-road, Ealing, physician, &c.	5
J. Jay, Littledown-road, Bournemouth	100
Mary Jay, Littledown-road, Bournemouth, widow	100
W. F. Vaughan, Legacy Duty Office, Somerset House, clerk	2

The number of directors is not to be less than four, nor more than ten; qualification, 20 shares; the first are the subscribers denoted by an asterisk; the company in general meeting will determine remuneration.

Dusseldorf Iron, Brass, and Steel Works and Foundries Company, Limited.

This company proposes to acquire the Dusseldorf Iron, Brass, and Steel Works at Dusseldorf, Germany, and to undertake and carry on as successors to Messrs. Eugene Franquinet and Pierre Franquinet, the executors of the late proprietors of the works, the business of manufacturers of, and dealers in, iron, brass, steel, and other metals. It was registered on the 18th inst., with a capital of £30,000, in £1 shares. An agreement of the 15th inst., between Hatton Webb, of 20, Bucklersbury, and George Bowack, of 39, Lombard-street, regulates the purchase, the consideration being £25,000, payable £12,500 in cash, and the balance in fully paid shares. The subscribers are:—

	Shares.
*Col. H. E. Glass, Bentley Lodge, Upper Norwood	1
*A. B. Wall, 10, St. James'-street, S.W.	1
*D. Owen, Merthyr Tydvil, mechanical engineer	1
J. Collier, Nottingham, manufacturer	1
*J. Taylor, Buxted, Sussex	1
Major-Gen. F. G. Pym, Wallington, Surrey	1
J. E. Starling, 5 and 7, Warwick-street, S.W., agent	1

The first London directors are the subscribers denoted by an asterisk and Mr. Hatton Webb, of 20, Bucklersbury. The directors in Germany are Mr. W. Marnach, C.E., of Darlmund, and William Owen, of Dusseldorf. The number of London directors is not to be less than three nor more than five, and of German directors not less than two. The London directors are to appoint their own remuneration, and Mr. Hatton Webb will appoint the remuneration of the German board. Mr. Wm. Owen is appointed manager of the works, at a salary of £250 per annum.

Morecambe Tramways Company, Limited.

Registered on the 18th inst., with a capital of £16,000, in £10 shares, to lay down, equip, and work tramways, commencing on the Crescent, Morecambe, and terminating at Heysham, both in the county of Lancaster. The subscribers are:—

	Shares.
E. Goville, Morecambe, boot manufacturer	20
R. Crabtree, Lancaster	20
T. T. Marsden, Lancaster, coal proprietor	10
W. C. Shackleford, Lancaster, engineer	20
S. Wright, Morecambe, architect	10
R. J. Hall, Thornbreaks, Lancaster, land agent	5
R. Townson, Morecambe, provision dealer	5

Registered without special articles.

Nottingham Plate Glass and Boiler Insurance Company, Limited.

For transacting plate glass and boiler insurance business, this company was registered on the 21st inst., with a capital of £20,000, in £5 shares. The subscribers are:—

	Shares.
Sir James Oldknow, Nottingham	40
C. J. Cox, Basford, Nottingham, bleacher	40
R. Birkin, Aspey Hall, Nottingham	40
T. N. Birkin, The Park, Nottingham	40
J. Pleox, The Park, Nottingham	40
R. Evans, The Park, Nottingham, architect	40
W. Lambert, Mapperley Hall, Nottingham, lace dyer, &c.	40
T. S. Piggin, Basford, Nottingham, estate agent	40

The number of directors is not to be less than five, nor more than 15; qualification, 40 shares; the subscribers are to appoint the first. The company in general meeting will determine remuneration.

Rex Bituminous Coal Company, Limited.

This company proposes to take over the business of manufacturing and selling composite coal carried on by the firm of Haigh, Owen, and Haigh, at Manchester, together with the letters patent No. 8761, dated July 5th, 1886. It was registered on the 16th inst. with a capital of £60,000, in £5 shares. The purchase consideration is £12,000 cash and 2000 fully paid shares. The subscribers are:—

	Shares.
T. C. Thompson, 43, Lower Mosley-street, Manchester, engineer	1
R. W. Haigh, 40, St. Bee-street, Moss-side, Manchester, traveller	1
F. Hough, Longsight, Manchester, traveller	1
G. Norton, 10, Dudley-grove, Manchester cashier	1
C. A. Whiley, 33, Cottenham-street, Manchester, book-keeper	1
C. L. Owen, 31, Craig-street, Ardwick, Manchester	1
J. Webster, 74, Hyde-road, Manchester, drysalter	1

Registered without special articles.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

18th December, 1886.

