THE DRAINAGE OF FENS AND LOW LANDS BY STEAM POWER.

By W. H. WHEELER, M. INST. C.E.

No. V.[1]

THE SCOOP WHEEL.

THE "scoop" or "float" wheel has been in use as a machine for lifting water from very ancient times. That the Romans used it for this purpose is proved by the discovery at the Tharsis mines, in the South of Spain, a few years ago, of a scoop wheel which had been exhumed in the excavations then being carried on. This wheel was made of oak, of light scantling, put together with oak pins, no nails being used in the construction; and although it must have been underground for nearly two thousand years, the wood was in a good state of preservation.—(Mr. J. Lee Thomas in "Trans." Inst. C.E., vol. xxxii.)

Mechanical power for drainage purposes in the Fen country came first into use about 200 years ago, when scoop wheels worked by horses were used by the Corporation of the Bedford Level. Horse power was superseded by wind. In 1726 an Act was obtained for the drainage of Haddenham Fen by the use of windmills working scoop wheels, after which time their use became general throughout the Fen land, also for the drainage of the low land along the Trent and in other parts of the country. In Holland scoop wheels still largely exceed all other kinds of machines for lifting water from the low lands, and in Italy they are considered by some of the principal engineers as more effective for this special purpose than any machine yet invented.

Scoop wheels have done exceedingly good service in the drainage of the land. When well constructed, and for situations where the height to which the water has to be raised is not great, and where there is not much variation in the lift, they are effective and useful machines. The slow speed at which they travel fits them for being driven by windmills or the slow-speed beam engines by which these were succeeded. They are simple in construction, and easily repaired by the aid of such mechanical skill as is readily obtainable in country districts. They are not liable to get out of order when laid by, or easily damaged by floating substances brought to them in the water.

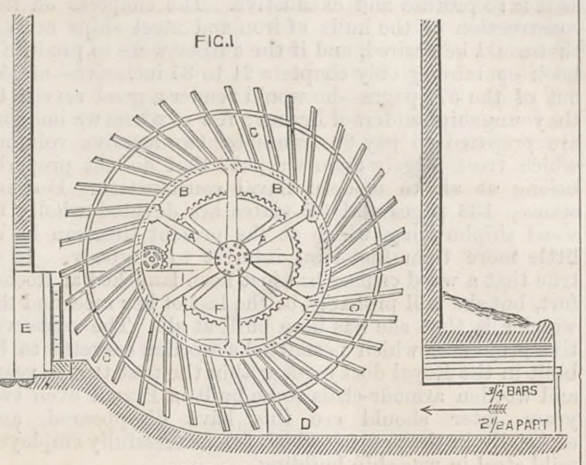
To the mind of those living by the side of the rivers and drains of low flat countries, and accustomed to the slow practices of an agricultural life, there is a sense of power and solidity about a massive beam engine with its slowly revolving fly-wheel and heavy beam rising and falling, driving a ponderous water wheel lifting a large mass of water, for which the small parts of a centrifugal pump and its rapid movements seem but a poor substitute. They are, however, exceedingly cumbrous, the wheel, weighing as much as one-fifth of the total body of water lifted at each revolution. The larger wheels, of, say, 30ft. in diameter, weigh from thirty to forty tons, and therefore require very heavy foundations and expensive masonry work for the wheel race. The slow speed engines used for driving wheels are themselves as ponderous as the wheels, and also require heavy foundations and a large area of buildings. If engines of quick speed are used the loss of efficiency due to the gearing necessary to reduce the velocity of the engine to that of the wheel absorbs considerable power.

As generally constructed scoop wheels are very wasteful of power, and badly adapted to meet the alterations in the level of the water due to the falling of the level on the inside, as the water is pumped out of the drains, or on the outside due to the rise and fall of the tide, or of flood waters in non-tidal streams. As the angle at which the scoops enter and leave the water seriously affects the working of the wheel, even in the best constructed machines, there must always be a loss due to variation in the level. The unnecessary height to which some part of the water must be lifted also throws undue work on the engines, although it is not so regarded by all engine-men. Professor Airey mentions a case of a wheel which he visited, the attendant on which took considerable pride in his wheel because it lifted the water well up into the air, regardless of the fact that the steam power by which all this water was tossed in the air had to be paid for, and was so much waste of power—("Trans." Inst. C.E., vol. xxxii.) There is also loss from leakage of the water between the wheel and the sides and bottom of the masonry trough in which the wheel revolves. In the event of the surface of the land drained becoming lower—a frequent occurrence—it becomes necessary to deepen the drains and lift the water from a lower level, involving the owering of the wheel, or the lengthening the scoops, and reconstructing the masonry breast of the course, an expensive and difficult work, owing to the foundations being generally built upon piles.

Most of the old scoop wheels employed in the drainage of land are unnecessarily wasteful of power. Sir G. B. Airey, then Astronomer-Royal, who examined one of these machines at work, for the drainage of a large district in the Fens, was of opinion that four-tenths of the power applied was wasted, which might be saved by a proper arrangement of the parts, in which opinion he was confirmed by Sir W. Cubitt. Many of the wheels do not give off a useful effect of more than 30 per cent. of the power applied.

By improvements recently effected in the engines and wheels used for the drainage of Deeping Fen, more than double the quantity of water was raised, the consumption of coals being at the same time reduced 42 per cent.

The scoop wheel in its simplest form—Fig. 1—consists of an axle, upon which are fastened discs, to which are attached radial arms A, terminating at the other end in the rim B, upon which are fastened arms with boards called "scoops," C. The wheel revolves in a trough, connected with the drain on the one side and the river or place of discharge on the other. The scoops beat or lift the water from the lower to the upper side, the water way on the river or outlet side being provided with a self-acting door E, which closes when the wheel stops. On the inside of the rim are cast iron cogs fastened on in segments, and geared into these is a pinion keyed on to the shaft of the fly-wheel of the engine, which gears into a pinion working on the crank shaft. In some wheels a spur wheel F is fixed on the shaft of the wheel, in place of the toothed segments. The former plan occupies less space, but the wheel is more difficult to repair in case of damage to the teeth. In some wheels the framework, including the rim, is made in four castings, two forming one side of the wheel, and are bolted together and keyed to the axle.



SECTION A A

A large number of the scoop wheels in the Fenland were designed by Mr. J. Glynn and made by the Butterley Company. These have a cellular casting or disc keyed on to the axle. The spokes are each in one casting through the width of the wheel, bolted through the disc and transversely to the rim. The wheels of more recent construction have had each spoke made in a separate casting bolted transversely to the disc and to lugs cast on the rim, the spokes being connected by struts and bolts. The rim is cast with sockets, in which are fixed with pins oak arms or "start posts." To the start posts are bolted boards, from 1in. to 1½in. thick, varying at the circumference from 1ft. to 3ft. apart. Wheels of small width have only one start post, and the boards are placed lengthways parallel with the post. In wider wheels there are two or more start posts, the boards being placed in the opposite direction. These boards are called indifferently "scoops," "ladles," "floats," "paddles," the former term being adopted by myself, as that most generally in use.

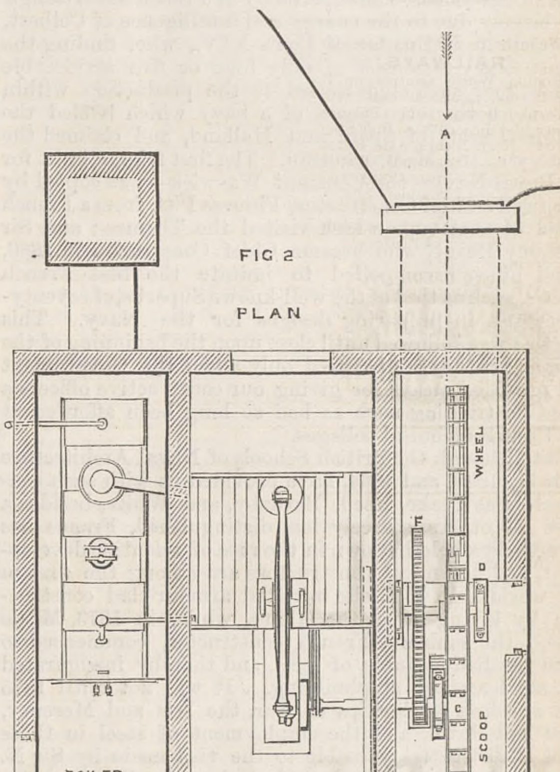
The axle in the old wheels is carried on bearings resting on the masonry of the trough, and not provided with any means of adjustment except by packing. The gudgeons in the old wheels have no means of adjustment, and are generally unnecessarily large, increasing the friction. In more modern wheels the gudgeons are kept in their place either by a shoulder running close against the plummer blocks or by screws bearing against the ends. The trough in which the wheel revolves is made of masonry, carried up as high as the centre of the wheel. The invert is made to the same radius as the wheel. The clearance, or space between the wheel and the trough at the sides and bottom, varies from $\frac{1}{16}$in. in the best machines to ¾in., and even more, in the older ones. Owing to the large diameter of the wheels and their great weight, it is necessary that the foundation should be rigid and the wheel very nicely adjusted, as the slightest settlement causes the wheel to grind against the sides. Even with thorough adjustment there is always loss of water, owing to the space which must be left between the wheel and the masonry. In order to prevent this loss, some wheels have rims or shroudings on the sides, which partially or wholly enclose the water. If only partially shrouded, only a portion of the leakage is stopped, and, if wholly, a difficulty arises in providing for the escape of the air contained in the space between the two scoops, which consequently do not become fully charged.

The scoops are generally flat boards bolted to the start posts and dripping from the radial line at an angle varying from 20 to 40 deg. Owing to the variation in both the external and internal water-levels, it is impossible to fix the scoops at such an angle as that they should always enter and leave the water in the way most favourable to the discharge. The larger the angle which the scoop forms with the surface of the water the better the scoop enters, and the better hold it gets on the water; and the larger the angle of egress the better the water leaves the scoops; consequently the more the angle of ingress is improved the worse becomes the delivery. If the angle of ingress be too small, too much of the scoop comes in contact with the water on first entering, and instead of drawing it gently forward, beats it back, causing a disturbing element detrimental to the discharge. If the angle of egress be too small, the water does not drip off the scoop readily, but a portion is carried up with it above the level of the surface of the water, the height to which the part of the extra water is lifted in some wheels due to this cause being as much as 6ft. to 8ft., while the remainder is lifted from 2ft. to 3ft. The undue work thrown on the engine from this cause may be realised when it is considered that the lift of these wheels seldom exceeds 10ft., and is frequently only half this. The angle at which the scoop is placed should be regulated by the relative mean levels of the internal and external water.

The most common rule is to fix the scoops so that their angles of ingress and egress with the mean internal and external water levels should be equal. Inspector Beijerwick, the engineer of the Zuidplas and Haarlem reclamations, who has paid much attention to this matter upholds this rule. If there is any variation it is better to increase the angle of egress, as this prevents useless lifting of the water at the point of discharge, and more is gained on the egress than is lost on the ingress side. Some of the Dutch wheels, however, are constructed so that the angle of egress is double that of the angle of ingress. The wheels at Katwijk, which are of recent construction, are made tangential to a circle concentric with the wheel, and having a radius of 5·25ft., the diameter of the wheel being 29ft. 6in. This gives the angle of ingress with the water at mean level 20 deg. 30 min., and the angle of egress 42 deg. The wheels at Podehole for the drainage of Deeping Fen, the larger of which is 30ft. in diameter, have scoops which incline from the radial line 35 deg., being tangential to a circle 5ft. in diameter. The scoops are 6ft. 6in. long; the ends for a length of 18in. are bent back from the straight line about 6in.

In order to avoid the undue lifting of the water, and also to facilitate the entry, wheels, both in this country and in Holland, have been fitted with curved scoops made of sheet iron, the rest of the wheel also being generally of iron. At normal levels these wheels work well, but when the internal water level alters, the convex part of the scoop strikes the water, and any advantage otherwise gained is lost. Wheels with curved floats should always be provided with a shuttle to adjust the flow of water. The variation in the level may, to a certain extent, be thus provided against. Curved wheels provided with a proper adjusting shuttle may be run with a greater speed than with flat scoops, as the water escapes off the scoops more readily, and will work effectively if run at a speed on the periphery of 9ft. per second. Curved wheels may also be made of less diameter than those having straight scoops. Wheels with curved ladles are in use at Zuidplas, Holland, for the Up-well and Out-well district in the river Ouse, and at Ravensfleet and Sturton on the Trent.

The older wheels made in Italy had the scoops straight and radial. These wheels were of low efficiency, dashing the water about as each scoop entered and left the water.



More recently the practice of some of the Italian engineers has been to make the wheels of iron, the scoops being inclined at about 60 deg. to the radius and formed with a double curvature, a sliding iron shuttle being provided so as to admit the water to the lower part of the wheel only—"Trans." Inst. C.E., vol. lxvvi., p. 402. At Gouda, those of the scoop wheels erected in 1857 were subsequently changed to wheels having curves with the concavity towards the outer water, one having the concavity towards the inner water, and two with the water nearly flat. The difference in the delivery of these wheels was slight, the first-named giving, on the whole, the best result. These have since been changed to flat scoops. As a matter of experience, wheels with flat scoops give the best results when all circumstances are taken into consideration.

The inlet and outlet courses for the water are constructed of masonry, the wall of the engine-house generally being placed on the inner side and the shafting from the engine passing through an opening. The outlet channel is provided with either single or double self-acting doors, according to the size of the channel. These close automatically when the wheel stops. In some cases these doors are placed close to the wheel in a set-back in the masonry. A disturbance is thus caused in the flow of the water by the alteration in the size of the channel and by the water striking against the framing of the loors and the angles of the masonry. To ensure an even flow and prevent eddies the outlet channel should have the same width as the wheel, and gradually widen outwards to the outfall drain. The sides should be smooth, and free from any projection or recesses, and the door removed to some distance from the wheel. The breast of the raised outlet cill should be rounded off. When the level of the water in the outfall drain varies much in height and the wheel is run with a large load of water

[1] For article No. IV., see THE ENGINEER, March 4th.

the scoops as they come round churn up and move round a large quantity of water without discharging it. The wheel thus becomes choked, and does not part with its load as efficiently as it otherwise would. To obviate this movable breasts have been fitted to some of the old wheels, which can be raised or lowered to suit the level of the water. The wheel at Podehole has thus been altered (see figure). On the breast of the outlet cill an iron plate has been fitted in a recess cut in the masonry. This plate is hinged to another plate which lies on the floor of the outlet channel. By means of a segmental-toothed rack geared into a pinion on the windlass this movable breast can easily be raised or lowered, and the cill of the discharging channel adjusted to the height of the water. A similar arrangement has been carried out in the large wheel on the Hundred Foot River, and the discharge in both cases has been very greatly improved.

Experiments made by the superintendent of the latter wheel showed that with the same pressure of steam in the boiler, and other circumstances being the same, the number of revolutions of the wheel—50ft. in diameter—increased about one-third, or from 31 in three minutes, with the movable breast lowered, to 41 in the same time when it was raised its full height of 4ft., making a total rise of 8ft.

LITERATURE.

Cours de Construction Navale professé à l'Ecole d'Application du Génie Maritime. Par A. HAUSER. Paris: E. Bernard et Cie. 1886.

NAVAL architecture was scientifically studied in France for at least a hundred years before similar methods were applied to the development of ship construction in this country. During our wars with France in the eighteenth century, their ships were, in most cases, superior in form and sailing qualities to our own, and it was not unusual to model new line-of-battle ships for the Royal Navy upon the lines of those captured from the French. Our successes in those naval wars are attributable rather to our seamen than to our ships. The superiority of French naval design was largely due to the energy and intelligence of Colbert, the celebrated Minister of Louis XIV., who, finding the French Navy to consist of only four or five serviceable vessels, took such steps as led to the production within little more than ten years of a navy which baffled the combined fleets of Spain and Holland, and claimed the mastery of the Mediterranean. The first frigate built for the Royal Navy—the Constant Warwick—was copied by Cromwell's Chief Constructor, Phineas Pitt, from a French vessel of that type which visited the Thames; and Sir Anthony Deane, who became Chief Constructor in 1686, found himself compelled to imitate the best French models, such as that of the well-known Superbe, of seventy-four guns, in preparing designs for the Navy. This practice was followed until close upon the beginning of the present century, and ceased only when the Government had provided means for giving our constructive officers a scientific training such as had so long been afforded at the French technical colleges.

But although the British Schools of Naval Architecture of 1811, 1848, and 1864, have provided us with such constructors as Peake, Reed, Barnaby, and White, besides a score of others, scarcely less distinguished, France has nevertheless held her own in the race of scientific development, and her naval constructors are among the first in the world. In 1858 she initiated armour-clad construction by laying down the Gloire, while, in 1873, M. de Bussy, the eminent French constructor, commenced to build the Redoubtable of steel, and thereby inaugurated the steel age of shipbuilding. It was not until 1875 that our first steel ships of war, the Iris and Mercury, were laid down, and the employment of steel in those ships is distinctly traceable to the visit made by Sir N. Barnaby in 1874 to the French dockyards. The barbette system of mounting ordnance in armour-clad ships was first adopted in France, and in many other important particulars our neighbours across the Channel have in recent years shown themselves to be as enterprising and ingenious as ever they were in all that relates to the science of naval design. The transition from wood to iron afforded us from the first a great advantage in the building of mercantile shipping, and that advantage is still maintained. France does not compete very strongly with us for the production of the world's merchant shipping. Our mineral resources are greater than hers, and our workmen produce more cheaply, notwithstanding that their rate of wages is much higher than is paid in France. War-ships cost more per ton to build in France than in our own dockyards, notwithstanding the reputed idleness and wastefulness of the latter establishments, and even with the advantages of a Government subsidy mercantile shipbuilding in France is not a growing industry.

Whatever cause may be assigned for the decline of the shipbuilding industry in France, it certainly cannot be a want of excellent technical schools, nor a deficiency in the literature of naval architecture. The work before us is an evidence of what has just been stated. If all that is contained in M. Hauser's book is taught at *l'Ecole d'Application du Génie Maritime*, then both professors and pupils have plenty to do. This "course of construction" is in two large volumes, one of which contains 577 pages, quarto, of letter-press, and the other is a still larger book, containing 340 plates, showing 1771 distinct figures. The 59 chapters into which the work is divided refer to wood, iron, steel and composite construction. The book describes in the most detailed manner all that can well be said upon laying-off, building, launching, rigging, fitting, armour-plating, equipping, painting, docking, pumping, ventilating, surveying, repairing, and even breaking-up of ships. We learn in it all about the tides, modes of lifting sunken ships, the construction of docks, basins, patent slips and floating docks; the making of masts, spars and sails; the fitting of cabins, store-rooms, magazines, shell-rooms, and chain-lockers; the stowage of anchors, and even such minor details as the fittings of cook-houses, baths, and latrines. The plates illustrate all these things, and show besides the modes of arming and protecting the principal armour-clad ships now in existence or being built. Indeed, it is difficult to think of any matter pertaining to the construction and navigation of ships that has been omitted in the work.

M. Hauser's book is, without doubt, a most valuable treatise and a meritorious production; but in our opinion it falls short of what a text book should be, just inasmuch as it is so profuse and exhaustive. The chapters on the construction of the hulls of iron and steel ships are all that could be desired, and if the author were to produce a book containing only chapters 21 to 35 inclusive—or 158 out of the 577 pages—he would render a good service to the young shipbuilders of France; few of whom we imagine are prepared to pay 80 francs for two massive volumes which treat largely upon subjects that do not properly belong at all to modern naval construction. For instance, 138 pages and 55 plates are devoted wholly to wood shipbuilding, which at the present time can be of little more than historical interest to anybody. It is true that a wood cruiser has just been launched at Rochefort, but she will probably be the last of her race, and the wonder is that she has been built at all. The conservative prejudices which permitted a wooden corvette to be built in the Royal dockyards within the past twelve years and wooden armour-clads to be built in France even two years later should ere this have disappeared, and especially in the country which first successfully employed mild steel in war-ship building.

The work is evidently intended primarily for the use of students under training for the French dockyards, and perhaps a subordinate purpose is that of a book of reference for the guidance of the constructive officers in the several arsenals. To those who desire an acquaintance with the details of mercantile shipbuilding the volumes will be of but little service. Here and there reference is made to the rules of Lloyds' Register and the Bureau Veritas; but to collect the scattered grains of information relating to such details as concern the private shipbuilder, it would be necessary to toil through an enormous quantity of, to him, comparatively uninstructive reading. It could scarcely be expected that a professor engaged in the instruction of Government pupils at a national arsenal should be in a position to write usefully upon the construction of ships intended for commerce. This has more than once been exemplified in the shipbuilding literature of our own language. The examination papers which are set to the students of naval architecture at our science classes every year show unmistakable evidence of their origin at the Admiralty office. It is much to be regretted that this should be the case; and remembering how small a proportion is borne by the warship tonnage, built every year, to the tonnage of new merchant shipping, the attention usually given to the latter, both in text books and examination papers, appears wholly inadequate.