16,630. Scissors, W. H. Blackwell, Hooley Hill.
16,631. Compressed Metal Castings, C. M. Pielsticker, London.
16,632. Lamp Burners, C. M. Pielsticker, London.
16,633. Testing Dynamo-electric Machines, &c., J. Ryan, Newport.
16,634. Guide for Boot and Shoe Punching Machine Dies, C. Litchfield, Wellingborough.
16,635. Combined Table and Seat, W. Woolard, Stevenage.
16,636. Fastening Boots, &c., E. A. Remmett, Northampton.
16,637. Mantel-board, E. Mileson, Woodford.
16,638. Setting of Potatoes and Seeds, E. Buckle, Prestwich.
16,639. Guards for Omnibuses, &c., S. Andrews, Liverpool.
16,640. Printing on Footways, &c., G Quarrie, Liverpool.
16,641. Spinning Frames, D. R. Malcolm and G. Malcolm, jun., Glasgow.
16,642. Ball Taps, S. H. Gillam, Bridgwater.
16,643. Horseshoes, R. McDougall, Glasgow.
16,644. Gauge for Indicating the Depth of Water in Elevated Tanks, Baron J. Davenport, Birmingham.
16,645. Tip Wagons, G. Rowe, Lower Edmonton.
16,646. Cure for Sprains, &c., J. Critchley, Manchester.
16,647. Novel Substances suitable for Tanning, A. Bedu, London.
16,648. Clacks for Pumps, C. Vaughan, Sheffield.
16,649. Pickers for Looms, Messrs. Radcliffe and Mackey, Halifax.
16,650. Electric Apparatus for the Control of Watchmen, O. Skrivan and F. Dvorak, London.
16,651. Whipped Edge of Hat Leathers, J. Drabble and J. Hall, London.
16,652. Paraffin Lamps, E. P. Wright, London.
16,653. Friction Clutches for Transmitting Rotary Motion to Shafts, &c., I. Millington and C. Edmeston, London.
16,654. Production of Pictures on Transparent Substances, E. Haseler and N. Macfarlane, London.
16,655. Protecting Horses' Feet, C. J. Carr, London.
16,656. Explosions, &c., H. E. Newton.—(*A. Nobel, France.*)
16,657. Distributing Light by Reflection, W. Defries, London.
16,658. Mixing, &c., Machine, J. C. Isterwalden, London.
16,659. Maintaining a Vacuum, J. B. Prosser and R. Chaplin, London.
16,660. Materials for Filaments, &c., T. Mace and H. Edmunds, London.
16,661. Self-regulating Electric Generators, R. P. Sellon, W. M. Mordey, and C. E. Webber, London.
16,662. Regulating Electric Generators, R. P. Sellon, W. M. Mordey, and C. E. Webber, London.
16,663. Carrying Wounded, &c., Soldiers, D. du Boulay, Dorset.
16,664. Reels, W. Chesterman, London.
16,665. Locks, J. Y. Johnston.—(*H. M. V. T. d'Arneville, France.*)
16,666. Railway Signalling &c., Apparatus, W. Griffiths and E. T. R. Britain, London.
16,667. Permanent Way, E. P. Martin, London.
16,668. Tin Scrap, W., F. E., and A. S. Elmore, London.
16,669. Disinfecting &c., Closets, &c., B. Haigh, London.
16,670. Bolt and Lock Nut, L. Dove and J. S. Bush, London.
16,671. Drop Down Small-arms, W. Baker, London.
16,672. Locomotive, &c., Torpedoes, H. S. Maxim, London.

20th December, 1886.

16,673. Self-lubricating Axle, T. Cook, Ipswich.
16,674. Tobacco Pipe, F. L. Bennett, London.
16,675. Primary Batteries, N. G. Thompson, London.
16,676. Burglar's Alarm, W. Pressland, London.
16,677. Collotype Printing Machines, J. A. Berly.—(*L. Alauzet, Paris.*)
16,678. Dynamo Electric Machines, G. Hookham, Birmingham.
16,679. Brake, J. and H. J. Brooks, and R. Green, Birmingham.
16,680. Fixing Tiles, &c., S. Harvey, Weston-super-Mare.
16,681. Extracting Corks, E. S. Norcombe and W. McIntyre, Birmingham.
16,682. Universal Mill, S. Adams, Middlesbrough-on-Tees.
16,683. Safety Hinge for Step Ladders, W. Grayston, Keighley.
16,684. Kettle, &c., Spouts, G. Dodd, Birmingham.
16,685. Well Penholders, F. R. Baker, Birmingham.
16,686. Self-acting Sewing Machines, S. Davis, Brighton.
16,687. Fender Supports, F. Northall, Birmingham.
16,688. Snuff Boxes, &c., G. Lowe, Birmingham.
16,689. Metallic Layers for Boots, H. and H. J. Warrington, Hanley.
16,690. Steam Trap for Liquids, G. Weaver, Bath.
16,691. Preserving Perishable Goods, V. St. L. Symonds, Coryton.
16,692. Lawn Mowers, B. Kirkman, Braunstan.
16,693. Securing Hooks to Frames for Packing Sealskin, &c., G. H. Barraclough, Halifax.
16,694. Window Fastenings, J. L. Seymour, London.
16,695. Fastenings of Carriage Doors, G. W. Moon, London.
16,696. Improving the Tone, &c., of Musical Instruments, J. C. Martin, London.
16,697. Feed Mechanism for Logs, W. G. Buchanan, London.
16,698. Kettles, &c., for Heating Water, C. Darrah, London.
16,699. Endless Plate-ways for Wheeled Vehicles, &c., H. G. Tipping, Liverpool.
16,700. Safety Valve, A. Schmied, London.
16,701. Machinery for Excavating, T. Whitaker, Liverpool.
16,702. Pasteboard, H. Brehmer, London.
16,703. Damping Copying Sheets, G. Lowry, Bristol.
16,704. Casks or Barrels, F. Andrew, Lee.
16,705. Chimney Caps and Ventilators, A. A. Clarke, London.
16,706. Semaphores, D. Tapley, Canada.
16,707. Gauge Knife for Cutting Wood, &c., W. H. Whitear, London.
16,708. Syphon Cisterns for Flushing Closets, &c., M. Syer, London.
16,709. Clock Movement Frame, A. M. Clark.—(*S. P. Sandmark, United States.*)
16,710. Crushing Auriferous Ores, T. D. Williams, London.
16,711. Tricycles, C. C. Anderson, London.
16,712. Recovering Caustic Soda from Alkali Waste, R. M. Service, Glasgow.
16,713. Inhaling Medicinal Vapours, &c., T. Greenish and F. H. Glew, London.
16,714. Preserving Jute, &c., G. S. Pattullo, Glasgow.
16,715. Curved Form of Roller for making Paper Cloth, &c., D. and G. Bentley, and J. B. Jackson, London.
16,716. Organs, R. Schrader and G. Sander, London.
16,717. Carrier Tricycles, G. Singer, London.
16,718. Brake Apparatus for Railway Vehicles, &c., R. Maynard, London.
16,719. Fencing, H. H. Lake.—(*J. Gilson, Belgium.*)
16,720. Grain Drying Apparatus, F. Brandstaedter, London.
16,721. Heating Water, &c., T. S. Webb, London.
16,722. Magazine Fire-arm, H. A. Schlund, London.
16,723. Rotating Hook for Single Thread Sewing Machines, L. B. Bertram, London.
16,724. Driving Piles, S. Pitt.—(*W. C. and K. de Wit, Holland.*)
16,725. Spinning Yarns from Flax, &c., A. T. Lawson, London.
16,726. Spinning Yarns from Flax, &c., A. T. Lawson, London.
16,727. Obtaining Heat and Light, W. Boggett, London.