M. Hauser's description of the methods and processes of shipbuilding adopted at the French dockyards points to a degree of elaboration and nicety excelling even that of our own Government establishments. He is careful, however, to state that the private shipbuilders of France do not usually pursue the same laborious and, certainly, unprofitable courses. The amount of pains expended upon iron and steel shipbuilding very often varies in the inverse ratio of the workman's experience and skill; for a man who is constantly performing the same kind of task is able to dispense with many precautions which are indispensable to the success of his less practised competitor. Extreme division of labour is one of the chief causes which lead to the rapid and economical production of ships in our private shipyards; and many of the methods explained in the work before us are unknown in the Clyde and in the North of England, simply because the necessity for them has never been experienced. Even with all the care that appears to be exercised in the French dockyards, they meet with a greater proportion of failures than would be tolerated in this country. The author at one place counsels the ordering of a greater number of beams than are required for an iron ship in order to provide for those which are spoilt in forging their knees; and when describing the success experienced in the use of mild steel, he points to the failure at the shipyard of only fifteen tons out of 3190 as a satisfactory result. Mr. Ward, of Messrs. Denny and Co., at Dumbarton, informed the Institution of Naval Architects last year that of 48,000 tons of mild steel wrought upon their premises, consisting of about 350,000 pieces, only twelve pieces had failed, and that his firm had often lost more than four times that amount in a single iron vessel. M. Hauser claims that the iron and steel shipbuilding of France will stand comparison with that of this country in regard to quality, although not in respect to quantity. But upon looking over what he has to say about rivetting, which is so important an item in iron and steel ship construction, we are not disposed to concede that claim. It seems that zigzag rivetting is still adopted for the bottom plating in French dockyards, both in the laps and butts; and M. Hauser sees an advantage in one of the lap rivets passing through the line of the butt—which is scarcely avoidable with this system—inasmuch as it serves as a stop-water thereat. A butt that requires a stop-water at each extremity should not be permitted in the bottom plating of a vessel, and the attitude assumed by Lloyds' Committee towards the zigzag arrangement of rivetting is a sufficient condemnation of that system.

Upon several other particulars we fail to agree with M. Hauser's teachings on practical shipbuilding; as, for instance, in regard to his approval of horizontal watertight doors, which, as is well known, were largely contributory to the loss of the Oregon. Had vertical doors been fitted to the bunker bulkheads of that vessel they could not have been jammed by a few pieces of coal; and even if not completely closed, they would have been sufficiently so to have effectually kept the machinery space free from large quantities of water. But, on the whole, the portion of the work devoted to practical shipbuilding in iron and steel is both sound and instructive. The chapter on rivetting is particularly valuable, and most exhaustive; but we gather from it that there is a much greater variety of practice in France than in this country in regard to the sizes and spacing of rivets. Even each arsenal is a law to itself in this particular. M. Hauser very properly advocates the use of machine rivetting, wherever it is practicable to do so; but, judging by what he says of the frequency with which he meets with malformed rivet-heads, we conclude that in this particular, too, British workmen have an advantage over their Gallic fellow-craftsmen.

No portion of M. Hauser's work is more interesting than that in which he details the history of the steel question, and explains the chemistry of mild steel. His work is, however, incomplete, insomuch as he has omitted to record the valuable experimental results attained in this country or any equivalent for them. No treatise upon the use of steel in shipbuilding is educationally complete which omits the investigations made since 1875 by the British Admiralty and Lloyds' Register of Shipping. The longitudinal system of framing war ships is described in all its many varieties, and it is to be regretted that the author has not provided equally valuable and complete data respecting the cellular system of framing merchant ships. The description of merchant ship ballast-tank construction is similarly incomplete and unsatisfactory. Upon the subject of launching M. Hauser is a most explicit authority. We are not aware that so much upon that subject has ever been written before. Many modes of launching are described, some of which seem to be peculiar to French shipbuilders. At all events, the launching of a ship appears to be looked upon as a much more formidable task in that country than in this. Failures do sometimes occur in launching British-built ships, but they are extremely rare. It is comforting to find that even in France the same troubles are at times experienced. M. Hauser very properly looks upon the calculation of stability in the launching condition as a prudent, and indeed necessary, preliminary condition for a safe and satisfactory launch of a ship.

Regarding what is written in this book upon docks, basins, patent slips, anchors, chains, cabin and hold fittings, pumping, flooding, drainage, sail-making and rigging, we do not purpose making any comment except that much of it appears to be of an antiquated character, while a great deal is undoubtedly up to date. It surprises us, however, to see so much space devoted to the construction of wooden masts and spars, while so little is said about masts, yards and bowsprits made of iron and steel. One rarely or never sees such thing as a large mast or yard being made of wood in this country now-a-days, but the construction which is with us an every day occurrence finds scarcely any treatment in this large work. It is quite possible that, as in England, the Royal dockyards of France are behind the merchant builders in many respects, and that this is one instance of the kind.

In a work prepared by a sub-director of a Government school of naval architecture we may reasonably expect to find a great deal about armour-clads, guns, torpedoes, cruisers, and the like. It is so in this instance. The text and illustrations referring to purely warlike material are most copious and instructive. The work will doubtless be carefully studied at Whitehall, and we commend the attention of their lordships to the following sentences which occur on the last page of M. Hauser's book. "C'est donc plutôt sur mer, que par l'attaque de ses ports, que l'on cherchera à frapper l'adversaire dans sa richesse, dans ses ressources vitales: des croiseurs, plus rapides que les paquebots, doivent poursuivre sans relâche le pavillon ennemi. C'est surtout avec eux que l'on pourra conserver pour son usage, en les interdisant aux autres, les grandes routes de l'Ocean."

Exterior Ballistics. By JAMES M. INGALLS, Capt. 1st Artillery, U.S. Army. New York: D. Van Nostrand.

WE do not pretend to have done justice to this book. It calls for months of study, and the application of high mathematics. We can now, however, state that those who devote themselves to this branch of work speak most highly of this book. Professors Bashforth and Greenhill both have expressed strong opinions in its favour. The work is done in a good shape, and is rather in advance of any hitherto published; the method of Siacci in which the (A) function of altitude is employed, being embodied for the first time in a work in the English language. The writer appears to have largely employed the data supplied by Mayevski and Russian authorities, although Niven, Greenhill, and Flogel and Krupp are fully quoted. Major Mackinlay has reviewed this work favourably in the "Proceedings of the Royal Artillery Institution." We are almost tempted to hope that the number of American artillery officers who read it easily is very limited, as we fear that the mathematical standard is higher than in our own service.

WATER-RAISING MACHINES.

AN interesting experiment has lately been made in Messrs. Cail's workshops. The trial was of an apparatus, the outcome of a laboratory machine, a description of which was given in 1882 at the Académie des Sciences, and more recently at the Société de Physique. The elevation of water has for a long time been effected by rotary machines. They all consist of a fixed case, in which winged discs raise water by centrifugal force. The height attained by these machines is at the most 30 metres. Messrs. Gwynne and M. L. D. Girard have each successively invented machines. That of the latter has attained a water elevation of 40 metres. M. F. de Romilly has since obtained by his laboratory machine a water elevation of 200 metres. This machine, of very simple construction, is formed on different principles from the others. It is the outer casing which revolves, and in this cylinder a fixed tube bearing an especial ajutage or nozzle, Fig. 1, plunges into the circulating water. The turbine being set in rotation, the liquid under the action of the centrifugal force forms a ring clinging to the interior wall, just as the milk does in a cream separator. The tube T presents its orifice to the current, and thus receives the water as it whirls within its circle. The water rises in this tube to a height corresponding to its speed. It is seen by this that the height to be attained is only limited by the speed.

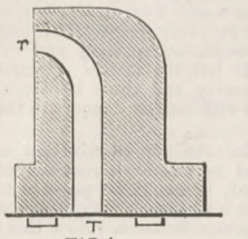
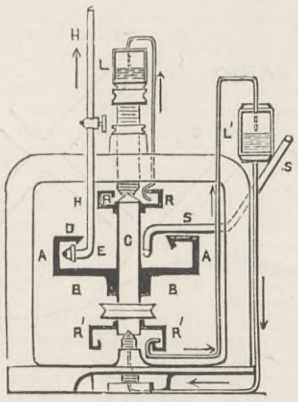


FIG I

Several circumstances may present themselves in practice. The turbine may be placed on the level at which the water enters, its only work being to throw it to a determined height. This is the most simple case. If the water runs in above the level of the rotating case, the fall of water can be utilised to increase the ascending force, or the water level may be below that of the turbine and necessitate suction, as will be seen further on. One of the most important parts in a machine of this kind is the lubricating apparatus. This has led the inventor to a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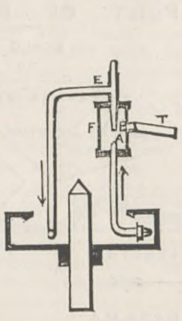


FIG.3

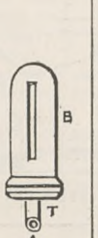


FIG4

particular arrangement, as shown in Figs. 2 and 3. A good result has been obtained by employing two small turbines R R placed upon the axis itself which it has to lubricate, each enclosing one of the points of the axis and the hollow fixed screw. They work like the large turbine. The oil is conducted from the small turbine into the hollow screw by a small tube, from thence to the extremity of the axis, which, by its rotation, throws it into the small turbine, from whence it returns to the hollow screw in increasing circulation. A sight feed lubricator is inserted into the tube L L, that the passage of the oil may be seen. These small turbines turn in a contrary direction to one another, whatever may be the plane in which the large turbine revolves—Fig. 2. The inventor has, besides, invented two suction apparatus. The first is formed on the following principle:—If a jet of liquid be

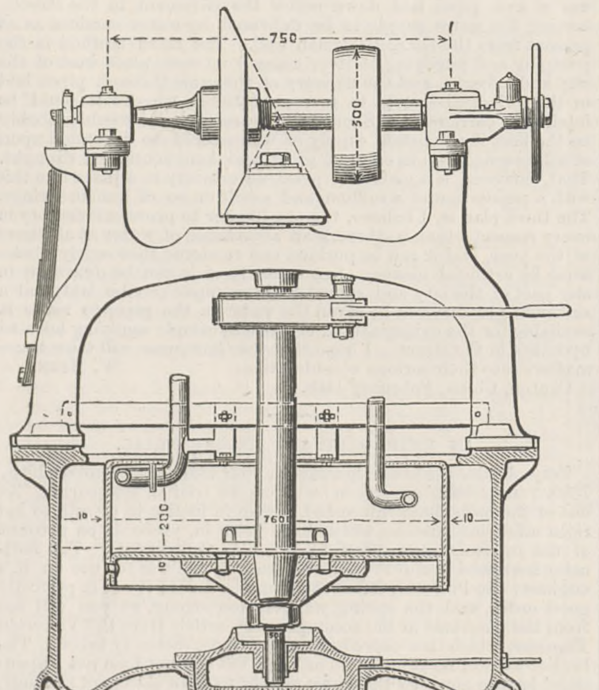


FIG 5

made to fall upon a surface of the same liquid in repose, the air is drawn into its depth in numerous bubbles, which afterwards rise to the surface; but if the level can be placed above the jet, the bubbles, once produced, coming from below, cannot return to their original level.

If a liquid jet be drawn into the tube A, the air or the gas which surrounds it will be separated from it in the chamber F—Fig. 3—which is interposed between the supply tube E and the driving tube A, and into which the tube T penetrates, communicating with the emptying recipient. The liquid which is then made use of, returns to the turbine and repasses into the tube A indefinitely, carrying with it fresh air or gas bubbles. With this arrangement the exhaustion can be done with mercury. At 700 mm. of mercury it can be carried off in eight minutes into a receptacle of 5 hectolitres. By the second method the same pneumatic results can be obtained by employing a suction tube called a "spirelle"—Fig. 4—which plunges into the water, and is provided with a slot running in the direction of the circle; one of the edges of this slot should be $\frac{1}{10}$ mm. lower than the other. The other end of the tube communicates with the emptying receptacle.

There is one objection to the use of this machine, which *Le Genie Civil* calls a pneumatic machine, and that is the necessity of largely increasing the volume of the jet in order to have a greater periphery for carrying off the gas. The single jet has therefore been replaced by a series of small circular orifices, to the whole of which the same circumference must be given. To find out what number of orifices are equal to a given section, they proceed as follows:—

R, the exterior circumference of the annular channel or groove;
a, breadth of the channel;
r, circumference of the small orifices;
n, their numbers;

We get—
$$R = n\,r,$$
$$\pi R^2 - \pi (R - a)^2 = n \pi r^2,$$
Thus—
$$2 R a - a^2 = n r^2.$$
Dividing by the first equation, we get—
$$2a - \frac{a^2}{R} = r;$$
a^2 being very small, may be dispensed with, $\frac{a\,r}{R}$, and finally obtain
$$r = 2a$$
then
$$n = \frac{R}{2a}.$$
For a machine of 10-horse power 2400 orifices would

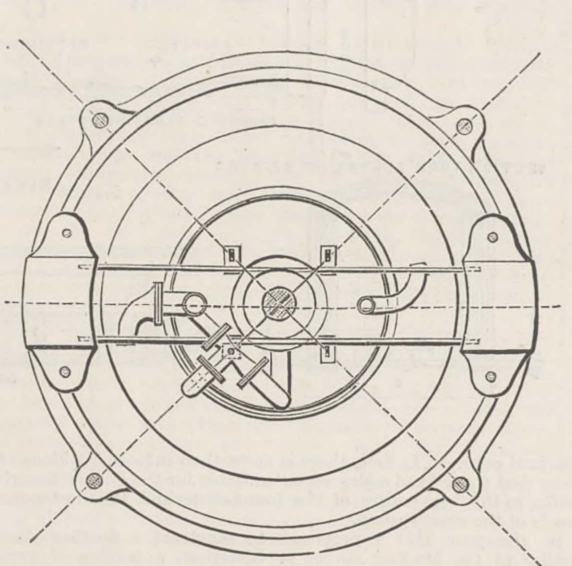


FIG.5A

be required, an impracticable number. A more practical solution will have to be found, but meanwhile the apparatus working as a pump gives very satisfactory results.

In the apparatus which has been constructed and tried, the design of which is given in Figs. 5 and 5A, very satisfactory results have been obtained in dealing with small volumes of water; what its capabilities might be under further experiments are yet to be determined. The most important organ of the apparatus is the ajutage at the end of the raising tube A.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Chinese native cloth at Pakhoi.—Pakhoi is the port of import of a district lying just within the tropics—a district neither populous nor rich—in which the common people are but imperfectly acquainted with European manufactures, and their costume consists almost universally of cotton cloth. This cloth may be divided into three kinds—foreign cloth, such as grey shirtings and tea cloths; homespuns of Indian yarn; homespuns of imported Indian or Chinese raw cotton. The consular report contains description and prices of the various kinds of native cotton cloth in use in this district. Eight samples accompanying have been sent to the Manchester Chamber of Commerce. The conclusion states that Chinese dyeing makes a wonderful difference in the closeness of the texture and the length of the material. The undyed stuffs contain no China clay, plaster of Paris, and such like abominations. Manchester goods, to take their proper place in this as in other markets in China, must be honest stuffs, such as Chinese peasants can wear and wash for years.

Italy: Customs duties.—The following decisions, affecting the classification of various articles which have been the subject of disputes, have recently been given by the Italian Customs authorities:—Copper plates, perforated for bottom and sides of ships, Category xii., No. 186*b*, 4s. 0¾d. per cwt. Fittings of carriages of iron, cast or nickeled, Category xvi., No. 297*a*, £1 4s. 0½d. per cwt. Iron articles having the appearance of tubes, but not being actually tubes, Category xii., No. 181*a b*, 4s. 9½d. per cwt. Iron locks, not polished, Category xii., No. 181*a b*, 4s. 9½d. per cwt.; if ornamented with other metal, 5s. 8¼d. per cwt. Iron in the form of rails not intended for railings, but for the construction of machines for weighing railway wagons, the iron having been subjected after rolling to a special process at the ends, Category xii., No. 181*a*, 4s. 9½d. per cwt. Iron rods which after having been rolled are bent in the form of a circle, Category xii., No. 181*a*, 4s. 9½d. per cwt. Mowing machines, Category xii., No. 198*c*, 2s. 5¼d. per cwt. Weighing machines, composed chiefly of wood, Category xii., No. 198*c*, 2s. 5¼d. per cwt.

Russia: Industries and manufactures.—Russia has been for too long looked upon as a purely agricultural country, and after having suffered severely from competition with America and Australia, has had to consider other means of utilising her natural resources. The industries of Russia have made enormous progress lately. There has been a steady decrease in the importation of manufactured products, caused partly by the heavy import duties now charged, but also to a great extent by the increased ability of the home manufacturer to supply goods of a satisfactory quality, especially in the cotton industry, whether as regards cheapness, originality of design, or quantity. The British Consul-General in Persia has reported that Russian interests are threatening to drive English goods out of the Persian market; but this is partly due to the fact that English manufacturers think it sufficient to send a very poor class of goods to that country.—These optimist views of Russian industry should be compared with those contained in the report on Russian trade for the year 1885, in page 123 of THE ENGINEER for 18th February, 1887, which states that the manufacturing districts of Russia, instead of developing, are suffering from great depression, and the manufacturers are calling for protection against the internal competition of Poland.—Metallurgic industry is represented in Russia by 143 establishments for casting metals, employing annually 4036 workmen, and producing goods worth £242,000. There are 41 manufactories for rails, employing 11,500 operatives, and turning out a value of £1,589,700; 261 manufactories of machinery, employing 41,300 men, and producing goods valued at nearly £4,000,000; 61 nail and wire factories, employing 3754 hands, and producing goods of the value of £879,200; 254 manufactories of various articles in metal, employing 11,500 hands, the annual produce amounting to over £750,000; 182 factories for bronze and copper articles, employing 5820 workmen, with a production of £713,300; 33 bell foundries, with a production worth £115,000; and 47 establishments for gold and silversmiths' work, employing 1364 workmen, with an estimated annual production of £216,300. The value of the product of metallurgical industry has gradually fallen from £5,029,100 in 1882 to £4,971,100 in 1883, and to £4,606,000 in 1884, diminutions of 1·2 and 8·4 per cent. The report contains details similar to the above respecting the other industries of Russia. The total product of the various industries of European Russia in 1884 may be stated as having been worth £152,145,300 from 33,815 manufactories, employing 932,094 workmen. Compared with 1879, the number of manufactories has decreased by 959, or 93 per cent., whereas the value of the production has increased £23,109,100, and the number of workmen employed 71,065.

France.—Steam communication with Brest.—In this part of France all branches of commerce have been during the past year decidedly depressed, almost stagnant, and as a rule unprofitable. Capital has not been forthcoming, speculation has been abandoned, and confidence in the future disturbed, while there is at present no appearance of an early and permanent improvement. The imports at Brest show a decrease of nearly 4 per cent. and the exports of 10 per cent., and with the exception of L'Orient, both exhibit an important diminution at nearly all other ports in the district. Trade between Great Britain and this district cannot fail to be considerably increased by the establishment of direct and frequent steam communication between Brest and a British port. The opening of such steam communication will probably at the commencement be a losing business, but after a time it cannot fail to prove profitable, not only to the shipowner, but to traders in general; for the three departments of this district could after a little time produce large quantities of articles required in England, such as cattle, horses, farm produce, &c. Considerable correspondence with English and Welsh merchants and shipowners has taken place on the subject, and the fullest information and statistics have been furnished them; but none of them have appeared disposed to commence an undertaking not yielding immediate benefit, which cannot be expected here, as the trade will have to be created. British shipping at Brest, as elsewhere in France, continues to labour under peculiar difficulties in consequence of the monopoly enjoyed by shipbrokers. The exorbitant charges made by shipbrokers and sanctioned by the French Government fall almost exclusively on British shipowners, and this is owing to the want of a knowledge of French on the part of the British shipmasters, because, as established by a judgment of the Cour de Cassation, any shipmaster knowing enough French to prepare his ship's manifest and make the necessary declaration at the Custom House in that language is free to dispense with the services of a shipbroker; but while most foreign shipmasters have an elementary knowledge of French sufficient to transact their ship's business at the Custom House, the British shipmaster, as a rule, has no such knowledge. The consequence is, that the foreign shipmaster who wishes to escape the trouble of personally entering or clearing his ship, can make a bargain with one of the shipbrokers and have his business done for a mere trifle, while those shipbrokers invariably decline to make any reduction in their charges to British shipmasters ignorant of the French language.

Holland—Extension of trade with.—The United States Consul at Amsterdam, having asked a Dutch merchant for his opinion as to the best means of extending American trade with Holland, received a lengthy reply dealing with various kinds of goods:—"On the whole, there seems an extensive field here for the American manufacturers, if they would turn out the goods more generally suitable to the taste of the public. Good serviceable tools are too high in price, and can but in few, if any, instances compete against the good and best makes sent from England. The cheaper goods have been found to be so poor that they are hardly any longer saleable. It appears to be a great mistake, if not a folly, for industries to seek to overcome competition by asking lower prices for their products of much inferior quality, as when American manufacturers brought out cast iron axes, hammers, and hatchets, which would fly to pieces as soon as put to any hard use, with the result that the business in these articles soon terminated. As for the rest, American cast iron ware is in most respects superior to any other, and many good models have been copied by English and French artificers, and now find ready markets. It is a mistake that a majority of American houses will only sell for cash against bills of lading. Purchasers on a small scale for the retail trade prefer to let the business alone to paying for the goods before they have a chance of seeing them. A credit of from one to three months, such as your manufacturers and wholesale dealers extend to the home trade, would ensure a large increase of their exports. The establishment of sample exhibitions on a large scale, at the principal centres, would prove very beneficial, and the expense of commercial travellers carrying samples would be saved. Articles intended for the markets here must be of recognised solidity, soundness, and taste, and at such prices and on such terms, &c., as similar goods can be procured elsewhere. Cheap and poor goods must be shunned; our public here, like elsewhere, will pay good prices for good articles. Your manufacturers and merchants in the pursuit of foreign trade should not disdain to realise that there is yet many a thing to be learned from the people of Europe in similar occupations, and that if they would often send young folks over here to perfect themselves in certain industrial pursuits, and become familiar with and learn to appreciate certain of our tastes and wants, the results would be most satisfactory."