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16,728. Nailing Machines for Boots, J. E. Cutlan, Wellingborough.
16,729. Disinfecting by Steam, F. Goddard, Nottingham.
16,730. Door Locks, A. E. Dawson, Halifax.
16,731. Holders for Ships' Rigging, J. R. Bird, Glasgow.
16,732. Weaving of Wire, E. Brewtnall, Thelwall.
16,733. Double-action Spring for Fishing Lines, D. Clarkson, Redditch.
16,734. Revolving Salvers, C. Pembrook and J. Dingley, Birmingham.
16,735. Bottle Washing Machinery, J. Lingard and J. McEwen, London.
16,736. Vehicle Springs, C. H. Twist, London.
16,737. Bearings for Shafts of Horizontal Engines, C. T. Porter, London.
16,738. Fountain Pen, N. F. Palmer and P. E. Richter, London.
16,739. Electric Motors and Dynamo-electric Machines, C. G. Curtis, F. B. Crocker, and S. S. Wheeler, London.
16,740. Ash-pan or Cinder Sifter, W. Cordon, London.
16,741. Hand Cranes, T. G. Rhodes, Leeds.
16,742. Flyers used in Machinery for Preparing Cotton, &c., for Spinning, J. Marsden, Manchester.
16,743. Making Envelopes, J. Richmond and W. Whiting.—(*R. J. Henderson, United States*).
16,744. Starting a Discharge Syphon from Cisterns, H. Dunn, York.
16,745. Refrigerating Inclosed Spaces, F. N. Mackay, Liverpool.
16,746. Fastenings for Shutters of Shop Fronts, A. C. Henderson.—(*J. B. Joubert and A. Fraissange, France.*)
16,747. Multitubular Steam Boilers, J. Gauldie and J. Henderson, Glasgow.
16,748. Starting Gear for Tramcars, &c., A. M. Vereker and S. M. Yeates, Dublin.
16,749. Gas Meters, E. Schrabetz, London.
16,750. Dust Catchers, C. M. Hardenbergh, London.
16,751. Bicycles, C. A. E. T. Palmer, London.
16,752. Ventilators, J. Honeyman, Glasgow.
16,753. Infants' Chairs, T. Ferguson, Glasgow.
16,754. Roller Window Blinds, W. J. Roffe, London.
16,755. Chest Protector, &c., G. P. Eustis, London.
16,756. Reception of Coin and Delivery of Articles, J. S. Wallace, London.
16,757. Cord-knotting Mechanism for Grain Binders, A. Stark, London.
16,758. Seaming Machines for Sheet Metal, C. Puddefoot, London.
16,759. Sad Irons, A. F. Chable and J. C. Price, London.
16,760. Filtering and Heating Water of Swimming Baths, C. H. Rosher, London.
16,761. Packages for Carrying and Shipping Lard, R. R. Gray, Liverpool.
16,762. Sofas, Lounges, &c., A. J. Boult.—(*T. Hofstatter, jun., United States.*)
16,763. Testing Machines, J. H. Wicksteed, London.
16,764. Lubricating Devices, A. J. Boult.—(*R. Faas, United States.*)
16,765. Drying Machines, J. H. Lorimer, London.
16,766. Scoring Boards for Boxes, H. Gardner.—(*J. Scherbel and T. Remus, Germany.*)
16,767. Knitting Machines, G. Banzhaf, London.
16,768. Sewing Machine, J. H. Johnson.—(*The Wilcox and Gibbs Sewing Machine Company, United States.*)
16,769. Vegetable Dishes, F. Plaister, London.
16,770. Operating Artificial Pigeons, J. Monteith, Glasgow.
16,771. Velocipedes, W. Smith, London.
16,772. Steam Cylinder Drain Cocks, W. Wood, Johnstone.
16,773. Compound Engines, H. E. Newton.—(*T. Main, United States.*)
16,774. Colouring Matter, R. G. Price, J. Harvey, and A. J. Dodd, London.
16,775. Vulcanisation of Pure Caoutchouc, B. J. B. Mills.—(*A. Fayaud, France.*)
16,776. Spoons, &c., A. Krupp, London.
16,777. Inhaling Apparatus, K. Reith, London.
16,778. Flat-irons, A. Buhe, London.
16,779. Hydro-carburetted Air Engines, W. D. and S. Priestman, London.
16,780. Drying Machines, J. H. Lorimer, London.
16,781. Utilising the Force of Wind for Storing, &c., Energy, H. H. Lake.—(*C. de Goyon, D. de Feltre, and R. de L'Angle-Beaumanoir, France.*)
16,782. Oil Lamps, A. Inskip, London.
16,783. Lifting, &c., Vessels and their Cargoes, G. Spencer.—(*D. Park, Brazil.*)
16,784. Skirt or Dress Bands, J. Wright, London.
16,785. Automatic or Self-loading Machine Guns, T. Nordenfelt, London.
16,786. Railway Signalling Apparatus, E. C. Turner, London.
16,787. Washing and Preparing Wool, &c., W. H. Beck.—(*C. Delerue, France.*)