Norway—Line of steamers to Newcastle.—The Government has proposed to the Storthing that a subvention of about £2770 per annum should be granted for the maintenance of a periodical steamship service between Bergen and Newcastle, with the object of exporting Norwegian produce. Efforts are being made to induce the Government to divide the subsidy between Bergen and Krageröe, a port about eighty-eight miles S.S.W. of Christiania, with a view to the establishment of a line of Norwegian steamers between that place and Grimsby and Hull.

Russia—Withdrawal of sugar bounties.—Countess M. Branitsky has given orders for the closing of two of her large sugar manufactories; the one at Selivonsky, turning out annually about 40,000 tons; the other at Kojamsky, about 24,000 tons of beetroot. The planters who supplied these works have been informed of this resolution. News has also been received in Kiev, from Smiéla, that Count Bobrinsky intended to close two of his sugar manufactories. Hence we see that, owing to the withdrawal of the bounties and the present crisis in the sugar trade, two of the most solid producers of beetroot sugar are going to cease work.

Sweden—Formation of a General Export Union.—A society called the Swedish General Export Union is being formed, which will endeavour to open commercial relations with foreign markets. It is proposed to appoint commercial agents abroad to distribute catalogues of objects of exportation, and to form exhibitions so as to bring foreign consumers in communication with Swedish manufacturers. With the assistance of the Norwegian and Swedish Consuls abroad, the union will establish in Stockholm an Export Pattern Museum, calculated to bring to the notice of Swedish industrials the kind of articles which find a sale abroad. The support of the Government has been promised to the undertaking.

Switzerland—Appointment of Industrial Secretary.—The Swiss Government have determined to grant an annual subvention towards the salary of a new official, to be nominated by the combined Swiss Industrial Associations, with the title of Industrial Secretary, whose functions will consist in the examination of the social condition of the working-classes, under the supervision of the Federal authority; in the institution of inquiries in all cases where they appear necessary; in the preparation of statistics of wages, and in the examination of questions of insurance—in fact, to act as an agent between the Federal Government and the industrial classes. His duties are to be purely economic and in no way political, neither can he interfere in matters properly appertaining to the Government, nor in the internal administration of the Industrial Associations who are to be entirely unfettered in their selection of the secretary. That official, though placed in communication with the Federal Department of Commerce, will not be in any respect under its orders. The Government at the same time reserve the right to make such modifications in this institution as experience may suggest to be desirable.

LETTERS TO THE EDITOR.

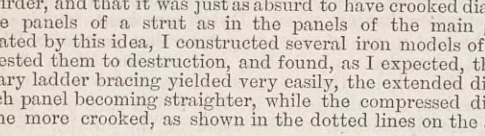
[*We do not hold ourselves responsible for the opinions of our Correspondents.*]

THE RIACHUELO BRIDGE.

SIR,—Several queries as to the above bridge, illustrated by you in October last, having received attention, I venture to submit a few remarks which appear to me to be of interest, in the hope of receiving the same courteous treatment that other correspondents have been accorded.

(1) I note a remarkable resemblance between this bridge and recent American practice. In fact, I should designate it an American bridge Anglicised. It is American in outline and general arrangement of parts, but agrees with English practice in the ratio of the depth to the span, and in having rivetted instead of pin joints. I have before me particulars of an American bridge of nearly the same span—264ft.—which carries a double line of railway, and which has girders 45ft. deep, nearly twice the depth at the Riachuelo. An approximate calculation that I have made leads to the conclusion that had the Riachuelo girders been made 40ft. to 45ft. deep, they would have required for equal strength 20 per cent. less material. Now, my first query is, What countervailing advantage is there to justify this reduction in depth, and consequent excess of material necessary to secure equal strength?

(2) I notice in the side elevation given on October 29th, p. 344, that the vertical members are stiffened with what is known as "ladder bracing." This form of bracing is very common in Australia, but I confess I never liked it. It appeared to me that as the function of this bracing was to keep the column from bending, it should be designed on the same lines as the web members of a girder, and that it was just as absurd to have crooked diagonals in the panels of a strut as in the panels of the main girder. Animated by this idea, I constructed several iron models of struts and tested them to destruction, and found, as I expected, that the ordinary ladder bracing yielded very easily, the extended diagonal of each panel becoming straighter, while the compressed diagonal became more crooked, as shown in the dotted lines on the accompanying diagram.



By inserting a single straight diagonal—instead of two crooked ones—in each panel, these diagonals running from *a* to *b*, *b* to *c*, *c* to *d*, and *d* to *e*, I found that with rather less metal and decidedly simpler and easier construction I obtained fully 25 per cent. more resistance to longitudinal compression. In view of these results, I should like to inquire whether this form of bracing possesses any practical advantage to compensate for its deficiency in point of strength.

(3) The compression members of the web, including the great terminal compression diagonal, are braced in a plane transverse to the length of the bridge by a series of plates with alternating gaps. Now, I must say that this seems to me precisely analogous to constructing an ordinary plate girder with every alternate plate of the web left out. Would it not have been just as cheap to extend the bracing plate from end to end of the member, or, if it be preferred, insert a properly arranged system of latticing such as has been adopted for the transverse distance pieces connecting the two top booms?

The preceding are my principal difficulties in connection with the Riachuelo Bridge, and I should be very glad to know whether the points I mention have been considered by the designers, and whether there are any valid arguments in favour of the features that appear to me objectionable.

W. C. KERNOT, M.A.,
Professor of Engineering, University of Melbourne.

January 27th.

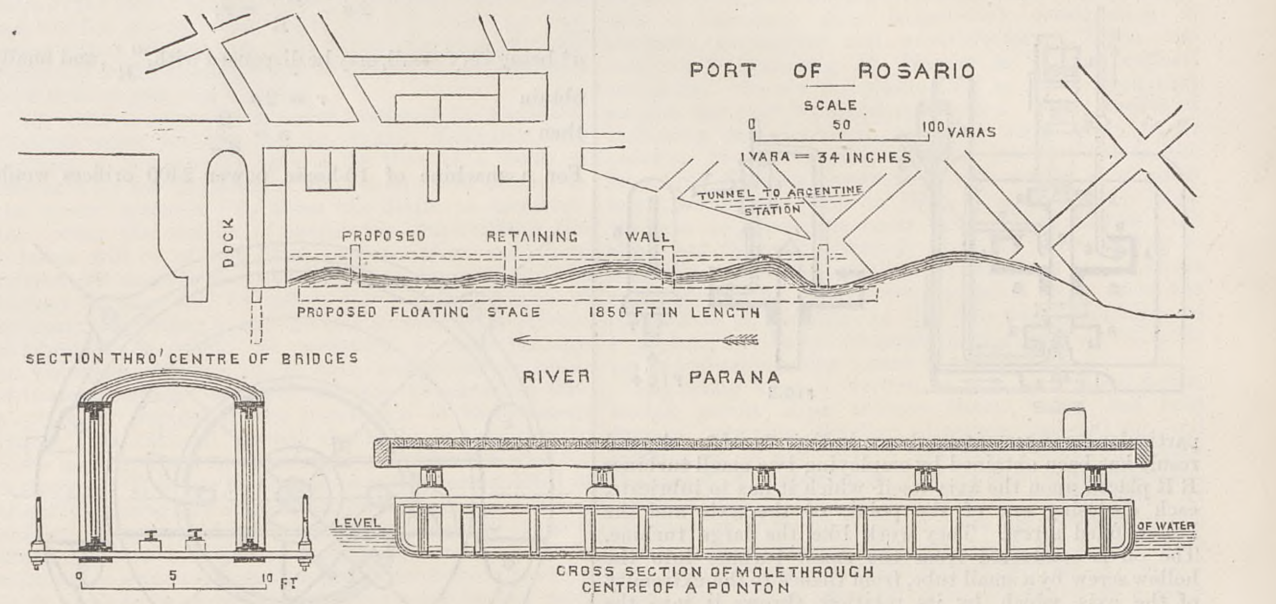
[It will be seen that Professor Kernot's letter is not on the same question as that upon which we closed the correspondence on the 4th ult. With respect to ladder bracing for struts, it may be questioned whether one system is not as good as the other, for the stresses to which such bracing is exposed are in practice never great enough to call upon it to prevent large deformation of struts.—ED. E.]

PORT OF ROSARIO DE SANTA FE.

SIR,—The following paragraph appears in the *Reporter* of Rosario, dated the 20th inst:—

"The collapse of the heavy woodwork of the new mole that is being constructed by the railway, near the goods sheds at the Central Station, on Wednesday, has been the topic in railway and maritime circles here ever since. The foundations were made apparently strong enough to stand for generations, and yet, as it seems they had been reared upon quicksands, they suddenly gave way all of a heap, and could not have made a more successful wreck had the sinking been the work of an earthquake. If we are to look on the bright side of such a catastrophe we can only congratulate all concerned that the collapse took place when it did, instead of a few months hence, when the new mole would doubtless be covered with men and goods."

This is not the first accident of a similar nature that has happened to the moles of the Central Argentine Railway; some years ago an iron mole constructed by the company met with a somewhat similar fate. A mole constructed by Mr. Casado, the chief owner of the Western of Santa Fé Railway, suddenly disappeared in a similar manner. Two moles belonging to the late Mr. Castellanos, the founder of the first colony in the Province of Sante Fé, were similarly destroyed, and two remaining moles constructed by the same gentleman have only been maintained at a considerable and constant outlay. In fact, there is more than sufficient evidence to show that these fixed moles are not suitable for the Port of Rosario, owing to the false nature of the foundations and the destructive floods of the river Parana.



In the year 1871 I proposed to construct a floating stage, similar to the landing stages at Liverpool, a tracing of which is enclosed. The plan is too limited to show the positions of the Central Argentine or Mr. Casado's moles; the former is a little higher up and the latter lower down the river, in front of the respective railway stations. The captain of the port highly approved of the project, inasmuch as the stage would be immediately in front of the centre of the town and property belonging to the National Government Custom House, &c., and could also be connected with the railway station by train or rail. As, however, I had not sufficient influence, and the project apparently clashed with the interests of the Central Argentine Railway, it was not proceeded with.

As the Central Argentine Company is now constructing a tunnel to connect its station with the port, it would evidently be advantageous to have an efficient landing stage that would cost less, and, judging from past experiences, be more durable than the fixed moles now being constructed. I may further add that I proposed to secure the land ends of the bridges of the floating stage on iron cylinders similar to those fixed in the year 1854 to carry the southern railway bridge across the Riachuelo, and now also being erected to carry the new Ensenada Railway bridge across the same stream, of which illustrations have recently been published. The simple construction of the bridges to connect the stage with the shore, as shown in the cross section, I copied from a bridge that was built years ago near Wellingborough, to carry the Midland Railway over the Peterborough branch of the London and North-Western Railway.

JAMES HADDOCK.

Buenos Ayres, January 23rd.

P.S.—As you appear to take an interest in engineering matters in this part of the world, I send you particulars of the tenders sent in for the construction of the syphon to convey the sewage from Buenos Ayres across the Riachuelo, excluding names and odd dollars and cents:—First tender, 642,300 dols.; second tender, 287,900 dols.; third tender, 289,700 dols.; fourth tender, 427,700 dols. The contract has been let for 300,000 dols., being considerably above the engineer's estimate.

WATER SUPPLY IN CANTON.

SIR,—We have quite recently had a revival of the question of water supply for this large city, but it has ended like the first time in nothing being done. The water supply available at present is scanty in quantity and vile in quality. It is neither fit to drink or wash in. It is hard and of a rusty-looking colour, and imparts that colour to everything that it touches, as effectual as if it was a permanent dye. People who are obliged to drink it become subject to a most unpleasant skin disease which looks like common itch, but which is not so easily cured, and constantly re-appears in some part of the body. There is a small supply of clear-looking water available at times which is said to be good, but is not so in reality. It is obtained from various small springs at the foot of the White Cloud Mountains. As these mountains are covered with graves and are simply an extensive burial ground, especially on this the southern side, it is evident that the water derived from springs at its foot cannot possibly be very good. Having percolated through the graves of the dead before reaching the springs it is natural to suppose it to have acquired some unpleasant properties not at all calculated to increase the healthiness of the population which has nothing better to drink.

The river water again is also exceedingly unsatisfactory in various ways. Flowing as it does through many large and populous towns, it receives various animal, vegetable, and mineral elements of a contaminating nature, not at all pleasant to think of, before it reaches the homes of those who have to use it. It is, however, the most reliable source of supply, and if properly treated by filtration, and thoroughly purified according to the most approved modern scientific methods, would undoubtedly prove satisfactory to this immense population, whose greatest desire is to have an abundance of good water at reasonable rates. Unfortunately for the majority of the population, they are enslaved by the caprices of a few of the most influential residents, who, instead of being in the van of all necessary and reasonable progressive measures, are in reality the only obstacles to every kind of reform—I mean the notables, or gentry of Canton.

The Viceroy had no real objection to the erection or establishment of properly organised works for the supply of good water to the population of Canton, providing the works were undertaken in a manner likely to prove satisfactory in every respect, without entailing any expense on the Government, nor placing any unnecessary burdens on the people. He left the matter of water supply to the decision of the local gentry, and these have condemned the proposals as being fraught with serious dangers to the lives of the inhabitants.

The gentry have urged as a plea for the non-introduction of waterworks in Canton, the stupid, and very childish reason, that with a water supply as that proposed, it would be possible to poison the whole of the population, as it is without any means of averting such a calamity in case of foreign invasion. Now this I think proves to be a sign of a guilty conscience amongst the gentry. It is well known that they once tried to poison the whole foreign population, as well as the garrison of Hong Kong, by introducing arsenic in the whole of the bread supply. A great deal of the former supposed unhealthiness of Chusan and Hong Kong may also be due to attempts at poisoning the water and food of all foreigners, but it is nevertheless a fact that those attempts failed in their principal object, that is, to destroy foreigners—wholesale as it were. No foreign invader would be so foolish and unnatural as to attempt the wholesale destruction of an immense population like that of Canton, by poison or otherwise; and if it were attempted, there are means available for frustrating such schemes. It is no doubt high time the modern schoolmaster were abroad in Canton to enlighten the gentry.

There are three plans available for the water supply of this immense community or population. The first is a system of reservoirs in the White Cloud Mountains or neighbourhood for the retention of rain-water and the storing of it in the wet season to last out during the dry season. The second method is the boring of several artesian wells in various parts of the city and suburbs, the which can easily be done at a reasonable cost, and without the use of iron pipes laid down under the pavement in the streets, leaving the water supply to be delivered by water carriers as at present from the nearest artesian well. The third method is the pumping and purifying of river water from some place west of the city and suburbs, and the delivery of the same through pipes laid in the principal streets to several stations, whence it could be fetched by carriers, as at Shanghai. The second plan would probably be the best if a constant supply of water could be depended upon at all seasons, even in cases of great and long continued drought. That, however, is a matter of great uncertainty in a place like this with a population of a million and a-half or so of human beings. The third plan is, I believe, the one likelier to prove satisfactory in every respect—that is, there is an abundance of water at all times of the year, and it can be purified and rendered thoroughly wholesome by artificial means. Any quantity of it can be delivered in any part of the city and suburbs where pipes can be laid, and a sufficient pressure can be given the water in the pipes to make it available for the extinguishing of fires by simply applying hose to hydrants in the street. I hope that the Cantonese will take these matters into their serious consideration.

W. MESNY.

Canton, China, February 14th.

AN EXTRAORDINARY ENGINE TRIAL.

SIR,—Under the above heading in your issue of December 10th, 1886, you publish an article on an engine trial at Melbourne. As one of the individuals interested, I wish in justice to myself to set right a few inaccuracies which have crept in, probably on account of the information supplied to you being incomplete. The indicator borrowed from Professor Kernot by me was for use on B.'s engines; the Professor did not send me to use it; it was in perfectly good order, and the spring was not too strong, as you will see from the diagrams in the accompanying article from the Victorian *Engineer*, which are reproductions of those actually taken. The brakes were of no value at all as tests, but for that I am not responsible, having gone to the show merely to take charge of the indicator in use on B.'s engines. When the stewards and judges discovered that A. had omitted to provide an indicator—he had one, I believe, but had broken the spring—they requested me to attach the one I had to his engine, and much against my will I did so, having with the instrument by chance a coupling that would connect it with A.'s cylinders. The speed of B.'s engine may have been reduced from 180 revolutions to 120, but of that I know nothing. The only record of the speed was taken by the judges, who made it 170 revolutions. The decimals in the report refer to minutes, as you supposed. I fail to see anything monstrous in such an arrangement, although the usual method may be to calculate it in horse-power per hour. There was no provision made for separating the fuel used for getting up steam from that used in running the engines, and they were only run for half an hour. The fuel was wood, as no other was allowed on the ground. Naturally the trial was a failure, as far as a comparison of pounds of fuel per horse-power was concerned, but if it were sufficient to compare the quantity used for getting up steam and running the engines for half an hour, then it was a success, as this was conscientiously done, and the only part that the indicator played was to compare the power of the engines. As to the value of any trials of this sort there is little question. In country places here, where portable engines are most used, fuel is plentiful and can be had for nothing, and an engine that burns a fraction of a pound per horse-power per hour less than another has no special advantage; but an engine which is simple, has its working parts easily replaced, is strong, and costs less to purchase and maintain, has many advantages over another. As to the judges, they are quite able to defend themselves, and could no doubt explain their reasons for the course they took. You may add "scandalous" to your description of the correspondence in the Melbourne papers, if you please. My only part in it was to defend myself from a personal attack; but I do not see how it affects the reputation of colonial engineers as a body, for, as far as I am aware, I am the only colonial engineer that took any part in it. The society concerned was the National Agricultural Society of Victoria—not of Australia. The latter I do not recollect having heard of before. JAMES B. LEWIS.

Prince's Bridge Works, Melbourne.

THE WESTINGHOUSE BRAKE.

SIR,—Although Mr. Marshall's paper on "Railway Brakes," read before the Society of Arts, is hardly worthy to be noticed on account of its great number of absurd statements, and its utter neglect of practical considerations, still the chief point developed in his paper is so totally erroneous that I think it only right to refer to it for the benefit of those who are not so well acquainted with brakes, and who would perhaps be liable to jump at conclusions.

The point to which I wish to refer is Mr. Marshall's description of the action of the triple valve of the Westinghouse brake, which he characterises as necessarily imaginary and theoretical. In other words, Mr. Marshall contends that the Westinghouse brake cannot be regulated in practice. Now I have had this brake, amongst others, under my supervision for some years, and during that time have conducted many experiments both alone and conjointly with Government officials on Continental railways; the results of these experiments, as well as the thorough tests in daily working, have convinced me, and lead me to say that the Westinghouse brake, by virtue of the triple valve, is capable of being applied to all degrees of intensity at the will of the person controlling the brake valve. I have for hours watched the working of the brake on a stopping train by means of pressure gauges attached to brake cylinder reservoir, and train pipe, and by a repeating triple valve moving conjointly with the one working the brake on the experimental coach, cut in section to show its movements; and it was thereby proved that, in ordinary station stops and slows, and when running down long and steep—2 per cent.—inclines, the brake was being applied, just as the driver wished, either very lightly or with full power, and to any degree between. This is not an idle, speculative assertion, nor one based on theory, but it is the performance of a mechanical contrivance which I have over and over again seen myself, and it can be seen by anyone who wishes to become clear on the subject. I have known most experienced engineers who formerly were hostile to this form of brake, say, after this ocular demonstration, "how well it—the triple valve—works" and "how well it regulates."

My experience has been extended to the working of this brake on some of the most interesting lines of Europe, lines which abound in long and steep inclines; and I have not only had the opportunity of observing, but also of working trains fitted with the Westinghouse brake running over these roads. I have never found the brake power got exhausted, as Mr. Marshall assumes. If he were intimately acquainted with the working of the Westinghouse brake he would know—his experience would teach him—that before the brakes are wholly released the reservoirs are by means of the triple valve recharged; and that therefore there is not the slightest objection to take the brake off occasionally, should this be found necessary. There is, however, a wide difference between taking off the brake occasionally and a manipulation as described by Mr. Marshall which is theoretically just as absurd as it is practically wrong. JOHN PLACE.

London, March 22nd.

[Mr. Place slays the slain. It is quite certain that the action of the Westinghouse brake can be regulated with perfect ease and certainty. Such regulation takes place, for example, thousands of times daily on the Metropolitan lines of the Brighton Company's system. Mr. Marshall must get hold of facts before he can express valuable opinions.—ED. E.]

THE INSTITUTION OF MECHANICAL ENGINEERS AND THE PATENT-OFFICE.

SIR,—In the recent report of the Board of Trade Committee on the Patent-office, I see that a certain member of the Council gave evidence as representing the Institution of Mechanical Engineers. The following is an extract of the evidence stated in the report to have been given by the gentleman in question:—"I can speak with all praise of the very pleasant, thoroughly business-like way in which assistance is given to those who prefer to take out their own patents; and I think it only due to the office that it should come as from the Institution of Mechanical Engineers that this has given general satisfaction to patentees and inventors if not to patent agents."

As a member of the Institution, I think this is a matter that demands some explanation. Unless I am mistaken, when a number of members some years ago desired to have some action taken *re* Patent Law, the Council did not accede to the request, because, as was understood, they were advised that it was not within the province of the Institution, notwithstanding that not long previously meetings had been held and resolutions adopted on Patent Law.

If I am right, as I believe I am, how did the Council get over the difficulty in regard to the action taken recently before the Board of Trade Committee? In the next place, I would like to know how many of the Council were present when the member above referred to was authorised to appear and make the representations he is reported to have made to the Committee? So far as I can remember, no general meeting of the members of the Institution was called to consider the matter. Therefore I fail to see how the member of the Council who appeared before the Board of Trade Committee can be said to have represented the Institution, even though he may have represented the views of some members of the Council. Had I received notice of a meeting of the members of the Institution, I for one should certainly not have voted in favour of any such statements as were made before the Committee, because I consider the attempts to induce inventors to apply for their own patents have been in the highest degree mischievous, disastrous to patentees, and most inconvenient to the public; and the evidence of the Comptroller and Deputy-Comptroller of the Patent-office tends to confirm this view. I believe the member of the Council to whose evidence I have referred is a patentee, though whether he employs a patent agent or not I do not know. For my own part, although my education and experience have been such as to qualify me quite as well as most engineers are qualified to take out my own patents, yet notwithstanding the experience I have had as a patentee—and a not altogether unsuccessful one—I have always abstained from trying so dangerous an experiment. I have usually found that educated inventors have realised the advantages to be derived from the assistance of an experienced adviser, who, being constantly occupied in dealing with inventions and patents, must necessarily know many things that even the well-educated patentee will not have had the opportunity of learning. Undoubtedly, every inventor who prefers to take out his own patents is entitled to do so, just as every man is entitled to make his own will or to draw up the conveyance of his own house or other property. But as I understand the matter, it was more especially for inventors of the poorer class that the law was altered, with a view of enabling professional services to be dispensed with, and, regarded in this light, it seems to me perfectly clear that, on the admission of the authorities themselves, and on the face of the report of the Board of Trade Committee, the attempt has been, as might have been expected, unsuccessful. Therefore, surely it is only honest to warn unwary inventors, especially those of the poorer and less educated classes, that except by obtaining the assistance of persons specially conversant with patent matters, they run serious risk of losing their inventions and their money in their attempts to obtain patents.

There have been many cases in which an invention has been disclosed under the new law, but in which its essential features have not been adequately claimed. In such a case usually it will be found that no amendment is possible that will make the patent cover the invention properly. I believe I am correct in stating that the Institute of Patent Agents wanted the law altered so that an amended specification might claim anything that was originally described in it, but the Government would only allow an amended specification to claim as much as, or less than, but certainly not more than, it originally claimed. This makes all the difference in the world, as any experienced patentee must well know.

The less a man knows, the more likely is he to prove a ready victim to the idea that it is true economy to save the few pounds he would have to pay for a patent agent's services. Of course there is great danger of his getting into the clutches of some disreputable person. Inventors of the poorer class especially run this risk. But if the roll of patent agents that has been suggested should be established, and due care taken to make it known amongst the working classes how to set about selecting an agent, it is to be hoped this difficulty will be overcome. The specifications that go to prove the utter fallacy of the notion that it is economical to dispense with the services of an agent are unfortunately only too numerous.

In conclusion, then, for the reasons stated, I desire to say that I regret the use that has been made of the name of the Institution of Mechanical Engineers before the Board of Trade Committee. I fear it is calculated to entirely mislead the public as to the opinions of many members who, like myself, neither are, nor ever have been, patent agents, but who have had enough experience to know that the official arrangements at the Patent-office, or any arrangements likely to be made there, are and will be necessarily such as, if trusted to, will end only in disappointment, and probably ruin to many deserving patentees who may be led to imagine that the official examination will ensure the efficiency of their specifications and the validity of their patents.

Adelphi, March 22nd. M. INST. M.E.

RAILWAY ROLLING STOCK.

SIR,—It would be interesting and instructive to know where your correspondent "General Expenses and Profit" gets his facts from.

Well-managed wagon and car builders have made—or I should say paid—5 per cent. dividends, and in some cases much more, for years past. What is the equitable footing your correspondent wants? I maintain, and I think you will agree with me, that if we are to carry out "the survival of the fittest" idea, it would be absurd to throw away the so-called benefits obtained by competition, unless we, at the same time change the whole method of anarchial competitive working for the orderly co-operative method. What is required to be understood is the fact that there is too much capital invested in the manufacturing of rolling stock. Here are the solid facts:—(1) All the large English railway companies now make their own stock. (2) European countries are now closed to us. (3) European countries compete with us. (4) Less railway work requiring rolling stock is now being inaugurated.

Taking your correspondent's letter as showing the correct facts of the case, the best question for "General Expenses and Profit" to put is whether the capital invested for profit had not better be withdrawn from a failing trade, and whether the profits, about which he is so much concerned, are possible only because the possessors of capital take advantage of buyers'—railways and others—and producers'—designers and workers—wants and necessities. If "General Expenses and Profit" desires to form a "corner" in rolling stock he will find it an impossible task. Nothing but a system of universal co-operation can meet the ever increasing national difficulty, which removes the whole subject from the sordid field of mere "profit mongering." FABIAN.

Birmingham, March 17th.

ENGINE DRIVERS' EYESIGHT.

SIR,—In your last issue, under the heading of "Railway Matters," reference is made to the testing of the eyesight of engine drivers. No one could for one moment think of allowing a man to be on an engine who could not distinguish signals, or see for any necessary distance in front of his train. Unfortunately there appears to be no standard test adopted for all railways, and on some lines the test is theoretical, and not practical. In all parts of the country meetings of engine drivers are being held and resolutions passed requesting that they may be subjected to the most careful practical tests—that is, that both by night and by day they shall be taken on the line to see signals at any required distances.

At the present time numbers of men who can see signals and go through a practical test entirely fail to tell the names of certain shades of coloured wool. They are then said to be "colour blind." But in fact this is nothing of the kind; they can see the colour, but are ignorant of the name, and this ignorance causes them to be suspended from duty and reduced to some lower position at a very great loss of wages.

Unfortunately, instances have occurred and been brought to the notice of the Amalgamated Society of Railway Servants, in which the tests have been "unfairly applied," in order to remove certain men from their engines. This naturally has caused a very strong feeling amongst the men who suffer, and it has formed the subject of a resolution by the committee of their Society. Having been requested to reply to the paragraph referred to, I shall be much obliged if any of your correspondents will express their opinions upon what is the proper test for the eyesight of an engine driver.

CLEMENT E. STRETTON,
Consulting Engineer Amalgamated Society of Railway Servants.

40, Saxe Coburg-street, Leicester, March 22nd.

THE VALUE OF SCIENCE TO THE ENGINEER.

SIR,—Permit me to address a few words to your readers on the above question. I have been prompted to write you after reading the interesting articles bearing on the subject in your last two issues. At the outset it is necessary to state that science means nothing more than an orderly knowledge of nature and natural law. Engineering is quite a different thing—it is an art—and is concerned with the question, "How a thing may be done." In other words, science is theory, so long as it is not transformed into the practice of the engineer. The reason that science does not reveal or anticipate the results of experience or practice is owing to the fact that our knowledge of the former is imperfect. Practice is perfect science. Hence the workshop mechanic may often enlighten the learned *savant* in virtue of his more intimate acquaintance with actual nature. The artisan's science is genuine, although, perhaps, somewhat confused. There is all the difference between a professor of physics or pure theoretic science and a professor of practical engineering. It is a remarkable fact that the very men who ought to be able to lead the way—our college engineers—are barren of invention. What is the cause of this deficiency?

I venture to think it is not the presence of their science or mathematics—the more the better—but the absence of other essentials, a want of knowledge of the requirements of the day, and that complete acquaintance with technical science which can only be obtained by a workshop training. Take the greatest inventors of the present century, with few exceptions they have been men combining a knowledge of rule-of-thumb and science, but the latter without the unnecessary refinements of the school-room. Consider such names as Armstrong, Siemens, Whitworth, Bessemer, and a number of others easily nameable.

I was gratified to read your candid criticism of Mr. Holmes's work on "The Steam Engine," the point raised respecting the starting of an engine and De Pambour's theory brings home to us again the old question we discussed some two years ago—Newton's third law, which seems destined to remain an insoluble riddle, at any rate until some light is thrown upon the nature of force. With an engine running with a uniform velocity the power and resistance are manifestly equal; to start on or accelerate the motion from zero to uniformity demands that the power exceeds the resistance by a small residual force. The discovery of the reactive force to this moving residua force is the problem of the "mystic law."

What engineering students require are a few plain books written by practical men—men who would lay before them so much of the science of the art as may be embodied in the first principles. Let Newton's first law be thoroughly explained, and it cannot fail to afford the beginner an unbounded field for inquiry. I shall never forget the first time the true tenour of that statement dawned upon myself. Let us leave the transcendental questions to the universities, the modern practical engineer has no time for such things. STEPHEN EDDY.

Colchester, March 16th.

BURTON-ON-TRENT SEWAGE ENGINES.

SIR,—But for Mr. Walker's letter being so absurdly untrue we should not have troubled you further in a matter of such small general interest. We deny that Mr. Walker did more in connection with the Burton engines than would be expected from any head draughtsman. The design is our own, and the results as to economy—shown by the tests—though very satisfactory have been surpassed by other beam pumping engines of our make. Though we wish to withdraw nothing from the testimonial which we gave to Mr. Walker to help him in applying for a special situation, we are very much surprised at the use he now makes of it. We shall not again trouble you on this personal question.

Leicester, March 23rd. GIMSON AND CO.

[This correspondence must end here.—ED. E.]

MISSISSIPPI LEVEES.

THE following is from the report of Mr. Wm. Starling, chief engineer, to the Mississippi Levee Commissioners at the meeting held last January:—

"It has doubtless not escaped the observation of the members of the board that very great and rapid advances are being made in completing the levee system on both sides of the river. The upper district of the Mississippi will have the present season an almost perfect line of levees, built to a height 3ft. above high water, with crown of 8ft. or more and standard slopes. The Arkansas levees will be rebuilt, raised, and strengthened against the coming high water, with the exception of three great gaps, and even they will doubtless be closed during the next year. This prospect should naturally turn our regards to our own imperfect system, not calculated at all for such a state of things.

What may be the effect of these wholesale closures upon the high-water line is a matter upon which there is the widest diversity of opinion. It was claimed by Humphreys and Abbott, as the result of elaborate investigations, that the levees would have to be increased enormously in height. Their proprtions, calculated for a grade 1ft. above high water, were:—From Osceola to Helena, 7ft. above their present height. Thence to Island 71—near Concordia—the height should be gradually increased to 10ft. Thence to Napoleon, to be gradually reduced to 8ft. Thence to Lake Providence to be gradually increased to 11ft. Thence to the mouth of the Yazoo, to be gradually diminished to 6ft., which height should be maintained to Red River.

This computation was based on the great flood of 1858. In 1875 a board, composed of army engineers and civilians, was appointed "to investigate and report a permanent plan for the reclamation of the alluvial basin of the Mississippi River subject to inundation." This board was composed of Generals Warren and Abbot, Major Benyaurd, and Messrs. Sickels and Hebert. They had before them the additional experience derived from the great floods of 1862, 1867, and 1874. Their conclusions were substantially the same as those of Humphreys and Abbot.

General Comstock, by a different method of reasoning, comes to a not very dissimilar conclusion. In his opinion, the completion of the levee system would raise the flood line at Columbus 3ft., at Fulton 10ft., at Helena 4ft., and at Lake Providence 10ft.

Diametrically opposite to these is the view taken by Captain Eads. This distinguished engineer thinks that the levees need not be raised at all, that the increased velocity obtained by confining the waters would cause such a scouring of the channel as to accommodate the increased volume.

The majority of the Mississippi River Commission appear to think that a height three feet above the flood of 1882 would probably prevent an overflow, though they do not profess to speak authoritatively upon this point.

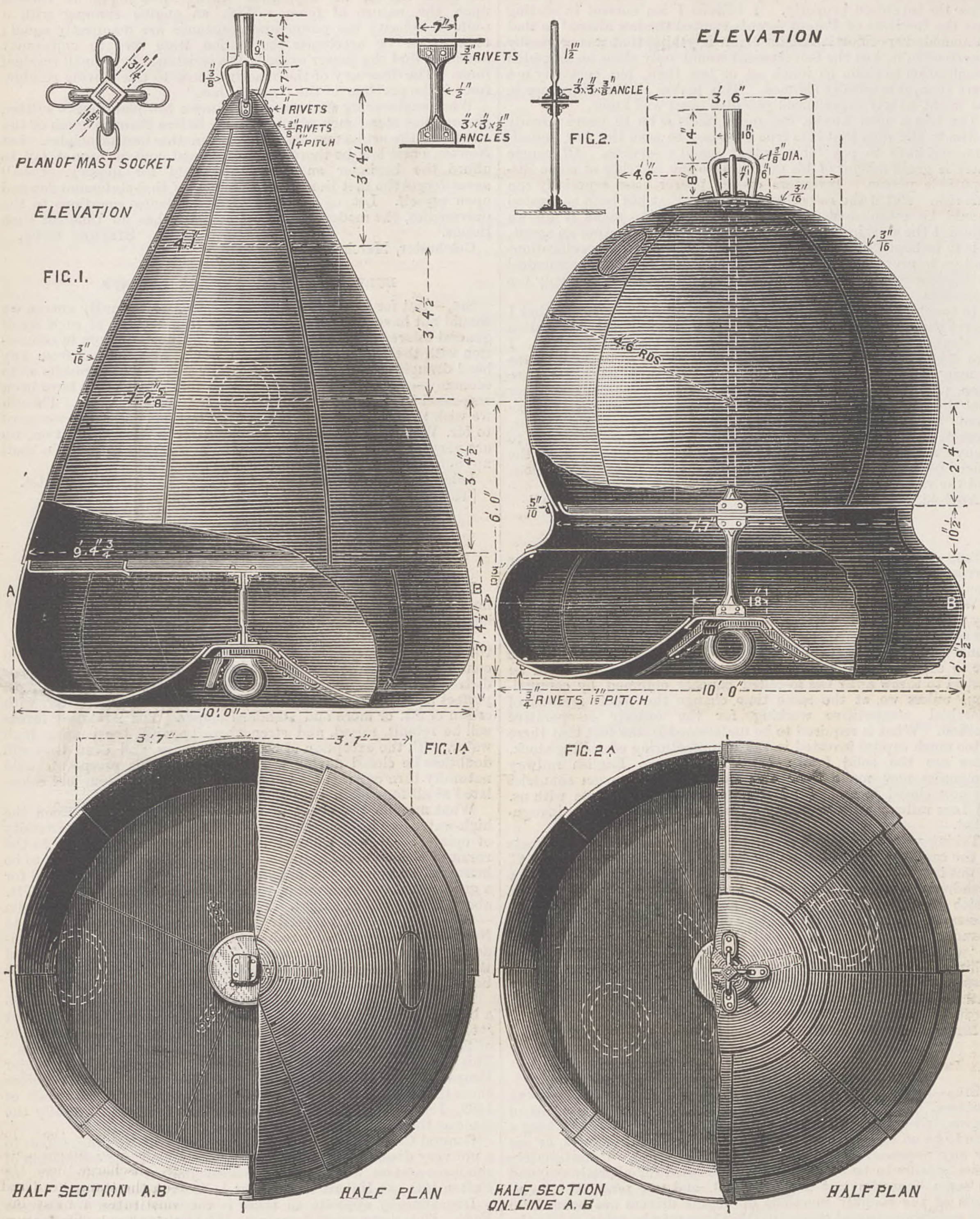
Between these widely differing opinions there is room for the greatest latitude of judgment. It accords with our experience, and it is the part of safety to assume that there will be an increase in the height of the high-water line whose exact amount we do not know, and to be prepared for this emergency by strengthening and raising our levees to the utmost extent that our means will allow. This enlargement is especially demanded in that portion of the district extending from the extreme upper end thereof to about Greenville. Below this point there are long stretches that are already high and strong enough, and the work of enlargement would be comparatively light. It need not probably extend in any event much below Mayersville, as here the influence of the comparatively low water at Vicksburg is felt, this low water being due to the absence of the return flow from the breaks in the Yazoo front which formerly played such a prominent part in raising the flood line at that point.

The contracts at present in force provide for raising the levees from Coahoma line to Shelby's below Mound Landing, to a uniform grade 3ft. above the high water of 1882, but with a crown of only 2ft. This would answer against a sudden flood wave which should quickly subside, but not against a prolonged high stage like that of 1882. The flood of 1886 was not in reality as great as that of 1882 or 1884, or even 1883. The river did not reach the same height at Cairo, nor remain high so long. Moreover, the Arkansas and White rivers were very low. Yet at the head of the district, and at various points the flood line of 1886 was the highest ever known. This may fairly be attributed to the partial rebuilding of the levees above us and opposite to us, unless some other cause be shown to exist. Had such a volume as passed Cairo in 1882 been precipitated upon us last year, our defences would probably have been found too weak and too low. Still more would this be the case in the future, with not merely casual gaps closed, but with lines perfected on both sides of the river.

It is therefore respectfully suggested to the board that they consider the propriety and feasibility of a general policy of enlargement such as that sketched above, for which estimates will be presented if required."

A MEETING of engineers and others was held at the offices of the London Chamber of Commerce, 84 and 85, King William-street, E.C., on Thursday the 17th inst., Sir Bernhard Samuelson, Bart., M.P., in the chair. Letters were read from a number of important firms, including one from the Secretary of the Engineer Employers' Association of Manchester, approving of the movement. On a resolution proposed by Mr. E. H. Carbutt, in his capacity as President of the Institution of Mechanical Engineers, and seconded by Mr. James Howard, it was unanimously agreed to form an Engineering and Allied Trades' Section in connection with the London Chamber of Commerce. Sir Bernhard Samuelson was unanimously elected chairman of the section and committee, which nomination he accepted.

CONTRACTS OPEN.—SPHERICAL AND CONICAL BUOYS.



CONTRACTS OPEN.

TRINITY HOUSE SPHERICAL AND CONICAL BUOYS.

THE work to be executed under these contracts consists in the construction and supply of 1 first-class, 2 second-class, 16 third-class, 14 fourth-class, and 5 fifth-class steel spherical buoys; and secondly, of 1 first-class, 1 second-class, 15 third-class, 12 fourth-class, and 6 fifth-class steel conical buoys, as shown in the several engravings given herewith. The tenders are to be delivered at the Trinity House on or before Monday, the 28th inst., to the Secretary of the Corporation of Trinity House, and marked "Tender for ——," &c.

The first-class spherical and conical buoys are 12ft. diameter; the second-class, 10ft. diameter; the third-class, 8ft. diameter; the fourth-class, 6ft. diameter; and the fifth-class, 5ft. diameter. The whole of the plates and angles are to be of Siemens steel, to bear a strain of 30 tons per square inch of original area, and show a mean contraction of not less than 50 per cent. at point of fracture. The wrought iron to be of fine fibrous quality, to bear a tensile strain of 22 tons per square inch original area, and show a mean contraction of area of 20 per cent. The buoys are to be single-rivetted throughout, the pitches being shown on the drawings. The manholes, manhole rings, mooring eye, mast sockets to be as shown on the drawings, the dimensions varying with each class. Of the spherical buoys the plates have the following thicknesses:—First and second-class: Spherical portion and bulkhead, $\frac{3}{16}$in.; waist, $\frac{5}{16}$in.; bilge, $\frac{3}{8}$in.; sides of concave bottom, $\frac{1}{2}$in.; crown of bottom, $\frac{3}{4}$in. Third, fourth, and fifth-class: Thicknesses the same, except that the sides of concave bottom are $\frac{3}{8}$in., and the crown of bottom $\frac{5}{8}$in. Of the conical buoys the plates are:—First and second-class sides and bulkhead, $\frac{3}{16}$in.; crown, $\frac{1}{4}$in.; bilge, $\frac{3}{8}$in.; sides of concave bottom, $\frac{1}{2}$in.; and crown of same, $\frac{3}{4}$in. Third, fourth, and fifth classes: Plates same, except concave bottom $\frac{3}{8}$in., and crown $\frac{5}{8}$in. A 2in. gun-metal plug and socket has to be provided for testing purposes, the test being water pressure to 5 lb. per square inch.

PFEIL'S "RETORT" MANGANESE STEEL.

MESSRS. PFEIL AND Co., London, are making bolts and nuts, bars and plates, and various articles, from an extremely tough soft manganese steel which is made under their own immediate supervision. In their large stocks of engineers' requirements Messrs. Pfeil and Co. are no longer keeping iron bolts, studs, and nuts; all are replaced by these very mild steel bolts and nuts, and nearly all the engineering establishments of note, as well as our Government works, are using these bolts and nuts and steel. We recently tested a number of these bolts by very rough and very severe trials in order to satisfy ourselves that these bolts were really strong as against the very heavy stresses and strains to which they are sometimes subject in practice, and to see whether the steel of which they are made would withstand bending, hammering close, and severe testing by hammering in various ways, or whether the steel would only withstand heavy stresses slowly applied. The steel proved, however, to be of the very toughest kind, for it would withstand being nicked and bent round away from or closed up at the nick. Bolts up to $\frac{5}{8}$in. were tested by holding the nut fast in a vice, and then hammering the bolt until it was bent down at the screwed part through an angle of 130 deg. and then taken out and doubled down, and closed up with a heavy hammer on an anvil. The screw threads were thus jammed up and compressed upon each other on the inside of the bend, and opened out to double their pitch on the outside; still the steel did not break.