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16,788. Steel Tempering, W. L. Purves, Wimbledon.
16,789. Brush Stopper, J. W. Houldsworth, Heckmondwike.
16,790. Reducing Antimonial Ores, T. C. Sanderson, London.
16,791. Latch Locks, Sir G. H. Chubb and G. G. Exton, London.
16,792. Colliery Tramway Sleepers, J. Broughall, Essington.
16,793. Pouches, &c., I. Evans, Birmingham.
16,794. Brace or Suspender Buckle, J. Cadbury and F. W. Lambert, Birmingham.
16,795. Lubricators, C. Law, Liverpool.
16,796. Stoppers for Closing Bottles, W. Noton, Manchester.
16,797. Direct-acting Steam Pumps, W. M. Wilson, Manchester.
16,798. Desk and Type-writer, J. Harrison.—(*Messrs. Wyckoff, Seaman, and Benedict, United States.*)
16,799. Lighting and Heating with Oil, R. McGhee and J. Magee, Glasgow.
16,800. Flyers of Throstle Spinning Frames, J. A. Berly.—(*E. Guillemaud, France.*)
16,801. Scoring Cardboard, L. Gunn, London.
16,802. Typographically Printing Music, H. Chossefoin, London.
16,803. Raising Steam, B. Talbot, jun., Birmingham.
16,804. Liquor and other similar Frames, C. Pembrook and J. Dingley, Birmingham.
16,805. Wheel Journals and their Parts, A. Dickinson, Birmingham.
16,806. Velocipedes, A. J. Boult.—(*C. Radinsky, Austria.*)
16,807. Side Coupling for Railway Rolling Stock, A Paul, London.
16,808. Fixing the Heads of Brooms, &c., J. Blakey, London.
16,809. Circular Saw Benches, E. Hughes, Liverpool.
16,810. Galvanic Elements, T. Goodman.—(*C. Gassner, jun., Germany.*)
16,811. Door Checks, H. A. House and H. A. House, jun., London.
16,812. Holding Tuning Pegs of Stringed Instruments, C. Salomon, London.
16,813. Advertising Show-case, C. Jones, London.
16,814. Rail Fastener, J. Edey and G. Wright, London.
16,815. Pyrographic Press, C. Noppel, London.
16,816. Compressing Air, R. Johnson, Bradford.
16,817. Valve, J. T. Naylor, Bradford.
16,818. Steam Governors, J. Gerhardt and S. Davis, London.
16,819. Feeding Trough for Pigs, W. Stevens, London.
16,820. Tramway and other Locomotives, F. J. Burrell, London.
16,821. Boiler for Rapidly Heating, A. B. Willway, London.
16,822. Vehicles, J. Colby, London.
16,823. Electrical Batteries, E. Barbier and M. Leclanché, London.
16,824. Horseshoe, W. P. Smith, Burnham.
16,825. Cases for Instruments, &c., J. Arnold, London.
16,826. Contracting or Enlarging Trunk, J. C. King, Middlesex.
16,827. Refined Sugar, H. Vivien, London.
16,828. Bottles, T. P. Greene, Middlesex.
16,829. Bottles, T. P. Greene, Middlesex.
16,830. Fixing Dowels in Edges of Boards, S. Dawson and R. S. Dawson, Manchester.
16,831. Increasing the Flexibility of Wood, G. F. Norris, London.
16,832. Polish, H. Buczkowsi, London.
16,833. Metal Baths, W. D. Cliff, Middlesex.
16,834. Candles, F. H. Weber, London.
16,835. Match Boxes, G. E. Norris, London.
16,836. Steering Boats, W. L. Mitchell, Glasgow.
16,837. Folding Cases, H. Greene, Middlesex.

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16,838. Pressure Reducing Valves, R. Roger and H. T. Robson, Stockton-on-Tees.
16,839. Rack Pulley, R. W. Cooke and W. Elkin, Birmingham.
16,840. Rendering Doors, &c., Air-tight, J. C. Reid, Leeds.
16,841. Metal Bobbins, A. C. Henderson.—(*La Société E. Hamelin and Cie, Paris.*)
16,842. Oil and Spirit Lamps, W. T. Johnson, Birmingham.
16,843. Duplex Hydraulic Hoists, F. M. Evanson, Liverpool.
16,844. Connecting Lead Pipes, &c., J. Rowland, Fulwell.
16,845. Self-acting, &c., Knitting Machines, J. Kitson, Bradford.
16,846. Material used for Constructing, &c., Railways, J. Whitley, Leeds.
16,847. Self-acting Bolts, F. H. Collins, Birmingham.
16,848. Scissor Clamp, F. A. A. Smith, Cheltenham.
16,849. Machine for Common Roads, H. Cooper, St. Paul's.
16,850. Ash Guard, W. Blakemore and J. Hindle, Manchester.
16,851. Pouches for Tobacco, &c., H. Wheeler, Manchester.
16,852. Adjusting the Cord as applied to Indicators of Marine Engines, S. Pellew, London.
16,853. Grinding Wheels, N. Whitley, F. W. Thompson, and H. Hoyle, Halifax.
16,854. Cranks, &c., W. Putnam, London.
16,855. Grates for Steam Boilers Furnace, A. Firth, Sheffield.
16,856. Hydraulic Appliances for Pressing Hats, J. Bevan, Denton.
16,857. Motive-power Engines, S. Robertson, Glasgow.
16,858. Springs for Wheeled Vehicles, F. J. Radford, Sheffield.
16,859. Carriage Wheels, G. E. Holmes, Derby.
16,860. Dressing Machines for Separating Corn from Straw, F. Grimaldi, Italy.
16,861. Brushes for Cleaning Carriages, &c., J. Findlater, Glasgow.
16,862. Piano Organs, C. Chiappa, London.
16,863. Generator for Producing Steam, F. Livet, London.
16,864. Safety Appliances for Wheeled Vehicles, V. C. di Tergolina, London.
16,865. Batteries for Lighting, L. R. Davies and M. Shearer, London.
16,866. Treating Excreta, &c., for Manure, J. H. Barry, London.
16,867. Cutting Sugars, &c., into Slices, W. and F. Waddell, Wishaw.
16,868. Rockets, T. T. Parkinson, Gloucestershire, and C. V. Boys, Middlesex.
16,869. Solder Bar, D. Sinclair and G. Johnstone, Glasgow.
16,870. Producing Aluminium, J. H. Noad and H. R. Hammond, Middlesex.
16,871. Race Games, W. Britain, London.
16,872. Combined Furniture and Fire escape, H. G. Powell, London.
16,873. Shafts, J. G. Maythorn and G. O. Gooday, London.
16,874. Cartridges, A. J. Boult.—(*N. Killean and A. L. Lohmiller, France.*)
16,875. Electric Signalling, W. P. Thompson.—(*J. Sycinski and A. Beray, France.*)
16,876. Rail Cleaners, A. Dickinson, Birmingham.
16,877. Pottery, W. Boulton, London.
16,878. Swivel Pulley Blocks, W. W. Wilcox, London.
16,879. Transmitting Apparatus of Printing Telegraphs, W. S. Steljes, London.
16,880. Knives, &c., H. A. Brognard, London.
16,881. Berths, T. Morton, London.
16,882. Slag, &c., G. F. Redfern.—(*M. Raty and E. Lambert, France.*)
16,883. Stoppers, H. G. Hellier, London.
16,884. Sewing Machines, J. Forbes, Belfast.
16,885. Horse Rakes, J. R. Jefferies and F. W. Garrard, London.
16,886. Belting, &c., W. Withall.—(*G. F. Jewell, India.*)
16,887. Sewing Machines, J. E. Carver, London.
16,888. Fusee Vestas, &c., J. T. Coles, London.
16,889. Duplex Gas Burners, J. J. Grant, London.
16,890. Piassava, &c., J. G. Horsey, London.
16,891. Petroleum &c., Lamps, N. Pouchkareef, London.