The material is being used for piston and other rods, and in slabs for forging and welding into screw propellers for torpedo-boats. It has also been tested for shields and armour-plate purposes by the Woolwich authorities, with results that show that its toughness and general behaviour are uniform. The following table is from a report on tensile tests of three pieces of manganese steel round bar, by Professor Alex. B. W. Kennedy. In each case the "remarks" are, "finely granular in centre, edges silky."

Dimensions.			Limits of elasticity		Breaking Load.		Ratio of limit to break	Extension on whole length of 10in.	Reduction of area at fracture.
Breadth Ins.	Thickness Ins.	Area. Sq. in.	Lbs. Per sq. in.	Tons. Per sq. in.	Lbs. Per sq. in.	Tons. Per sq. in.		Per Cent.	Per Cent.
1·054in. diameter.		·873	43,460	19·40	65,760	29·35	·661	25·7	55·0
1¾in. diameter bar									
1·055in. diameter		·874	38,580	17·22	64,510	28·80	·598	27·8	54·5
1½in. diameter									
·849in. diameter		·566	43,890	19 60	62,700	27·99	·700	23·7	57·1
1⅛in. diameter									

From this table it will be seen that steel combines toughness and elastic strength in a most remarkable degree.

Some tests were also made with hooks forged of S.C. Crown iron and this manganese steel, with the result that the iron hooks opened out equally with a pull up to 8 tons. With load in excess of this the iron hook opened faster than the steel hook, and ceased to hold as a hook with 11·7 tons. The steel hook was still serviceable, and showed no signs of distress.

ROYAL AGRICULTURAL SOCIETY.—We are requested to state for the benefit of intending exhibitors at the forthcoming show at Newcastle in July next, that the latest day of entry for machinery and implements is Friday, the 1st of April.

THE DOLPHIN DONKEY PUMP.

THE Dolphin donkey pump, which we illustrate by the accompanying engraving, comprises some interesting details. It has a deep steam piston, in which are two passages communicating one with each end of the cylinder, and with corresponding passages in the cylinder casing. The piston is partially rotated at each stroke by a pin projecting from it, carrying in its end

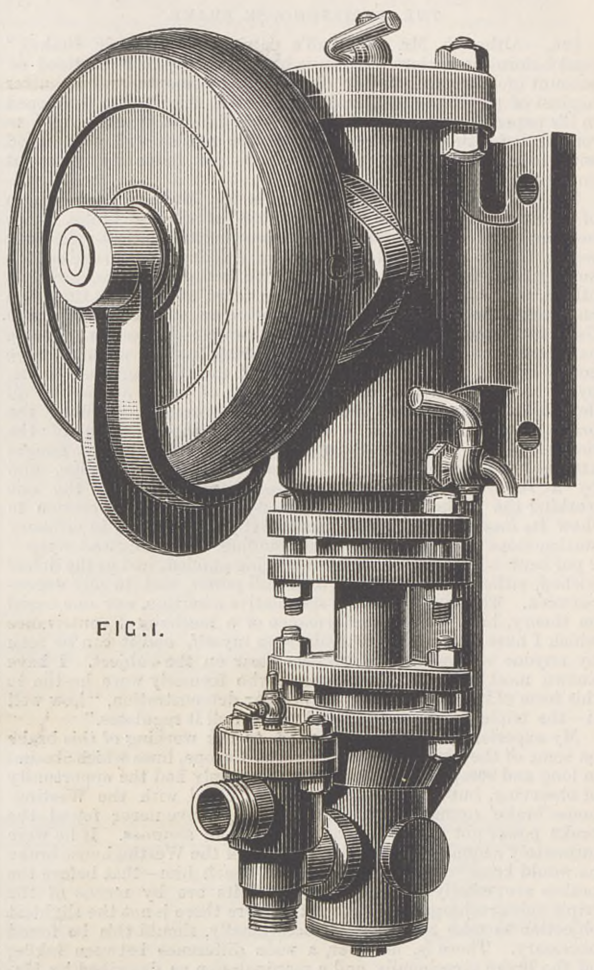


FIG. 1.

hardened steel bail, which works in a cavity in the fly-wheel, as shown in the section, Fig. 2. By the rotation of the fly-wheel, the piston, in addition to the reciprocating motion, receives a partial rotary motion which presents the steam and exhaust

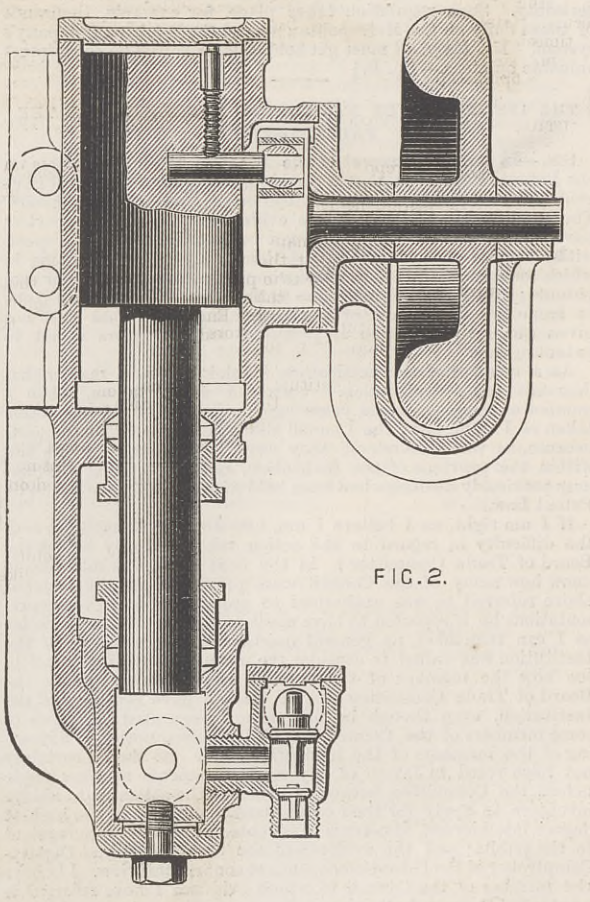
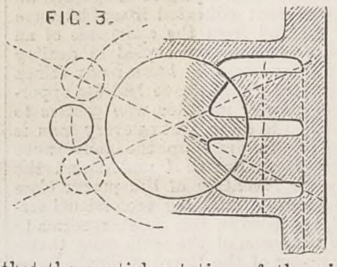


FIG. 2.

ports alternately to the passages leading to the top and bottom of the cylinder—see Figs 2 and 3. This motion enables the piston to take the place of the ordinary slide valve and excentric.

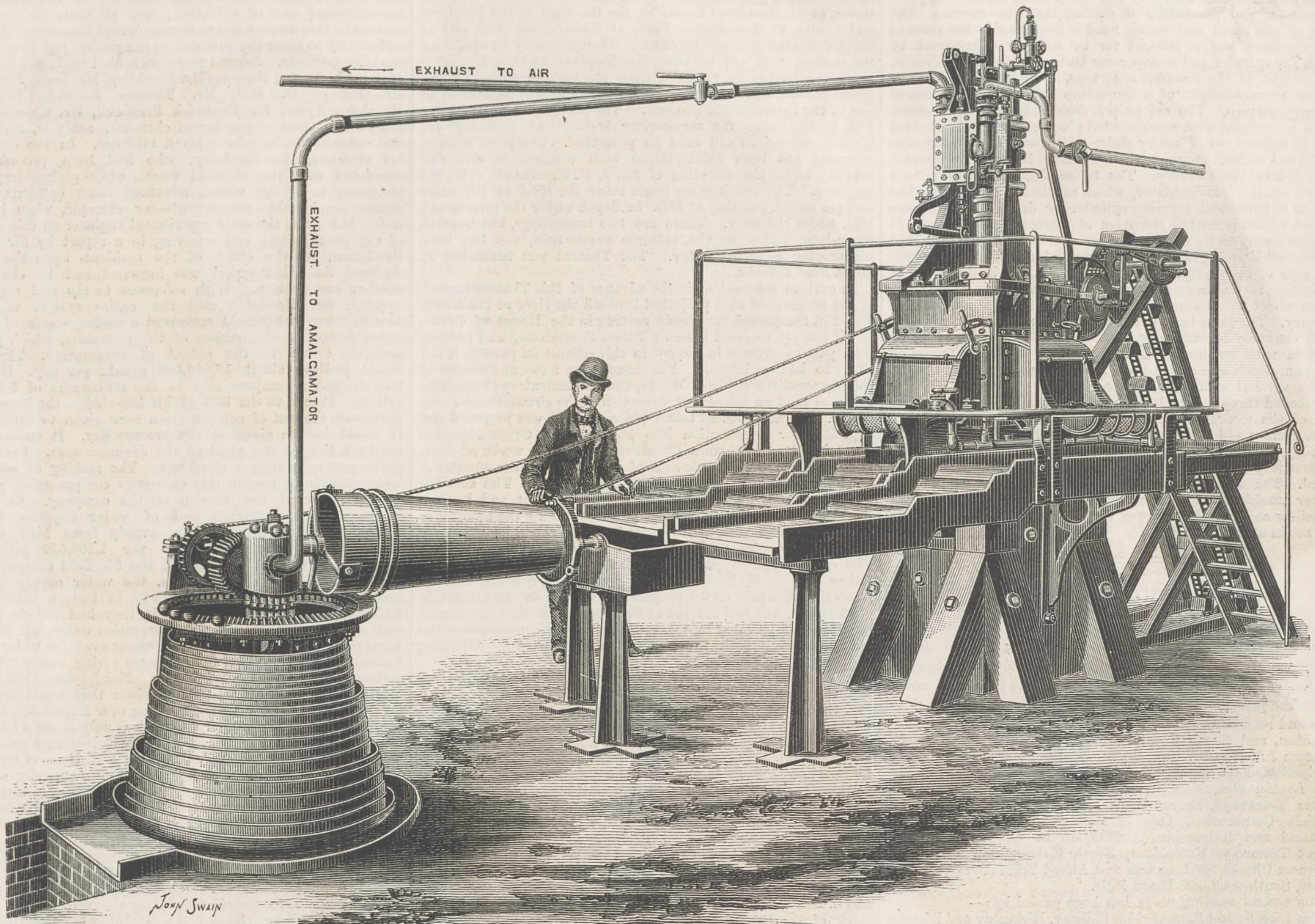
The engine will run either way indifferently, according to the connection made between the steam ports and passages, a three-way cock being fixed to change the connection between steam and exhaust where a reversing motion is required. A large number of these pumps has been sent out during the last few months, and has, we are informed, given the greatest satisfaction. It is found that the partial rotation of the piston keeps a splendid surface on it, and the simplicity and fewness of the parts render it most suitable for a donkey pump, which has generally to bear the roughest usage. This partial rotation also reduces the rubbing friction both of the piston and of the pump plunger. Messrs. Miller, Tupp, and Rouse are the makers.

FIG. 3.



WILLIAMS' STEAM STAMP ORE CRUSHER AND AMALGAMATOR.

CONSTRUCTED BY THE READING IRONWORKS COMPANY, READING.

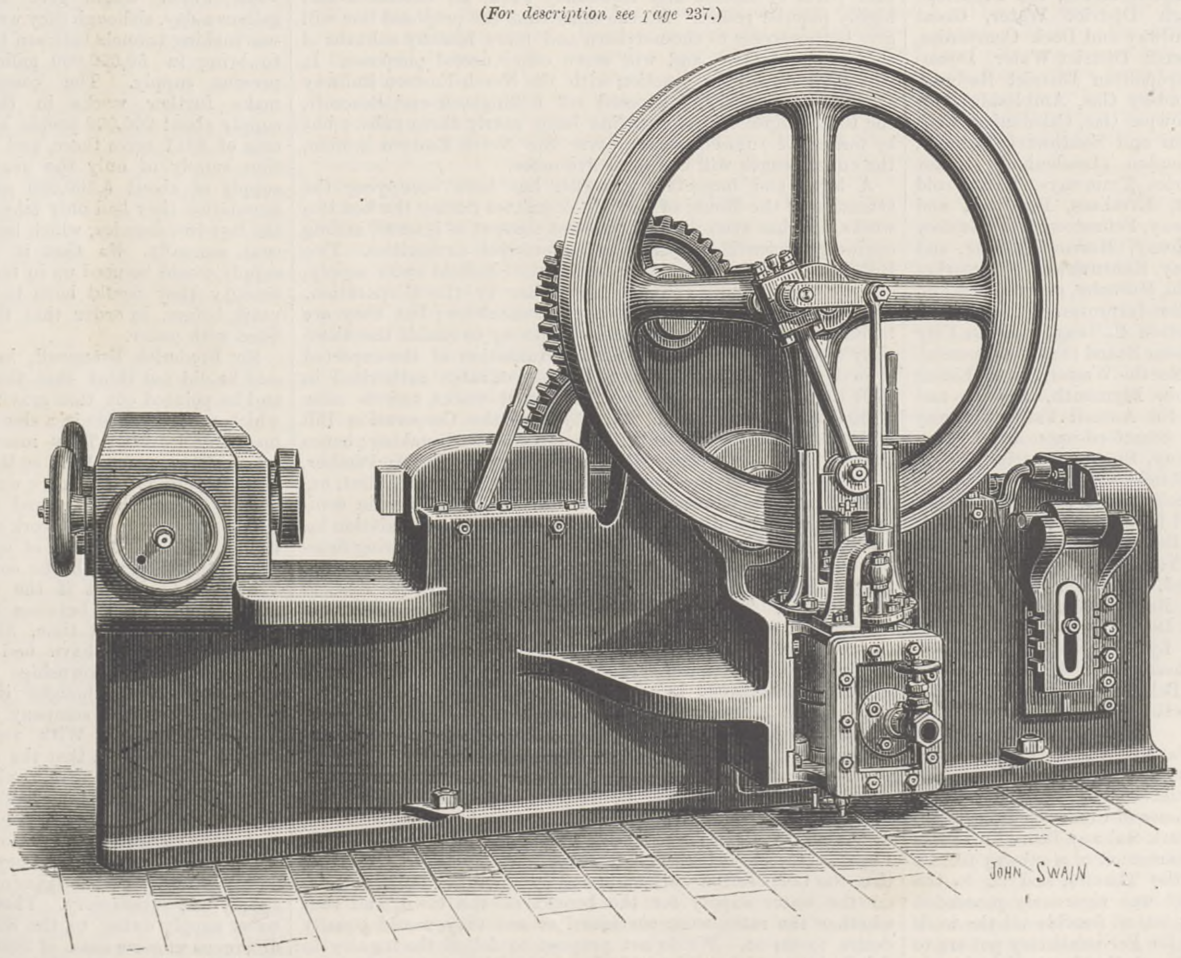


WILLIAMS' ORE CRUSHER AND AMALGAMATOR

The above engraving illustrates a new machine which has been made by the Reading Ironworks Company. The machine consists of an inverted cylinder 8¾in. diameter and 9in. stroke, attached to a cast iron standard, and having something of the appearance of an ordinary steam hammer. To the piston-rod is attached a steel head, which crushes the ore between it and the anvil beneath. The steel head and anvil are enclosed within a cast iron box or "mortar," which is provided with three mouths, within which are fixed steel grids arranged either vertically or adjustable to the angle most suitable for the ore to be treated. In front of these grids is a wrought iron removable plate which confines the pulp that splashes through the grid when the machine is at work. Water pipes are so arranged that jets of water are directed upon the quicksilver baths and grids and interior of the mortar. The hammer or stamp is raised by the action of steam beneath the piston which compresses the air contained in the upper part of the cylinder, the ingress and egress of the air being controlled by suitable valves. The stamp falls with a force due to its weight, plus the pressure of the compressed air above the piston. Steam is admitted to the cylinder by a slide valve and sliding plate of special construction, the latter being moved by a small auxiliary cylinder, which governs the admission of steam beneath the piston, and allows for variation in the thickness of ore in the mortar. The slide valve is moved by an arrangement of levers and link attached to a prolongation of the piston-rod which works through the top cover of the cylinder. The hammer or stamp is therefore raised by steam alone, without the tappets, cams, or other arrangements used in stamps of ordinary construction, and friction is thereby reduced. The ore to be crushed, being first broken to pass through a 1¼in. mesh, is raised by an elevator, consisting of cups fixed to an endless chain passing over a suitable wheel worked by means of friction palls. These are actuated by a lever, which in its turn is moved by a stud upon the prolongation of the piston-rod. In a report on the machine, Mr. Barnes Kinsey, M. Inst. C.E., says :—"This feed motion is very neat and effective, as it automatically prevents the mortar ever becoming too full, for should it do so, then the piston and stamp head would not fall so far by reason of the increased thickness of stuff upon the anvils, and consequently the stud on the piston-rod would not engage the feed lever. The feed wheel would therefore remain stationary until the thickness of ore upon the anvil was so reduced that the stamp might fall its proper distance, when the stud would again engage the lever, and the elevator cups discharge into the mortar. The thickness of material between the stamp head and anvil is therefore always uniform and constitutes a most important and valuable feature of the machine. The mortar, as before mentioned, is provided with three mouths, to each of which is attached a tray with mercury bath, by which a considerable quantity of gold is caught before reaching the tables or amalgamator; there are also three baths inside the mortar for this purpose. The grids, being movable, can be set at any angle required to suit hard or soft ores without altering the mesh. Adjustment is provided wherever necessary, the power being regulated to the work to be done. The machine was driven during my inspection by a patent Nozzle vertical boiler of 10-horse power nominal, manufactured by the Reading Ironworks, and is well suited for the purpose. Indicator diagrams taken gave 7·57 as the indicated horse-power. The quantity of ore crushed was at the rate of 12 cwt. per hour, equal to 14 tons per day. This result was obtained with grids having a mesh of 64 holes per square inch, and I estimate that had the grids been the ordinary mesh of 90 holes per square inch, the duty would have been equal to that of a 10-head cam stamp mill, which requires 10-horse power nominal to drive it, and will theoretically crush 10 tons per day; but being liable to clog owing to the irregularity of feed in machines of the cam type, the blow of the stamper and consequent useful effect are reduced. This cannot take place with Williams' patent stamp, the rapidity of the blow causing the water to act upon the ore in a much shorter time and thus assisting disintegration, which in the cam stamp is retarded through the stamper resting for a longer period upon the stuff. The large size of the mortar in the Williams' stamp combined with the

NEW'S BEAM BENDING AND PUNCHING MACHINE.

(*For description see page 237.*)



arrangement of the anvil face below the water line is very effective. A splash is produced each time the stamper falls, driving the crushed ore or pulp against the grids and at the same time cleaning them, and as the angle of the grids can be adjusted to the material under treatment, an excellent result can be obtained. The whole of the mortar can be cleaned in fifteen minutes. An effective arrangement has been devised by means of a tray fixed on the top of a mortar beneath the steam cylinder for collecting any oil or grease that may run down from the moving parts or cylinder, and preventing it getting into the mortar. The wear of the anvil and stamp head is considerably less than in cam machines, and is allowed for by a screw adjustment by which the cylinder and stamper can be lowered in a few minutes. The weight of the machine is 4½ tons, as compared with about 12 tons average weight of a ten-stamp mill with iron frame of ordinary pattern. The ore pulp is delivered on to three tables, which are covered with amalgamated plating; and either of them may be thrown out of use by sluice plates, and thus enable it to be cleaned without stopping the machine. Ripples are provided for collecting the mercury. The tables deliver the pulp to a patent agitator amalgamator, which consists of two parts. The first is a horizontal tapering cylinder or drum, having ripples formed within it for the reception of mercury and plating. It revolves slowly on the edge of amalgamator No. 2, which is kept in motion by a spur gear and chain worked from the automatic feed gear of the stamp. Amalgamator No. 2 is in the shape of a crinoline revolving on a vertical shaft. The top is formed into a pan about 3ft. diameter and 3in. deep for the reception of mercury. The sides hang down about 3ft., and are formed with small channels for mercury, the spaces between them being filled in with amalgamated plating. The whole rests upon an iron pan, which also serves as a foundation plate. On the top of the vertical shaft is a receiver for exhaust steam, which is distributed through a series of removable pipes on to the surface of the mercury contained in the top pan. This is kept in a constant state of ebullition by the steam, enabling the mercury to come in contact with every part of the pulp, this important point being greatly facilitated by the warmth produced. The ends of the distributing pipes are fitted with copper nozzles to act as collectors, and there are also a number of hollow amalgamated copper balls which float in the top pan and act in a similar manner."

PRIVATE BILL LEGISLATION.

Since our last *résumé* substantial progress has been made with the various Private Bills, especially in the House of Commons, and a fairly good record will probably be made when the Easter recess interrupts this part of the legislative work. Up to the present time the following schemes have been dealt with and read a third time in the Commons:—The London, Brighton, and South Coast Railway, the Midland and South-Western Junction Railway (No. 2), the Rhymney Railway, Clyde Navigation, East Huntingdonshire Water, Kirkheaton, Dalton and Lepton Gas, Manchester, Bury, Rochdale, and Oldham Steam Tramways, Barnet District Gas, Belfast Main Drainage, Carlisle Corporation, City of London Municipal Elections, Hillhead and Kelvinside (Annexation to Glasgow), London Street Tramways Extensions, North Metropolitan Tramways, Skegness Chapel, St Leonards and Alford Tramways (Abandonment), Southend Local Board Bills.

The second reading stage has been passed by:—

The Kilsyth and Bonnybridge Railway, Kirkcaldy and District Tramways (Abandonment), Furness Railway, Bexley Heath Railway, Bishops' Castle and Montgomery Railway (Abandonment), Mersey Railway, Pontypridd, Caerphilly, and Newport Railway, Tunbridge Wells Gas, Cathcart District Railway, Great North of Scotland Railway, Liverpool, Southport, and Preston Junction, Manchester, Sheffield, and Lincolnshire Railway, North Eastern Railway, West Lancashire Railway, Dublin Southern District Tramways, South-Eastern Railway, Leeds Suburban Railway, the Llangammarch and Neath and Brecon Junction Railway, the Clyde, Ardrishaig, and Crinan Railway, the Westminster (Parliament-street, &c.) Improvements, the Brentford and District Railway, Farnborough District Water, Great Eastern Railway and Felixstowe Railway and Dock Companies, Great Northern Railway, Farnborough District Water, Downham and Stoke Ferry Railway, Metropolitan District Railway, Limerick City and Port Railway, Pudsey Gas, Ambleside Railway, Basingstoke Gas, Blyth and Cowper Gas, Caledonian Railway, Chelsea Water, City of London and Southwark Subway, Clissold Park, Corporation of London (Leadenhall Market Approach), Dublin Southern District Tramways, Easingwold Railway, Edinburgh Improvement, Evesham, Redditch, and Stratford-upon-Avon Junction Railway, Felixstowe and Bawdsey Ferry Railway, Great Eastern Railway, Harrow, Ealing, and Willesden Railway, Highland Railway, Kanturk and Newmarket Railway, Kensington Vestry, Lincoln, Hornsby, and Spilsby and East Coast Railway, Liverpool Water Improvement, Llangammarch and Neath and Brecon Junction Railway, London City Tithes, the Mersey Docks and Harbour Board (Various Powers), Newark and Ollerton Railway, North-Western and Ealing Railway, Over Darwen Corporation, Plymouth, Devon, and South-Western Junction Railway, St. Austell Valley Railway and Dock, Southampton Harbour, Stratford-upon-Avon, Towcester, and Midland Junction Railway, Sutton District Water, Thames Tunnel (Blackwall), Wakefield Corporation, Weston-super-Mare Improvements, Weymouth and Melcombe Regis Corporation, Willesden Local Board Bills.

In the House of Lords the Belfast Corporation (Logan Bridge), Bristol Corporation, and Northampton Gas Bills have been read a third time and passed, while the following have obtained a second reading:—The Bristol Consumers' Water, Barry Dock and Railways, Millwall Dock, North-East Somerset Railway, Golden Valley Railway, Lynton Railway, Greenock and Port Glasgow Tramways, Chesterfield, Hasland, North Wingfield, and District Tramways, Belfast Main Drainage, Trent Navigation, Haslingden and Oswaldtwistle Tramways, and Sheffield Water Bills.

In the Commons, the Uckfield Water Bill has been rejected.

With regard to the proceedings of the Select Committees, the most generally interesting, and one of the most important results has been the passing by a House of Commons Committee of the City of London and Southwark Subway Bill. In 1884 a Bill was passed authorising the construction of a subway from a point near the Monument, under the Thames, and on to the Elephant and Castle. This project was vigorously proceeded with, and is now nearly completed; but so feasible did the work prove, that it was decided to apply for Parliamentary powers to extend the line from the Elephant and Castle to Kennington and Stockwell. The proposal was opposed by the Metropolitan Board of Works, the London Tramways Company, and the Southwark and Vauxhall Water Company; but the Select Committee ultimately decided in favour of the extending Bill, subject to the insertion of clauses for the protection of the water company's mains and the sewers of the Board of Works. The whole tunnel is to be used for a railway, with a double line of rails, and worked by an endless cable. The total distance to be tunnelled is rather over three miles, and the estimated cost is £550,000. The subway is to be lighted by electricity, and the passengers will ascend or descend by means of hydraulic lifts similar to those in use in the Mersey Tunnel, there being stations in King William-street, at St. George's Church in the Borough, at the Elephant and Castle, at Kennington Park, at Kennington Oval, and at Stockwell—the southern terminus. The machinery for operating the endless cable will be near the Elephant and Castle, and if more ventilation be required than the current caused by the trains passing simultaneously each way, a fan will be erected at one of the intermediate stations. The project when completed will revolutionise the across-river traffic, and probably yet further extensions will soon be promoted. The work already executed has been accomplished with remarkable skill and rapidity under the direction of Mr. J. H. Greathead, C.E., the engineer. The cuttings are made below the level of the water and gas mains, running at 40ft. in depth under the streets and 15ft. under the river. There are two tunnellings, but beneath Swan-lane, owing to the extreme narrowness, one has been constructed over the other. The Thames was tunnelled in about four months.

In curious contrast with the advance of this Thames tunnel, is the progress of that projected beneath the river at Blackwall. The Bill has passed the second reading in the House of Lords, but it has yet to come before a Select Committee, and judging from past experience in respect to this scheme its passage is not likely to be over smooth. For example, at a recent meeting of the Metropolitan Board of Works, the Parliamentary Committee reported that an important alteration of the circumstances connected with the Bill had taken place since it was prepared and deposited for introduction into Parliament. Great objection was raised by the Thames Conservators to the works of dams and other works in the channel of the river on the ground of the impediment they would cause to navigation. The solicitor had accordingly made inquiries upon the subject, and he was doubtful whether Parliament would consent to the navigation being interfered with to the extent which would be necessary if the tunnel were to be constructed as originally proposed. The engineer, in conjunction with Sir F. J. Bramwell, Mr. B. Baker, and Mr. H. Low, had considered the objection, and the possibility of injury to the property and docks on the north side of the river, and had arrived at the conclusion that the tunnel might be constructed by means of atmospheric pressure without interfering with the navigation or damaging adjoining property.

Among the measures which have stuck fast is the Channel Tunnel (Experimental Works) Bill, which has only been read a first time. How much further it will get cannot yet be conjectured, but the promoters do not intend to relinquish their efforts. Referring to this scheme at a meeting of the South-Eastern Railway Company, Sir Edward Watkin said the directors wanted to keep it alive till the people of England some morning awoke to the desirability of putting an end to the toil and difficulty of crossing the Channel by allowing people to go under it. It was simply a dry Bill, which would cost £50 or £100. If the South-Eastern Railway were continued to the Continent, he asked what would be the price of their ordinary stock the day after this was done. One large financial house, when the work was shown to be practical, before Lord Wolseley and others condemned it, bought nearly half a million of the stock of the South-Eastern Railway. If the tunnel was to be made, he wanted it to be an extension of the South-Eastern Railway. In the course of some discussion, he stated that coal had been found by the borings made at Calais, and they were trying to find coal by using the tunnel machinery now. The shareholders approved of the Bill being pushed forward, but the chances at this moment seem very much against success.

The Leeds Suburban Railway Bill, which, as mentioned above, has been read a second time in the House of Commons, has for its main object the construction, at a cost of about £50,000, of railway communication between the central and the more distant parts of Leeds, and Roundhay Park, an extensive and highly popular resort. At the same time the proposed line will give better access to the northern and more healthy suburbs of this crowded town, and will serve other useful purposes. It will commence by a junction with the North-Eastern Railway at Ormondthorpe, and proceed *viâ* Killingbeck and Seacroft, the total length of the new line being nearly three miles; but by means of running powers over the North-Eastern system, the entire length will be nearer five miles.

A large and important question has been occupying the attention of the House of Lords' Committee during the last two weeks, and has attracted the greatest amount of interest among engineers, scientific experts, and municipal authorities. Two Bills have been introduced respecting the Sheffield water supply, one by the existing company, the other by the Corporation. Both are referred to Lord Derby's Committee; but they are taken separately. The first seeks authority to enable the Company to continue—owing to the non-realisation of the expected growth of population—a certain increase of rates authorised in 1864 for 25 years; to construct additional works, and to raise £100,000 for the purpose. The object of the Corporation Bill is the compulsory purchase of the company's undertaking; hence the spirited contest witnessed in the Committee-room. Mr. Pember, Q.C., on behalf of the company, whose Bill was taken first, explained that the increased rate was intended to enable the company to pay a fair dividend; but so far from the population increasing it had decreased, and several large manufacturing firms had removed their works, and as a result of this decline the company's dividends had fallen from 5½ per cent. and 7½ per cent. to 2½ per cent. This fall was largely due to the bursting of a reservoir in 1864, which caused serious loss of life and involved the company in heavy liabilities for compensation, and this had brought about the powers granted in 1864. The company had expended £2,000,000 in providing Sheffield with the water required, and he complained that now for the fifth time in twenty-five years the Corporation was striving to deprive the company of their undertaking. This view he emphasised by stating that the Corporation only advanced the Bill when they heard of the company's notices, and declaring that their design was to prevent the increased rates being perpetuated, and then to force a sale on them. This, however, Mr. Pope, Q.C., on behalf of the Corporation, denied, asserting that the Corporation were animated by a genuine desire to carry on the water supply for the benefit of the town, and that whether the rates were continued or not they would equally desire to do so. We do not propose to follow the inquiry in detail, but some portion of the counsels' speeches, and the evidence will interest our readers. Dealing with the projected new works, Mr. Pember explained that although the water was pure and soft, and therefore excellent for domestic purposes, the pipes in general use were of lead and, to some extent, ill consequences had ensued. The company were not liable on that account, their responsibility ending with an efficient supply of good water; but they were willing to deal with the difficulty as though they were responsible. They were prepared to erect works for silicating the water before delivery, and thereby rendering it insensible to the action of the lead, while only making the water slightly harder, and not materially depreciating it for domestic use. For the process new works would have to be constructed, at an estimated cost of £100,000; but all that the company desired in this respect was to be empowered to increase the rates sufficiently to meet the interest on the outlay, and to cover the working expenses. Several prominent civil engineers had been examined. Among these are Mr. Hawksley, Mr. James Mansergh, Mr. George H. Hill, Mr. Thomas Fenwick, Dr. Pole, Mr. John Ayres, Sir Frederick Bramwell, Mr. Charles Gott, and besides these a number of chemists, analysts, architects, and other authorities have given evidence. In the course of his evidence, Mr. Hawksley, who had been professionally associated with the Sheffield works, while giving important testimony as to the works, advanced some opinions which caused considerable amusement—for example, when he described himself as the most experienced engineer on this subject of any man living; and referring to a report by Sir Robert Rawlinson, on the effect of the accident upon the pipes, declared that that report was incorrect, and he challenged another examination. With reference to the real matter of inquiry, Mr. Hawksley said the entire system of works now existing at Sheffield embraced a drainage area of 15,200 acres, deducting the surface of the reservoirs, which yielded nothing, owing to the extent of evaporation. That area would produce about 19,000,000 gallons per day. On that was charged a compensation to the millowners of 9,125,000 gallons. It was, to the best of his knowledge, the largest proportionate amount of compensation ever given to millowners. It would not be given at the present day. It amounted to nearly a half of the yield of the drainage area. Parliament never gave more than a third now. The making of reservoirs large enough to render this enormous compensation possible greatly increased the burden of the company. As to the question of the average cost of water supplies, he calculated that for a gravitation supply from hilly country the cost was about £160,000 per 1,000,000 gallons of daily capability. In the case of the Sheffield company, notwithstanding their disadvantages, the water supply had not cost more than this. The cost was, in fact, a little under £160,000 per 1,000,000 gallons. If they had not to provide such an enormous amount of compensation water, but only the usual proportion, their 10,000,000 gallons available water would become nearly 13,000,000. They were giving nearly 3,000,000 gallons more than they ought to do. Multiplying £160,000 by thirteen—the number of million gallons they would then have available—would give them something over £2,000,000, whereas the present capital of the company was only about £1,800,000. The average expense of procuring and distributing a gravitation supply of 1,000,000 gallons a day, from a distance of ten miles, was rarely less than £160,000, and not unfrequently a larger sum. Sheffield being left by the millowners with only 10,000,000 gallons per day, if they took 400,000 people as being supplied in their district, and if, as was contemplated, Sheffield became a water-closeted town, that would allow 25 gallons per head per day. At present Sheffield was using something under 20 gallons per head, but then the trade supply was not a full one, and water-closet supply amounted to little. The Corporation contemplated fitting the whole town on the water-closet system. They had a capability of supplying about 80,000 more people than they at present supplied. They found they had a charge upon them of 320,000 people, but one in twelve of the ordinary houses were empty, and they had made allowance for this in the above figures. So far from a reserve of 80,000 being too large, it compared rather unfavourably with what all the great Corporations were doing now. Manchester was adding to its present supply of 25,000,000 gallons daily 50,000,000 additional; and Liverpool was making a reservoir to deliver 40,000,000 gallons daily, the present supply being 12,000,000 or 13,000,000. Leeds was making reservoirs which would give from 20,000,000 to 25,000,000 gallons a day, although they were only using 10,000,000. Glasgow was making tunnels between twenty and thirty miles in length, to bring in 50,000,000 gallons a day in addition to its present supply. The company had, however, power to make further works in the Ewden Valley, which would supply about 200,000 people additional. There was a drainage area of 6311 acres there, and it was charged with a compensation supply of only the usual one-third. It would afford a supply of about 5,260,000 gallons. In their calculations of population they had only taken the ascertained increase during the last two decades, which had been, in round numbers, 2 per cent. annually. So that it would be seen their sources of supply would be used up in ten or twelve years, and in all probability they would have to begin other works four or five years before, in order that the reservoirs might be ready and filled with water.

Sir Frederick Bramwell, in the course of his examination said he did not think that the reservoir storage was excessive, and he pointed out that gravitation reservoirs were not works which could be made in a short time, or works which could be made bit by bit. They must place their dam at the point which nature pointed out as the cheapest and best, even though they impounded far more water than for a time they needed If the Corporation acquired the waterworks to-morrow they would not dare to go to work without both Daledyke and Damflask reservoirs. He was of opinion, however, that the amount of compensation which the company had to give was excessive. Witness added that if the ratio of increase of population which took place between 1851 and 1861 had continued up to the present time, Sheffield, excluding the outlying townships, would have had a population of 400,000, and including the out-townships 440,000, to have been supplied with water. He thought it would have been imprudent on the part of the company if they had not made provision for the increase. With regard to the allegation in the Corporation petition that the supply of water was inadequate and unsatisfactory; with a view of finding out whether that was so or not, he visited Sheffield on the 26th of February, and without giving previous warning to twenty-three different places, and made separate examinations into the supply. He heard a few complaints made, but they were susceptible of explanation, and the result of his examination showed generally that the supply was satisfactory. There was a difficulty in the Sheffield water supply owing to the different elevations. There was a difference in some cases of 200ft. of pressure owing to the elevation. In consequence of the differences of elevation the lower portions of the town had a very heavy pressure indeed, and therefore the necessity for good fittings and for the company's regulations. The maximum pressure was 420ft. and the minimum 120ft.

clauses in their contracts, might well go further, and stipulate that the choice of arbitration shall, if occasion arise, be left to the president of the Chamber.

IMPORTATION OF BRITISH MARKED GOODS.

THERE is no mystery about the importation of British-marked goods from abroad. The Custom House authorities, although anxious enough to do what is right in the interests of just trading, have managed by one of their General Orders, dating back to 1883—which came into force in January, 1884—to arrange their regulations so as to practically favour the foreigner. By the 39th and 40th Vic., c. 36, 1876, it was prohibited to import goods bearing any name, brand, or mark of English manufacture. This section was altered in 1883 to "name *and* brand," "name *and* place." Acting under this order the Customs authorities decline to notice such goods as do not bear both name and place, or name and brand, though the marks put upon them point directly to intent to deceive. For example, goods may come in marked "Brown's Steel," or "Joseph Rodgers and Sons' Cutlery," though not an ounce of the steel was made by Brown, and the cutlery was never inside the famous "No. 6." A Sheffield steel firm finding that their steel was being imported into this country marked "———'s steel" brought the fact under the notice of the Custom House. They contended that their name being a registered trade mark the goods ought to be seized on importation. The Custom House decided against them, and forwarded a copy of the General Order. It would be interesting to know why the provisions of the Act of 1876 were over-ridden by this General Order, which seems to have widely opened the door for fraudulent dealing. Imitation may be the sincerest form of flattery, but this class of compliment is expensive.

WILLIAM DENNY.

THE principal topic in industrial and commercial circles throughout Glasgow and the West of Scotland for the past week has been the sudden and lamentable decease of Mr. William Denny, shipbuilder, Dumbarton. This sorrowful event took place on the 18th inst. at Buenos Ayres, South America, whither the deceased gentleman had gone about eight months ago, partly on business, but mainly to recruit his health, which had been far from satisfactory for some considerable time. Some two years ago Mr. Denny was prostrated by a serious attack of typhoid fever, from the effects of which he had never completely recovered. The journey to the River Plate was undertaken, as has been said, with a view to benefitting his health; but being of such an ardent nature in all that concerned the business prosperity of his firm, he overtaxed his strength so seriously that his health broke down, his mind became unhinged, with the result that he terminated his life with his own hand. The details of his death were not known in this country till some days after the melancholy event. Of the Institution of Naval Architects, Mr. Denny was one of the best known and most esteemed members, his share in the deliberations of that Institution being at once extensive and important. The meetings of the Iron and Steel Institute have on more than one occasion been enhanced in interest and value by the part he took in the proceedings, and the same remark applies to the meetings of the Scottish Institution of Engineers and Shipbuilders. The Institution of Civil Engineers, the Institution of Mechanical Engineers, and the Royal Society of Edinburgh, also claimed him as a member, and will share in the general regret.

Mr. Denny was in the prime of life, having just entered his fortieth year. He was born at Dumbarton in 1847, and received his elementary education in the Burgh Academy of his native town. From thence he went to Edinburgh High School, where under the tuition of Mr. John Carmichael, one of the most celebrated teachers of his day, he received a classical education. In his seventeenth year he entered the Leven Shipyard, much like an ordinary apprentice, and during a period of three years served stated terms in several of the practical departments, finishing up with the drawing-office. Mr. Denny had no regular mathematical or scientific training; what knowledge he possessed in these departments of learning, he acquired by self-tuition, principally during the morning and evening hours, before and after engaging in hard physical labour. Mr. Denny always looked back upon this period of his life with just pride, and it was largely owing to his experience in the workshop, and his coming closely into touch with working-men, that his well-known sympathy with them and hearty co-operation in all that concerned their social and intellectual interests were so great. At the comparatively early age of twenty-three he was admitted a partner of the shipbuilding firm, and shortly afterwards of the engineering firm, of Denny and Company, a distinct business of which his father, along with several others, had been the founders in 1851. After becoming a member of the shipbuilding firm, he displayed such a grasp of practical detail, due to his training in the various departments of the works, coupled with such marked abilities as an administrator, that in a short time be was made managing partner and intrusted with almost the entire control of the affairs of the shipyard. Under his spirited and energetic rule, many important improvements were made in the conduct of the works in the shipyard. One of the first matters to which he directed his attention was the system of payment of wages by result, or, piecework. This system, now so universally followed throughout shipyards and engineering works, was at that early stage instituted by him in various departments of the shipyard, and to the success attending it there was due its rapid extension in other works. He published a pamphlet on the subject, entitled "The Worth of Wages," conspicuous for its grasp of the principles underlying the labour question, and for its lucid exposition of the soundness and equity of the principle of payment for work by the piece. Later on he inaugurated a unique system of premiums for inventions or improvements made by workmen in machinery or modes of work, which has been attended with very successful results as regards the interests of both employers and employed. As evidence of this, it may be stated that during the comparatively short time it has been in vogue nearly 200 of the many claims made by workmen for improvements have received awards varying from £2 to £12, representing in all the disbursement by the firm of nearly £1000. Similar schemes have subsequently been introduced into several other industrial establishments on the Clyde and elsewhere.

Realising the need for extended premises and thoroughly modern appliances, if the firm were to keep abreast of the developments of marine architecture, Mr. Denny as managing partner inaugurated, about four years ago, a system of extension and rearrangement of their premises, which has scarcely yet been completed. Comprised in the scheme were the enlargement of the area to almost double its previous dimensions, the readjustment and increase of building berths so as to accommodate vesels of the greatest length, the formation of a new tidal dock and the erection of the most powerful shear legs now manufactured, the introduction of narrow gauge portable railways throughout every part of the premises, the introduction of the electric light throughout the offices and workshops, the substitution of powerful hydraulic punching, pressing, and rivetting machines for those worked by steam, the introduction of a telephone system embracing every section of the works as well as the residences of members of the firm, and the provision for accomplishing portions of the work of vessels' outfit, such as electric lighting, upholstery and saloon decoration, formerly contracted for outside the works.