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16,892. Roundabouts, A. G. Bingley, London.
16,893. Embossing Leather, W. Tuke, London.
16,894. Burring and Cleaning Hairy and Woolly Skins, J. Straiton, Liverpool.
16,895. Knitting Machinery, J. Mellor and G. R. Parker, Nottingham.
16,896. Cisterns, J. Fagan, Skipton-in-Craven.
16,897. Fabric, J. Booth, Halifax.
16,898. Exhibiting the Name of Householders upon some Conspicuous Part of the Premises, H. Rothery, Whitehaven.
16,899. Producing Gas, G. Tolson and J. Illingworth, Halifax.
16,900. Internal Flues, &c., of Steam Boilers, J. Hailwood, Grimesthorpe.
16,901. Electric Safety Lamps, F. Wilkinson, Manchester.
16,902. Applying Armour Plates to Ships, T. Osborne, C. H. Woodhouse, and J. T. Shipman, Sheffield.
16,903. Clip-rest for Knives, &c., T. Hill, Sheffield.
16,904. Low Pitch Silent Billiard Cushion, A. Toghill, London.
16,905. Wire Rope, B. B. Glover and J. Hodson, Liverpool.
16,906. Stoves, W. P. Thompson.—(*C. Garlick, United States.*)
16,907. Boring or Drilling Holes to Receive Bristles, B. Woodfield, London.
16,908. Effecting Elecrical Signals, W. Armstrong London.

16,909. COVERING WIRES, J. Gale and H. Taylor, London.
16,910. PICKS, R. and J. McHardy and J. Cowan, Dollar, N.B.
16,911. SIGN BOARDS, J. R. Hunter, Manchester.
16,912. HAY COLLECTORS, J. T. Mitchell, Birmingham.
16,913. SADDLERS' &c., PUNCHES, S. Heath, Birmingham.
16,914. TRUNKS, F. Starr and H. Hurst, London.
16,915. CONVERTING the GRADUALLY ARRESTED MOMENTUM into a MOTOR POWER, D. de la M. du Boulay, Dorset.
16,916. ANATOMICAL CHARTS, J. T. White, London.
16,917. GRAPNELS for SUBMARINE CABLES, A. Jamieson, Glasgow.
16,918. SAFETY HAMMOCK SWING, W. Griffith, Norwood.
16,919. ANCHOR, G. H. Little and P. Hale, London.
16,920. WATER METERS, H. Bright, Birmingham.
16,921. SUBSTITUTE for INDIA-RUBBER, J. Anderson, jun., London.
16,922. BRICKETTES, E. Clarke, Leeds.
16,923. CLEANING, &c., METALS, E. Vlasto, London.
16,924. INK STAND, C. H. Felton, London.
16,925. BUOYANT SOAP, Sir D. L. Salomons, London.
16,926. COATING, &c., WALLS, E. A. Bronson, London.
16,927. COMPOUND ENGINES, J. P. Hall, London.
16,928. SAFETY LADDER, &c., APPARATUS, J. F. Haskins, London.
16,929. DRYING, &c., TEA LEAF, M. Ross, Glasgow.
16,930. HYDROGEN, A. Fritschi and E. Beaufils, London.
16,931. STOPPERS, A. Kempson, London.
16,932. TUNING the STRINGS of PIANOFORTES, &c., H. Cohn.—(*R. Thompson, New Zealand.*)
16,933. TROUSER STRETCHER, H. McBride, London.
16,934. VERTICAL COLUMN STEAM ENGINES, T. Jefferiss, London.
16,935. PRESERVING the SURFACE of COPPER, &c., E. de Pass.—(*La Société Industrielle et Commerciale des Métaux, France.*)
16,936. DYNAMO-ELECTRIC, &c., MACHINES, A. J. Boult.—(*F. L. Pope, United States.*)
16,937. DECORATION of PHARMACEUTICAL VESSELS, A. J. Boult.—(*J. G. Laporta, Spain.*)
16,938. TAPS, &c., for BOTTLES, &c., F. E. Witham, London.
16,939. REFRIGERATING STANDS, &c., F. E. Witham, London.
16,940. HYDROSTATIC PRESS SIGHT FEED LUBRICATOR, W. Fraser, London.
16,941. SCREENING or SIFTING APPARATUS, L. Loiseau, London.
16,942. CONVERSION of ELECTRIC CURRENTS, J. D. F. Andrews, London.
16,943. PROJECTILES, &c., C. T. Cayley and R. S. Courtman, London.
16,944. GOVERNORS, &c., T. Heather, London.