Many of Mr. Denny's principal achievements, however, were connected with matters which though having risen in the conduct of his firm's business yet had a wide bearing and marked effect outside this limited sphere. A few of these may be briefly alluded to. One matter is the investigation of speed and resistance of steamships. As early as 1874-75, adopting what in a few cases had been carried out in Government vessels, he instituted the system of trying merchant steamers for speed progressively, on the measured mile, and recording the results graphically in such a way that the power required to propel the vessel at any other intermediate speeds than those for which the results were obtained could be at once measured, and an analysis of other elements made. This, and other advantages which need not be named, caused the practice to be followed by other private shipbuilders, until now it is almost universally adopted by firms of good standing. In 1875 Mr. Denny embodied the results of experiments of this nature in a paper, for which he was awarded a gold medal by the Institute of Shipbuilders and Engineers of Scotland. Appreciating the value of the experimental work with ships' models of the late Dr. William Froude, F.R.S., as regards throwing independent light on the nature of resistance, enabling a trustworthy estimate to be made of the propulsive power required for proposed ships, and affording additional knowledge of a ship's characteristics as evinced on trial, Mr. Denny established an experimental tank in connection with the works similar to that of the late Dr. Froude. No other private mercantile firm is possessed of any feature of a similar kind, and doubtless the exclusive knowledge acquired by its means will ultimately place the firm in a better position than their competitors to predict and obtain speed results with the smallest expenditure and with the least sacrifice of other desirable qualities. While speaking of these special facilities for acquiring the best results, reference may be made to the unusually large drawing staff employed by Messrs. Denny—the outcome, like many other features in the yard, of the ardent love of science and method on the part of the late managing partner. This feature in the organisation of the yard is one to which the utmost importance has been attached by Messrs. Denny, and in its maintenance a very large sum is expended annually. The staff includes many gentlemen who have brought to the work of the drawing-office all the advantages of a University training, and the larger number are students or past students of the Naval Architecture and Science classes held under the auspices of the Government Science and Art Department, an agency for education in which the late Mr. Denny took very great interest, and was instrumental in improving as regards the naval architecture branch. The analysis of stresses to which vessels are subject at sea, and the best means of providing against such without unduly weighting the structure, was another favourite study of the deceased. Early in his professional career he took exception, in an able paper read before the Institute of Naval Architects, to Lloyd's method of fixing scantlings, and advocated an alternative method aiming at a more minute and evenly-graduated scheme of scantlings. The criticism since kept up through other channels, has been the means of causing modifications to be made in the Registry rules as to scantlings and construction. At a very early stage in the introduction of mild steel as a shipbuilding material Mr. Denny took the matter up with great spirit, and did much by personal advocacy, as well as by its actual employment in the shipyard, to further its extended use. Early in 1879, while yet the Admiralty were hesitating to make large use of the new material, Mr. Denny secured the order for a large steamer which the enterprise of builders and owners alike determined should be constructed of mild steel entirely, and have steel boilers. This was the Buenos Ayrean, the first steel steamer employed on the Atlantic service. In order to meet the stringent conditions laid down by the registration societies as to the strength of material, as well as to satisfy all concerned, a powerful testing machine of the best make was introduced into the yard, and large numbers of experiments were conducted. The results of these, as well as of the working of the new material into the actual ships—of which several were soon in hand—were communicated to the Institution of Naval Architects in 1880, in a paper on "Steel in the Shipbuilding Yard." Mainly through Mr. Denny's representations, a serious hindrance to the development of steel shipbuilding was removed when it was arranged that the registry tests would be conducted before the material left the steel works, in place of when it had arrived in the shipyards. The economical aspect of the subject did not of course escape Mr. Denny, and in two or more papers read before the Iron and Steel Institute and the Institution of Mechanical Engineers he discussed the economical advantages of building in steel. A further matter worthy of notice in connection with the deceased is his share in the development of the modern system of fitting water-ballast cellular bottoms in steamers. Adopting it about seven years ago in four sister vessels for the British India Steam Navigation Company, Mr. Denny, on behalf of his firm, subsequently raised the important issue with the Board of Trade as to whether the tonnage of these vessels should be measured to the top of the inner bottom, or, as this body insisted upon, to an imaginary line, half-way down the double bottom—in fact to where the top of the ordinary floor would have come. It was maintained by Mr. Denny—and the Court upheld the contention—that as the register tonnage was meant to be a measure of the space available for cargo carrying, the top of the ceiling on the inner bottom was the only equitable line of measurement. The successful action of Mr. Denny in this matter removed a serious hindrance to the general adoption of the cellular water ballast system. The important subjects of overloading and instability of cargo steamers, to which attention has been so forcibly directed of late years, were always matters of deep concern to Mr. Denny. Aided by the large staff at his command he did much, by actual experiment, with vessels in the finished state and by elaborate calculations, to simplify the intricate problem of stability. The system of inclining vessels to ascertain the position of centre of gravity and of the metacentre has been followed by his firm for many years, and using the results of these inclining experiments as a basis, the elaborate and complicated problem of stability has been worked out for many of their vessels. Mr. Denny was a member of the Load-line Committee.

Mr. Denny's was a singularly active life, for not only in matters connected with the business of his firm and the furtherance of the profession he loved so well, but in affairs concerning the educational and social improvement of the people he laboured with untiring enthusiasm. He was instrumental in forming the Dumbarton School of Art; and, with his father and other friends, contributed funds for its accommodation in the Academy-buildings. He was a prominent member of the Philosophical Society of the town, and read papers on various subjects at its meetings. The co-operative and benevolent societies of the town had his warm sympathies and assistance. In these, and indeed almost all the institutions of the burgh — educational, benevolent, and social—he took a lively interest and contributed ungrudgingly to their support. All with whom he came in contact, either as a man of business or in any outside capacity, at once recognised in him a high-principled and courteous gentleman. With the officials and foremen of the works he was on excellent terms, and he had the faculty in rare degree of inspiring them with the same enthusiasm for work and study by which he was himself actuated. His death in the very prime of life, and in the midst of many projects charged with great consequence to the firm, the community of Dumbarton, and the shipbuilding profession generally, may well be deplored as a decided public loss. His death supplies another example, if one were wanting, that the man who overworks himself shortens his life, and is very far from having found true wisdom.

THE FASTEST BOAT IN THE WORLD.

THE application of twin-screws to torpedo boats is practically a new departure, for although twin-screws have been suggested and even used in fast launches capable of carrying a spar torpedo, they have never been adopted or even tried on a large scale in torpedo boats of the first class. The more interest therefore attaches to the trial trip made on Tuesday last of a twin-screw torpedo boat, one of two built for the Italian Government by Messrs. Yarrow and Co., of Poplar. This boat has the following dimensions:—Length on water line, 140ft.; beam, extreme, 14ft.; draft, 5ft. 4in.; displacement, 100 tons. Steam is supplied by two locomotive boilers, one forward and one abaft the engine room. Either boiler can supply either engine or both. The screws are driven by two pairs of compound engines, indicating over 1400-horse power combined. Condensing water is supplied by centrifugal pumping engines, arranged to pump out of any compartment in case of leakage, while ejectors and hand pumps are fitted to each of the main compartments. This boat is fitted with no less than ten water-tight bulkheads, and Yarrow's patent water-tight ashpan arrangement to both boilers, by which the fire is prevented being put out in case of water entering the stokeholes, and the boat can run 50 or 60 knots after the stokehole is flooded, an advantage the importance of which cannot be over-estimated. Double steam steering gear is fitted to work either rudder quite independently of the other.

The armament consists of two bow tubes and two at a very small angle with each other on a turntable aft for side discharge simultaneously, to ensure at least one torpedo hitting. She also carries two quick-firing Nordenfeldt guns. Cabins are fitted for the crew forward, petty officers right aft, and a saloon, lavatories, &c., are provided for officers further amidships.

The trial trip took place in the Lower Hope, below Gravesend. The weather was very rough, the number of people on board thirty-three, equipment complete, and load carried 12 tons.

	Steam pressure	Vacuum	Revolutions.	Speed.	Mean.	Second mean.
				knots.	knots.	knots.
1	135	27	365	22·641		
2	129	27	364	27·272	24·956	
3	128	26½	365	22·360	24·816	24·886
4	130	26½	370	27·692	25·026	24·921
5	131	26½	372	22·360	25·026	25·026
6	132	27	364	27·692	25·026	25·026
Means	130	26¾	366	—	—	24·964

This is practically a speed of 25 knots, or 28 miles per hour. *This is the greatest speed ever attained through the water by any ship or boat*, and is a wonderful performance. We shall have more to say concerning this Italian torpedo boat; meanwhile we may point out that our own Government would use only a necessary precaution if they took care to provide this country with an adequate number of similar boats.

STEAMSHIP OROYA.

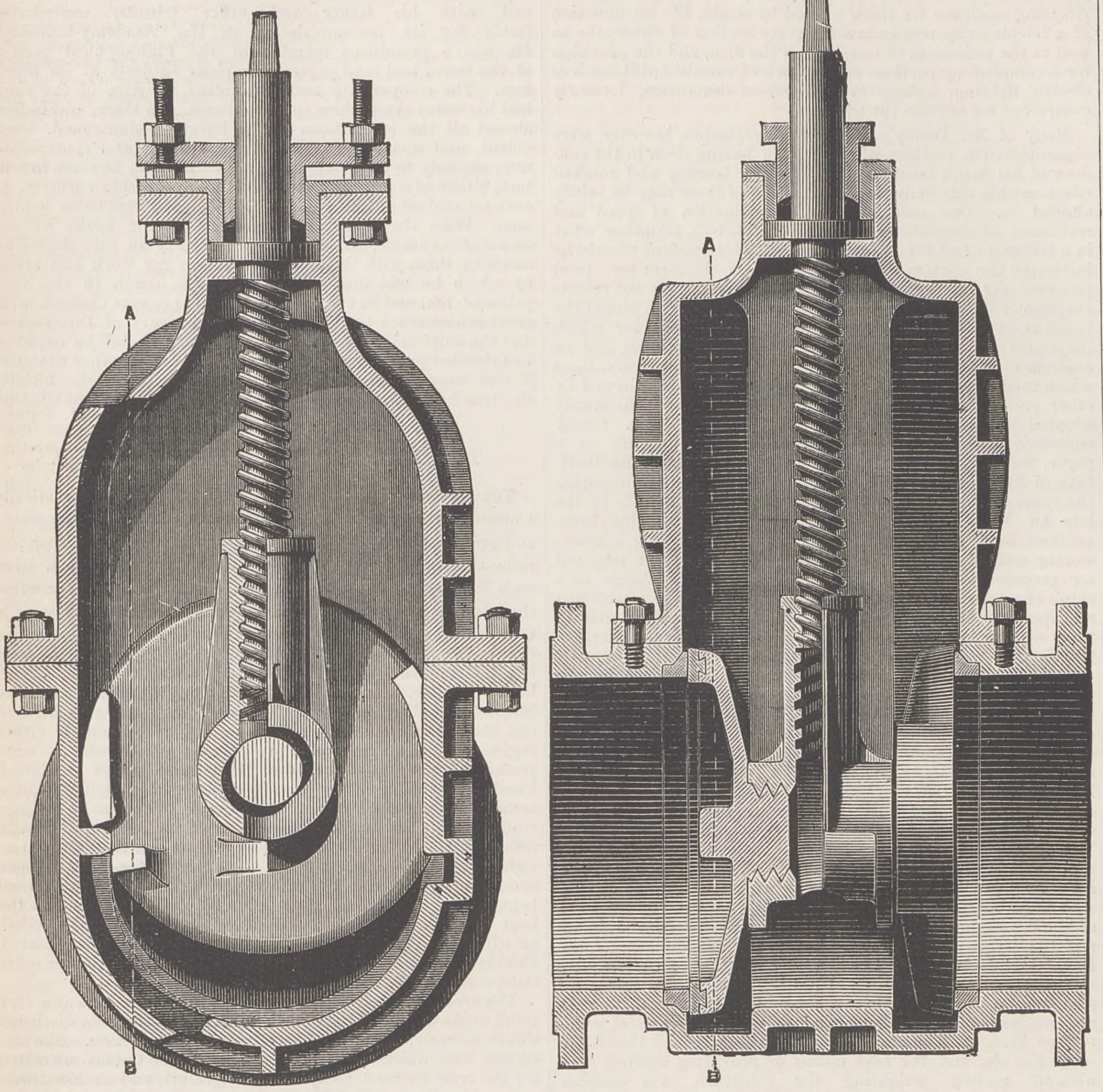
WE this week publish the first of a series of engravings of one of two large steamers (sister vessels) built by the Barrow Shipbuilding Company for the Pacific Steam Navigation Company. The vessel is intended to ply between London and South Australia under the Orient flag. She was launched in September last, and sailed from London on her maiden voyage on February 17th. The vessel is 460ft. in length, 49ft. in breadth, and 38ft. 3in. depth, moulded, and has a gross register tonnage of about 6200 tons. She is fore and aft rigged with four masts. The hull has been constructed on the longitudinal double-bottom principle, fitted with four complete closed-in-decks, all fore and aft, and promenade decks extending to the ship's side. Her superstructures consist of a short poop and forecastle, and a long range of 'midship deck-houses. The deck erections and various 'tween decks have been fitted up to accommodate 126 first, 154 second, and 412 third-class passengers, and have ample accommodation for officers and crew. We must postpone more minute description until we publish further engravings.

BEAM-BENDING AND PUNCHING MACHINE.

WE illustrate on page 231 an improved angle and beam-bending and punching machine, which has been made from improved designs for Messrs. D. New and Co., of Bishopsgate-street, London, and Melbourne, for one of their Australian customers.

The principal feature and novel improvement in this machine is the adjustment given to the side stops, which have a transverse movement from 12in. outwards, at the same time being adjustable in a direction parallel to the plunger. This arrangement allows of any bend being immediately set, commencing from almost a straight line to a most acute angle. The machine is capable of bending up to 6in. angle iron, and 10in. beams, and will punch holes 1in. diameter through 1in. thick. It is entirely self-contained in one massive casting, forming a very solid and powerful machine. It is complete with steam engine, stop motion to both ends, and punch stripper. Its total weight is 6¼ tons.

THE DENNIS FULLWAY VALVE.



THE DENNIS FULLWAY VALVE.

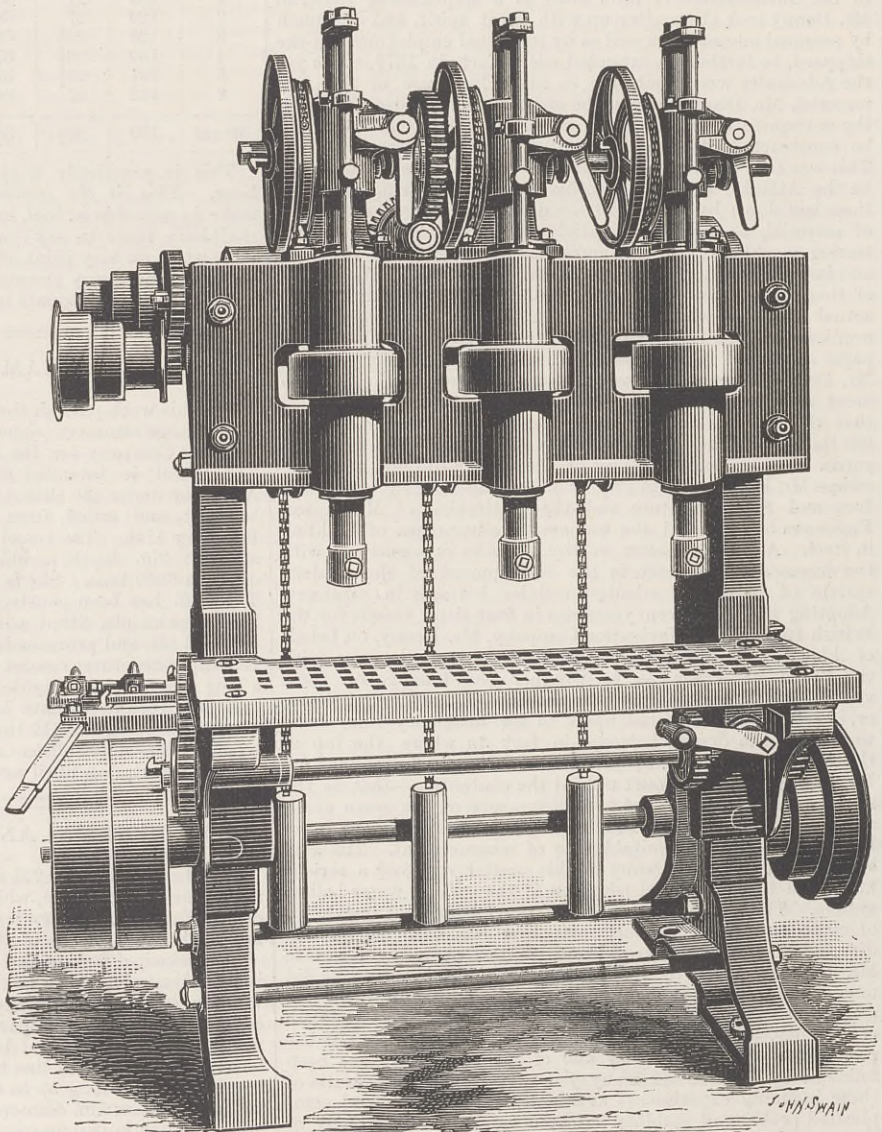
The above illustrations show fully the construction of the Dennis patent fullway valves, which are now being manufactured in cast iron in sizes from 2in. to 12in. by Mr. A. G. Mumford, Colchester, who has purchased the entire sets of patterns and sole right to manufacture. This valve possesses many advantages. It gives a straight fullway equal to the area of the pipe, and in the act of closing, owing to its peculiar construction, clears its seats thoroughly from all dirt, grit, or deposit. This valve can be fixed in any position, the spindle can be taken out, the cap removed, the whole interior of the valve can be examined, and the gland can be packed. Each and all of these operations can be performed without damage or trouble whilst the valve is under heavy pressure. The valves and valve seatings are faced with gun-metal, and the working nut and screw are also gun-metal. The construction of the valve will be readily understood from the engravings. It will be seen that it is really a double valve, the faces of which are pressed to their seats by the automatic action of the screw between them.

AUTOMATIC DRILLING MACHINE.

This machine has been designed by Messrs. Wilkinson and Lister, of Keighley, to meet the requirements of machinists and others who require to drill quantities of small holes up to 1in. diameter, in numbers of articles which are alike and require holes of the same depth. Proper holders are fixed on the table to secure the work, the spindles are then set to drill any required depth, a maximum of 6in. The machine then feeds itself to the depth, and releases the feed motion, returning clear of the work, which is replaced by another of the same article. Each spindle may be set to feed different depths, so that one class of work may be done on one spindle and another on the next. The machine is entirely self contained, being driven direct from the main shaft and provided with stop motion. The spindles are 13in. apart, and 1⅞in. diameter, with 6in. feed. The table to rise and lower by hand, admitting 18in. deep at lowest, and rising 16in. The weight is 32 cwt.

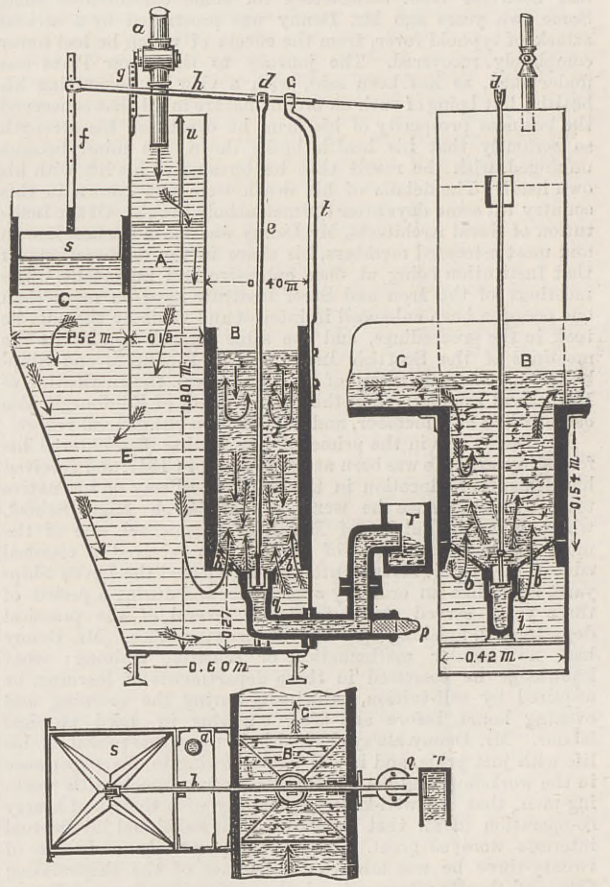
Our engraving is a front view of the tool, showing the balancing gear and the long heads in which the drill spindles are revolved. The gearing rotating the spindles being at the back of the framing is not seen. A tool of this kind cannot fail to prove useful in many shops. It is an example of the tendency now apparent to use special tools for special operations.

WILKINSON AND LISTER'S DRILLING MACHINE.



HYDRAULIC SEPARATORS AT THE MECHERNICH MINES.