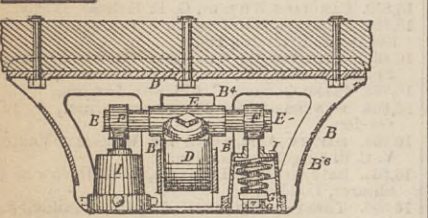
SELECTED AMERICAN PATENTS.

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

350,010. PEDESTAL AND AXLE BOX FOR CARS, *Daniel McAlister, St. Louis, Mo.—Filed May 13th, 1886.*

Claim.—(1) A pedestal comprising side plates B^1, having flanges B^3, horizontal plate B^4, end plates B^6, apertures B^7, cheek plates B^2, and journal bearings B^5, substantially as shown and described. (2) An axle box D, formed with trunnion block E^1 and trunnions E, and a pedestal B, in combination with spring connections between the trunnions and the base of

350,010.

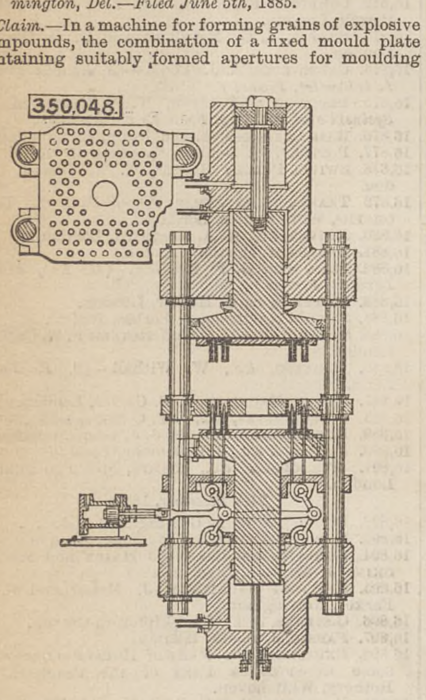


the pedestal, substantially as shown and described. (3) The combination of the pedestal B, axle box D, formed with trunnion box E^1, having trunnions E, eyebolts F^1, forming hangers hinged to the trunnions, having nuts G, springs supported on the nuts, and inverted bells I, supported on the springs, having bearing studs, substantially as shown and described.

350,048. GUNPOWDER PRESS, *Eugene Du Pont, Wilmington, Del.—Filed June 5th, 1885.*

Claim.—In a machine for forming grains of explosive compounds, the combination of a fixed mould plate containing suitably formed apertures for moulding

350,048.

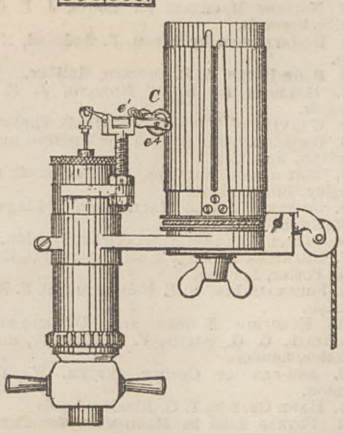


powder, two equally moving and balanced rams acting to compress the grains from both ends, and pins passing through the apertures in said mould plate and having a longitudinal motion therein independently of said rams, substantially as and for the purpose described.

350,069. STEAM ENGINE INDICATOR, *Frederick R. Low, Chelsea.—Filed September 16th, 1885.*

Claim.—(1) The combination, with a card carrier, of an indicator, the planimeter wheel C, piston A, yoke E, the block e^1, the planimeter wheel being journalled in said yoke and thereby connected with said block, the support e^4, and connecting rod e^2, substantially as and for the purposes described. (2) The combination of a movable drum, means to move said drum about its axis, a rock-shaft adjacent to said drum, the axis of which is transverse to the axis of the drum, means to rock said rock-shaft actuated by the same prime mover as those which actuate the drum, but by an independent train, means for opposing a differential and cumulative resistance in one direction to the rocking of said rock-shaft, a planimeter wheel mounted on the end of said rock-shaft with its axis of rotation transverse to the axis of rotation of the rock-shaft and normally at right angles to the axis of rotation of the drum, and with its surface in contact with the surface of the drum, all substantially as and for the purpose described. (3) An organised indicator consisting of the following parts: a spring piston of usual construction, its piston-rod and link, a rock-shaft connected with said link and actuated by it, and carrying bearings on the end of its axis for a planimeter wheel, a plani-

350,069.

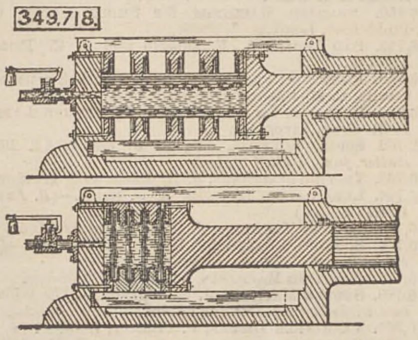


meter wheel mounted on said rock-shaft with its axis transverse to the axis of rotation of the rock-shaft, and a usual reciprocating diagram, drum, or card carrier, substantially as and for the purpose described. (4) In an indicator, the combination, upon the end of the rock-shaft which is actuated by the movement of the pressure weighing device of such indicator, of a planimeter wheel mounted at right angles to the axis of reciprocation of the rock-shaft and normally at right angles to the axis of reciprocation of the diagram drum, with the diagram drum and rock-shaft to bear against said diagram drum and register the areas of the power diagrams continuously, substantially as described.

349,718. APPARATUS FOR CORRUGATED METAL TUBING, *Hermann Hollerith and Samuel G. Metcalf, New York, N.Y.—Filed February 4th, 1886.*

Claim.—(1) In an apparatus for corrugating metal tubes, a tube closed at its ends and adapted to be filled with a fluid, an internally corrugated mould surrounding the tube, and means for imparting longitudinal pressure to the tube, substantially as described.

349,718.

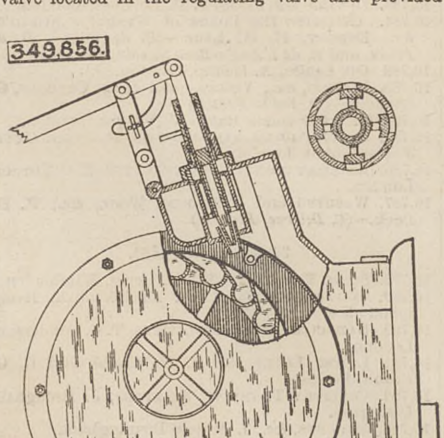


(2) In an apparatus for corrugating metal tubes, a tube closed at its ends and adapted to be filled with a fluid, a mould for surrounding said tube, constructed of independent partible rings or sections, and means for imparting longitudinal pressure to the tube substantially as described.

349,856. WATER MOTOR, *Peter Murray, un., Newark, N.J.—Filed May 12th, 1886.*

Claim.—(1) The combination, in a water motor, of a cylindrical casing having water supply and discharge channels, a rotary water wheel within said casing, an axially adjustable supply regulating valve, a casing surrounding said valve and provided with an annular equalising chamber and injection nozzle, a needle valve located in the regulating valve and provided

349,856.

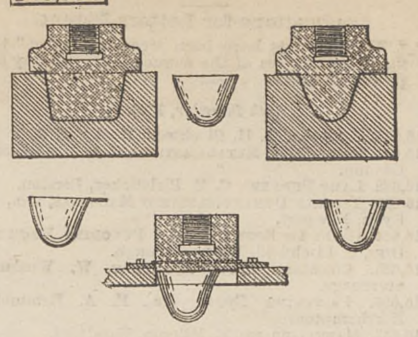


with a hollow slotted nozzle, whereby an exterior and interior jet are supplied to the water wheel, substantially as set forth. (2) A water wheel having a rim formed of ring-shaped flanges and buckets formed of straight and inclined front parts and semicircular rear parts projecting back of the plane of the front parts and resting upon the straight portion of the next adjoining buckets, substantially as set forth. (3) A water wheel having a rim formed of ring-shaped supporting flanges and buckets arranged tangential to the jet, said buckets having straight front parts and cup-shaped rear parts which project out of the plane of the front parts, and are adapted to deflect the water so as not to interfere with the jet, substantially as set forth.

349,754. METHOD OF MAKING ELEVATOR BUCKETS, *Charles C. Scaife, Allegheny City, Pa.—Filed June 17th, 1886.*

Claim.—The method of making elevator buckets, which consists in striking up a blank of cold plate metal into a cup shape by a series of operations in dies increasing in depth and decreasing in width in regular order, whereby the cup is increased in depth and decreased in diameter at each step, annealing the blank during the operation, and finally shaping it hot

349,754.

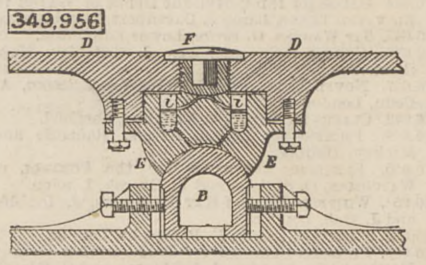


in a suitably shaped die, substantially as and for the purposes described.

349,956. CENTRE BEARING FOR TURNTABLES, *Edward Samuel, Philadelphia, Pa.—Filed June 28th, 1886.*

Claim.—(1) The combination of the bearing block B, table D, and block E, attached to the table, with a screw plug F, within and completely below the surface of the table D, and adapted to be turned by a

349,956

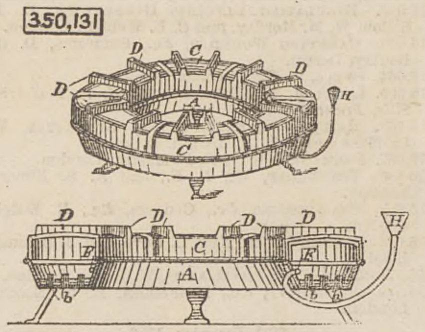


key, substantially as set forth. (2) The combination of the bearing block B and table D, with block E, having an annular oil chamber *i*, and a plug F, having a socket and passages in the plug, and block E, connecting the said socket with the top of the bearing block, substantially as and for the purpose set forth.

350,131. TIRE-HEATING FURNACE, *Joseph Harris, jun., Boston, Mass.—Filed May 22nd, 1886.*

Claim.—(1) A tire-heating apparatus consisting of a base or oil receptacle A, in combination with a cover composed of sections C, each provided with radial flues or openings D D, as shown and described. (2) In a tire-heating apparatus, the circular base or oil receptacle A, provided with perforated nipples *b*, all

350,131



cast in one piece, as and for the purpose set forth. (3) In combination with the oil receptacle A, the perforated oil supply pipe F, provided with a mouthpiece H, as shown and described. (4) In a tire-heating apparatus, the sections C, provided with radial flues or openings D, and connected together to form a circular cover for the heating chamber, substantially as shown and described.

350,386. HARVESTER SICKLE-GRINDING MACHINE, *James N. Parker, Elkhart, Ind.—Filed January 26th, 1886.*

Claim.—(1) The combination of a standard, a plate projected in a horizontal plane therefrom, a reciprocating crosshead mounted on the plate, set screws projecting lengthwise of and in opposite directions

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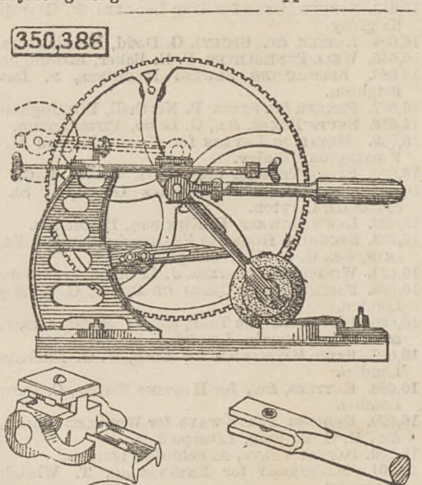
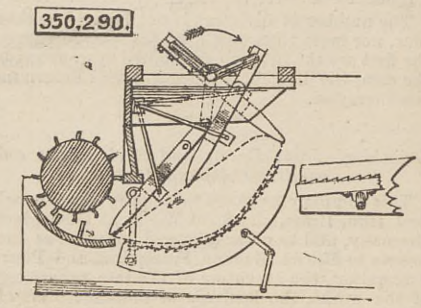


from each end of the plate to regulate the movement of the crosshead, a grinding roller, supporting frame therefor carried by the crosshead, and mechanism to drive said roller, substantially as described, and for the purpose specified. (2) The combination of a standard, a plate transversely slotted at one end, and having a lateral adjustment on the standard, to which it is secured by bolts passing through the slotted end, a crosshead traversing on the plate, a grinding roller, supporting frame therefor carried by the crosshead, and mechanism for imparting a rotary movement to the grinding roller, substantially as set forth. (3) The combination of the standard, a plate projected horizontally therefrom, a transverse bar secured to the plate, a crosshead invertibly secured to the plate, a grinding roller, supporting frame therefor pivotally supported by the crosshead, and having its free end engaging with the transverse bar and held in position thereby, substantially as shown and described. (4) The combination of a plate, a crosshead, a grinding roller, supporting frame therefor hinged to the crosshead, and a spring secured at one end to the crosshead, and having its free end projected within the path of the frame to contact therewith and keep the roller to its work, substantially as set forth. (5) The combination of a plate, a crosshead traversing thereon, a grinding roller, supporting frame therefor hinged to the crosshead, a guard located within the path of movement of the crosshead, to contact with the frame and prevent its dropping when nearing the end of its stroke substantially as and for the purpose specified. (6) The combination of the standard, a plate projected horizontally therefrom, a crosshead traversing on the plate, adjustable stops to limit the movement of the crosshead, a guard adjustably secured to the standard, a grinding roller, and a supporting frame therefor hinged to the crosshead and adapted to contact with the guard near the end of its backward movement, substantially as and for the purpose set forth. (7) The combination of the standard, a plate extended horizontally therefrom, a crosshead traversing on the plate, a swinging frame carrying a grinding roller and supported by the crosshead, a slotted guard secured to the standard by a bolt passing through the slot in the guard, and a second bolt passing through the slot and a vertical slot in the standard to pivotally adjust the guard about the first bolt, as and for the purposes set forth.

350,290. THRASHING MACHINE, *Constantius G. Case, Battle Creek, Mich.—Filed February 12th, 1886.*

Claim.—In a thrasher, the combination, with thrashing devices, a grate to receive the straw, a crank shaft, and guiding arm, of a fork mounted on the shaft and connected to the arm and adapted to force the straw away from the thrashing devices, the above parts being relatively adapted and arranged, substantially

350,290.

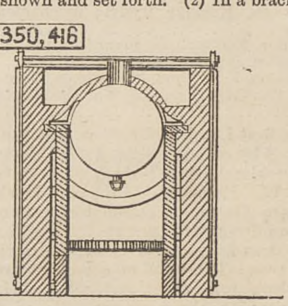


as described, to give the fork an extended plunge movement substantially in a straight line to engage the straw, a curvilinear movement while forcing the straw to the rear, a movement directly away from the straw to release it, and a slightly curved movement from thence to the beginning of said plunge movement, substantially as set forth.

350,416. BRACKET FOR STEAM BOILERS, *Thomas Cunningham, Chelsea, Mass.—Filed July 17th, 1886.*

Claim.—(1) A bracket for a steam boiler, consisting of a curved portion for fastening to the boiler shell and a detachable toe having means for securing it to the rounded portion, and having a flat under side, as and for the purpose shown and set forth. (2) In a bracket for

350,416



steam boilers, the combination of a curved portion having upwardly converging ribs upon its back, and having rivet-holes, with a toe having its inner end shaped to fit between the converging ribs, the lower portion of the curved portion projecting below the under side of the toe, forming a lip, as and for the purpose set forth.

350,439. VAPOUR BURNER, *Fordyce A. Lyman, Cleveland, Ohio.—Filed August 5th, 1885.*

Claim.—(1) The combination, with a hollow arm and disc, formed integral, the latter having a concave upper surface and a drip-hole, of burner located above the disc, a commingling tube extending through the disc and terminating in the burner, and a conduit leading from the hollow arm to a point below and directly underneath the lower end of the commingling tube, substantially as set forth. (2) The combination, with the hollow arm B and disc, formed integral, the latter having a concave upper surface, of the com-

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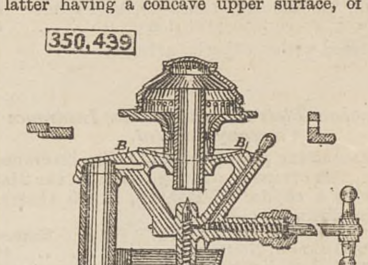

mingling tube passing through the disc, the cone surrounding the upper portion of the tube, and having legs or supports, which rest on the concave surface of the disc, the vertical jet orifices formed in the bottom of the cone, and a conduit leading from the hollow arm to a point directly underneath the lower end of the commingling tube, substantially as set forth. (3) The combination, with a generator having a drip opening extending through same, a cone seated on said generator and provided with jet orifices in the bottom thereof, a burner cap, and a lighting cup located in a position to receive the oil from the drip opening, of a commingling tube terminating inside of the burner cap and a conduit leading from the generator to a point below the lower end of the commingling tube, substantially as set forth.