In describing these separators, the American *Engineering and Mining Journal* says:—" The problem of handling and cheaply concentrating very large quantities of low-grade material has seldom been so successfully solved as at the mines of the above company. The amount of material daily treated is about 1400 tons, which contains 2 per cent. only of lead in the mass. The handling of such a mass has chiefly been made possible by the introduction of the automatic hydraulic lever separators, of which the accompanying cuts will explain the action. The hydraulic separator, as will be seen, consists of a boiler-iron rectangular tank, the lower portion of one narrow side of which is run bevelled to the bottom. The whole apparatus rests on two |———| iron girders. The tank is divided vertically by the partition plate *w* into two main chambers E and B. The front chamber B is lower than the rear chamber, and is connected on top with the inflow and outflow launders G. In the bottom it is formed like an ordinary Spitzkasten, with perforated bottom plates. This compartment is also lined with wood throughout, to resist the wear of the ore. The rear compartment E is again divided half way down by the partition Z into two smaller chambers A and C, also of equal height. The water to run the machine is admitted through the pipe *a* into the compartmeut A, in such a manner that it will have to pass through the perforated plate *u*, as shown by the arrows, before entering the body of the machine. This is done to prevent impact of the falling column of water having any effect on the working of the machine. The compartment C is, in its upper portion, lined with wood, and fitted with a wooden plunger or float S, which is suspended by the rod F to the lever *h*, whose fulcrum is at *i*, on the rod or support *t*, which, as shown, is bolted to the tank in the front of the compartment B. At the point *d*, on the lever *h*, is suspended the plug valve *v* by the stem *e*. This plug-valve is fitted to the opening of the conical perforated bottom *b* of the compartment B, and regulates the discharge through the pipe *q* into the receiving-trough *r*. The operation of the machine is as follows :—The material to be concentrated is run through the flume G, and falls into the front compartment B, in which it is met by an upward current of water, which, coming from A and C, is forced up through the perforated bottom *b*, thus



HYDRAULIC SEPARATORS

causing a separation of the lighter from the heavier particles. The pressure of the water column is maintained and regulated by the plunger S. Thus, when the richer ore-grains settle to the bottom, and gradually cover up the perforations, they check the upward current of water, and cause the column to rise, lifting the float S, which in turn, through the lever *h*, raises the valve *b*, whereby the accumulated concentrators are discharged into the trough *r*. This discharge lowers the head of water, and immediately closes the valve *v*, when the whole operation begins again. The machines are placed generally in batteries of three, and are really continuous automatic jigs, as well as sizing-boxes, each one of the three compartments taking a size smaller than the one preceding it. The amount each battery will treat, of material ground to 5 mm. size, is from 216 te 243 cubic feet per hour, with an expenditure of 1215 cubic feet of water. The size of the perforations of the bottom plates, the volume and the height of the water column, are regulated in each machine to suit the sizes to be treated. At Mechernich they have 124 of these machines in operation. Of the resulting materials, 98 per cent. is in coarse grains averaging from 20 to 24 per cent. of lead, which is re-crushed and treated on the slime-tables, and 2 per cent. of fine ore ready for the furnace, having a tenor of from 55 to 60 per cent. lead. In cases where the mineral to be concentrated occurs free from the gangue in grains varying from 1 to 5 mm. in size, the concentrates resulting from these machines fully equal what can be obtained from ordinary jigging ; and by curtailing the amount of material fed to each machine, almost perfect concentration is attainable. The advantage of these machines lies principally in their simplicity and enormous capacity in cases where a preliminary concentration can be made to save from 50 to 75 per cent. of the crushing expenses, which are always the chief item of cost in all concentrating works.

On concluding a series of lectures on "Basic-slag as a Manure," held at the Rhenish Agricultural Casino, Dr. Grupe gave a short biographical sketch of Sidney Gilchrist Thomas, ending with the remark that agriculturists in Germany would ever hold his memory in thankful remembrance as the inventor of a process which caused basic slag to be produced.

ON REVERSIBLE LEAD BATTERIES AND THEIR USE FOR ELECTRIC LIGHTING.[1]

By Desmond G. Fitz-Gerald M.S.T.E.

When the cheap production of electrical power by means of the dynamo machine was first realised as a *fait accompli*, there were many who naturally, but somewhat rashly, assumed that cheap electrical power would immediately become generally available for electric lighting in private dwellings and for many other applications on a small scale. These anticipations, we all know, were doomed to disappointment—most of us have found it impracticable to introduce electrical power into the household; and the privilege of making use of the most beautiful, cleanly, and hygienic means of artificial lighting has hitherto been denied to us. It may be interesting at the present moment—when the lead storage battery is claiming renewed attention—to glance briefly at the grounds for the sanguine anticipations which were formed soon after Werdermann brought the machine of Gramme into this country, to recall some of the main causes of their non-realisation, to examine critically the accepted views as to the chemical and electro-chemical reactions involved in the working of reversible lead batteries, to estimate the probable extent to which such batteries may be improved, or the room there may be for improvement, and, lastly, to consider, at least in its *primâ facie* aspect, the question as to the practicability of carrying the original anticipations into effect by means of an improved form of reversible lead battery.

It is admitted by high engineering authority that, with steam engines of improved construction and of not less than 300-horse power nominal, it is quite practicable to obtain a horse-power-hour mechanical by the combustion of 2 lb. avoirdupois of good coal. Allowing 20s. per ton for such coal, the cost of the fuel to develope this quantity of energy would be considerably under one farthing —·214d. Putting the commercial efficiency of the dynamo machine roughly at 70 per cent., the cost of the horse-power-hour electrical would be less than one-third of a penny—·306d. Taking everything into account, Sir W. Siemens in 1882 could not estimate the cost of production in London at a higher figure than nine-tenths of a penny—·895d. There are incandescent lamps that will yield a candle-power for every $2\frac{1}{2}$ watts expended; and, taking the horse-power electrical as 736 watts t would thus be equivalent to the illuminating power of 294 standard candles. The price in London of the gas to produce this illumination for one hour may be estimated at about $2\frac{1}{2}$d.; and in London gas is cheaper than in most other localities. It was natural that figures analogous to these should arouse sanguine anticipations in the electrical engineer—

"And duller should we be than the fat weed
That rots itself in ease on Lethe's wharf
Were we not moved at this."

But when, in this country and elsewhere, the requirements for domestic electric lighting came to be practically considered, it was found on the one hand that—in spite of the capabilities of the individual celebrated amongst our Parisian *confrères* as *le jardinier de M. Preece*—no private individual would, as a rule, willingly incur the prime outlay, trouble, and comparative expense of a small steam or gas engine and a dynamo machine; and, on the other hand, that the cost and difficulty of laying down leads to supply even a populous district with electrical power from a central station was a very serious consideration. After 1882, when electric lighting was made a stalking-horse by the worst sort of company promoter, it was clearly seen that this mode of supply, involving an investment of capital even larger than that which had gradually been made in gas, would be out of the question for many years to come. I have no doubt that it will ultimately be adopted to a large extent—but this will not be, I think, in the lifetime of those of us who have passed the middle-age; nor do I think that the distribution of electrical power from central stations will at any period altogether supersede the method of distribution, by means of elements in which electrical energy has been stored, to which I shall presently advert.

The electro-chemical means at present available for the storage of electrical energy cannot, either from a scientific or a practical point of view, be regarded as perfect; and it seems certain that they will be considerably improved in future years. The trite saying that the storage battery is still in its infancy is perhaps not inapplicable; but it would be a mistake to ignore the fact that important improvements have been made in this apparatus since—seven years ago—the cell of Gaston Planté was first modified by Camille Faure. Under the headings of "Storage Capacity," and "Weight per Horse-power-hour," I have jotted down from my notebook, in tabular form, some figures, subject to correction and

Table I.—*Storage Capacity of various Secondary Cells.*

Name of cell.	Per lb. of Pb.		Per kilo. of Pb.		Authority.
	Foot lbs.	Watt hours.	Kilogram-meters.	Watt hours.	
Planté	12,000	4·52	3,664	10	
Faure	18,000	6·78	5,495	15	
E.P.S. L plates	48,000 (?)	18·09 (?)	14,600 (?)	39·8(?)	Howard.
,, R ,, ...	36,080	13·6	11,010	30	(?) Hospitalier.
,, S nominal 22 lb. cell ..	31,800	12	9,540	26	Fitz-Gerald.
Elwell - Parker (old form)	6,633	2·5	2,018	5·5	Prospectus.
Lithanode battery (old form)	39,798	15	12,110	33	Fitz-Gerald.
Lithanode battery "Union" cell ..	47,170	17·8	14,671	39·16	G. Forbes.

Table II.—*Weight per Horse-power-hour Capacity of various Secondary Batteries.*

Name of battery.	Elements only.		Cell complete.		Authority.
	Lbs.	Kilos.	Lbs.	Kilos.	
Planté	..	..	396	180	Reynier.
Faure	..	..	88	40	Faure.
	..	..	165	75	Sir W. Thomson.
,, (old model) ..	..	..	198	90	Reynier.
,, (new model ..	..	..	134	61	
E.P.S. L plates ..	..	..	133	60·4	Prospectus.
	..	..	110	50	Reckenzaun.
,, S ,, ...	66	30	135	61·3	Fitz-Gerald.
Reynier Zinc posve.	50·6	23	117·5	53·4	R. Tamine.
Reynier Planté form	105	47·6	..	..	*Idem.*
Lithanode battery (old form)	42	19·1	76	34·5	Fitz-Gerald.
Lithanode battery "Union" cell.. ..	42	19	70	31·5	G. Forbes.

amplification, which in some measure illustrate this improvement, although there are other points of equal importance which require to be taken into account. The "lithanode" mentioned in these tables were the subject of a paper which I read at the British Association Meeting at Birmingham, and which will be found in the *Electrician* of September 10th last year. It is peroxide of lead—with more or less sulphate of the metal—in a coherent and highly-conductive form, having generally a specific gravity between 7·5 and 7·9. I shall have occasion again to refer to this material presently.

In Table I., I have taken the liberty of placing a note of interrogation after the values, relating to the storage capacity of the plates formerly manufactured by the Electrical Power Storage Company, taken from the paper read by my friend and old pupil, Mr. F. G. Howard, in June, 1885, at a meeting of students at the Institution of Civil Engineers. No doubt Mr. Howard referred to the total storage capacity, instead of the useful capacity, of these plates; but even in this case the value given would seem to be much too high. Certainly the plates now issued by the Electrical Power Storage Company are at least equal to those manufactured by them two years ago; and at the present moment the useful storage capacity claimed by them per lb. of battery is, I believe, three ampère-hours on a rough average. In the smaller cells this value may be surpassed—in the larger it is scarcely attained. The present "thin-plate" electrical power storage cells have a capacity of 2·8 ampère-hours per lb. of battery. In practice, as for instance at the Colonial and Indian Exhibition, this value we know is not always even approached. Now, taking the high value of three ampère-hours per lb. of battery, the horse-power-hour cell would weigh 129 lb. But, according to the values I have called into question, 41 lb. of lead in the battery would suffice to produce the horse-power-hour; and this lead would constitute only one-third of the total weight of the battery—a ratio which is far too small, and requires to be increased to at least one-half.

A high ratio of stored energy to weight is not always the most important consideration in a reversible lead battery; and the few data I have collected in tabular form would have been of greater interest if I had specified in each case the rate of discharge, since it is well-known that the useful capacity becomes diminished as this value is increased. I will to some extent remedy the omission by stating, in regard to the lithanode battery, that when the rate of discharge is about ·446 ampère per lb. of plates, or ·257 ampère per lb. of battery, the useful capacity may be as high as 9·32 ampère-hours per lb. of plates, or 5·3 ampère-hours per lb. of battery. But when the rate of discharge reaches ·64 ampère per lb. of plates, or ·36 ampère per lb. of battery, then the useful capacity falls to 8·6 ampère-hours per lb. of plates, or 4·8 ampère-hours per lb. of battery. These results have already been far surpassed in the laboratory; but they are probably the maxima hitherto obtained on a practical scale.

Whatever may be said of the lead storage battery itself, it is quite certain, I think, that our electro-chemical knowledge in relation to it is "in its infancy." We should be thankful even for small mercies in this direction, for very few electricians or electro-chemists have given any real attention to the matter, which is one of vital importance to progress. But we should be specially grateful to Dr. J. H. Gladstone and to the late Mr. Alfred Tribe, who gave a great deal of careful labour to "The Chemistry of the Secondary Batteries of Planté and Faure."[1] I am glad to say this before criticising, to the best of my ability, some of their conclusions from which I venture to differ—or to imagine that I differ.

In the first place there is a little matter—perhaps a *lapsus*—of no great importance perhaps in itself, but which seems to me of importance by reason of the detestation in which I hold anything in the form of white sulphate—non-conducting sulphate—in the negative element of a lead storage cell. In their little work, under the above-mentioned title, Messrs. Gladstone and Tribe propound the following question and answer:—"In a Planté or Faure battery, the mass of peroxide which is in contact with the—negative—metallic lead plate expends its energy slowly. How comes it to pass that if the same mass of peroxide be brought into connection, through the first lead plate, with another lead plate at a distance—in the same electrolyte—it expends its energy, through the greater length of sulphuric acid, in a tenth or a hundredth part of the time? The answer . . . . is doubtless to be found in the formation of the insoluble sulphate of lead, which clogs up the interstices of the peroxide, and after a while forms an almost impermeable coating of high resistance between it and the first metallic plate." Now, it appears to me that this suggested explanation involves a misconception as to the conditions which are favourable to the passage of the local current, of which the direction is from the metallic support to the peroxide through the electrolyte and from the peroxide to the metallic support by simple conductive contact. Not that the resistance—electrolytic—between the supporting plate and its peroxide is common both to the local circuit and to the main circuit; for there must be a simple conductive contact between the plate and the peroxide at one or more points—otherwise the detached layer of peroxide would become inactive, and there would be no current in either circuit—and the main current would pass wholly through this contact, as indeed would the local current in its passage from the peroxide to the support. But it is evident that the local current, under the given electro-motive force, will be inversely as the sum of the resistances in its circuit, and that one of these resistances—that which opposes its passage from the peroxide to the support—must be small—since otherwise the main current would be impeded. The remaining resistance in the local circuit—that which opposes the passage of the local current from the lead support to the peroxide through the electrolyte—must evidently be very considerable in order to comply with the conditions under which the current in the main circuit may be ten or a hundred times greater than that in the local circuit. In my view, the electrolytic resistance in the local circuit would be diminished instead of augmented by interposing even an almost impermeable—but more or less moist—coating of sulphate of lead between the peroxide and its support, excepting at one or more points where the peroxide and the lead would be in perfect contact. To maintain perfect unbroken contact everywhere between the layer of peroxide and the lead supporting-plate would, I think, be the best means of diminishing local action, by augmenting the electrolytic resistance in the local circuit. And this, in substance, was the burden of the paper read by Messrs. Drake and Gorham at the British Association last year.[2] The clogging up of the interstices in the peroxide might, I am ready to admit, be beneficial, provided this unbroken contact were maintained. It may be observed, however, that the suggested explanation appears to be further disproved by the figures given by the authors of the work referred to—page 6. During the first two hours, when the quantity of sulphate formed is a minimum, the quantity of peroxide reduced by local action is only 3·6 per cent. per hour. In the next hour, when the quantity of sulphate must have augmented, the percentage of peroxide reduced is shown to be nearly 8; and in the following hour it rises to about 10. It is true that this percentage afterwards diminishes, but this may well be due to a diminution of the electro-motive force acting in the local circuit.

Passing to a matter of more general importance, the equation given by the writers I have named as applicable to the batteries of Planté and of Faure—and presumably also to all lead secondary batteries with the same electrolyte—is substantially as follows:—

$$Pb\,O_2 + 2\,H_2\,S\,O_4 + Pb = \underbrace{Pb\,O + H_2\,S\,O_4} + Pb\,S\,O_4 + H_2\,O.$$

The compounds bracketted together react, however, upon each other, so that the final result may be expressed by

$$Pb\,O_2 + 2\,H_2\,S\,O_4 + Pb = 2\,Pb\,S\,O_4 + 2\,H_2\,O\,;$$

the final result being sulphate of lead on both plates.

This equation is very simple, and has been generally accepted as entirely satisfactory. As an expression merely of the chemical results observed, after a certain percentage of the peroxide has become reduced, it is perhaps unassailable. As an electro-chemical equation, applicable during the whole period of the discharge of a lead secondary battery with the given electrolyte, it is impossible, I think, to accept it. I will endeavour to lay before you the difficulties I have found in the way of its acceptance. But in the first place it will be expedient to consider whether there has been any intention of putting forward or accepting the above formula as an electro-chemical equation, expressing the reactions on which the efficiency of the battery is dependent. Has there actually been any assumption that the whole of the peroxide is, or may be, converted into sulphate of lead? that a large proportion of isolated sulphate of lead, "white sulphate," is necessarily produced in discharging the battery? that the reduction of the peroxide takes place, not in two or more stages, but continuously? and that the electro-motive force of the battery is independent of the quantity of sulphate which has been produced from the peroxide? Because, if not, I might be setting up imaginary antagonists and incurring unnecessary trouble in endeavouring to overcome them.

The authors of the work already referred to make use of the expression given above: "The final result being sulphate of lead in both plates." Dr. Gladstone, moreover, has explained that, "When we stated that sulphate of lead is finally the only product of the discharge, we were referring to the disappearance of any peroxide, and did not mean to imply that in actual practice the whole of the spongy lead is usually converted into sulphate." Mr. Tribe, in the *Electrician* of July 10th, 1885, wrote that "One of the conclusions was that both the peroxide of the negative plate and the finely-divided lead of the positive were converted into lead sulphate during discharge." Mr. George F. Barker, in his paper read at the Montreal meeting of the American Association for the Advancement of Science, says: "My experiments with the Faure battery confirm entirely these of Gladstone and Tribe as to the formation of lead sulphate." "On examining the plates, lead sulphate formed the entire coating upon both of them." Mr. C. T. Kingzett states that "As fast as the monoxide of lead, produced by reduction at the negative pole during discharge, forms, it is converted into sulphate. Upon complete discharge, then, there remain two supports of lead coated with sulphate of lead." And Professor Oliver Lodge says: "The use of peroxide alone—without any support of lead—looks hopeful; but, when the cell is discharged and the peroxide reduced, the plate will no longer be a conductor—and it does not appear probable that such a cell could ever be charged up again." This conclusion, I may here state is emphatically disproved by the "lithanode" battery plates now before you, most of which have been charged and discharged down to the potential of 1·8 volt—a great number of times, without losing their conductivity or exhibiting the smallest patch of "white sulphate."

Mr. G. F. Barker further observes that, "Obviously, so long as any peroxide is present, the electro-motive force is constant." The same experimenter also makes the following very suggestive note, showing that one at least of his cells had been, apparently accidentally, worked upon an improved system. He says: "In one of my Planté cells the peroxide is beautifully crystalline and very hard. Not a trace of—free—sulphate has been formed in it apparently, though it has been in use for six months, and has been frequently charged and discharged during that time." On the other hand, Messrs. Gladstone and Tribe state—*loc. cit.* p. 32—in relation to the negative plate: "At the conclusion of the action, we have always found more or less of the substance unaltered. Thus, as one instance, after a discharge lasting five days, and approximately complete, we found that only 68 per cent. of the deposit was lead sulphate." And Mr. J. Swinburne—in the *Electrician* of July 10th, 1885—makes an important observation in the same direction. He says: "The appearance of the coating of an ordinary discharged peroxide plate does not prove the absence of sulphate, for only a very small proportion can be sulphate. Some years ago, when I made a large number of experiments on batteries, I found that in no case more than six or seven per cent. of the coating is used, even when the cell is completely run down. The expansion of the peroxide of lead in becoming sulphate perhaps blocks the coating up."

Let me at once observe that if Mr. Barker were right in stating that the electro-motive force is constant so long as any peroxide is present, I should have no difficulty in accepting the above-mentioned formula as the electro-chemical equation applicable to lead secondary batteries. But, like Mr. Swinburne, I have found that long before the whole of the peroxide is exhausted the electro-motive force has fallen practically to zero. If the formula be true, as the electro-chemical equation of the battery, why should there be any fall in the electro-motive force before the peroxide is exhausted? Is it because the peroxide becomes "blocked up" or clogged, or so diluted by the inert material, that the support becomes rapidly "polarised" by hydrogen? If so, the formula may be true. But on open circuit, when there can be no polarisation, and with a strip of solid peroxide without support, we should, if the formula be true, obtain the full electro-motive force corresponding to the nature of the chemical reaction indicated by it. We should expect this so long as any peroxide remained — certainly when only 25 per cent. of the quantity originally present had been consumed. For, a true "battery equation" is of course independent of the resistance of the circuit, and indicates a definite electro-motive force. Conversely, if the electro-motive force alters—temperature and certain other conditions remaining the same—we know that the given battery equation no longer applies, that the original chemical reaction has given place to or has become complicated by another chemical reaction. I take two strips of platinum, to be used as negative elements with a positive of spongy lead in an electrolyte of dilute sulphuric acid. One platinum strip (A) I coat with a paste of electrolytic peroxide of lead; the second strip (B) I coat with a paste composed of one part of electrolytic peroxide of lead and one and one-third part of sulphate of lead—equivalent weights roughly—mixed together and with water. The couples are circuited, consecutively, through 60,000 ohms and a reflecting galvanometer of high resistance. The A couple, as soon as the negative becomes moistened by the electrolyte, gives a steady deflection of 130 divisions, corresponding to an electro-motive force of about two volts. I short-circuit this couple for 30 sec., or for ten times this period—of course the deflection falls to zero; but, when the short circuit is broken, the spot of light moves back to 130 within a few seconds. The B couple gives 128 divisions, falling steadily within a few minutes to 72 divisions, corresponding to rather more than one volt—this through a resistance of over 60,000 ohms. I short-circuit this couple for one second; on breaking the short-circuit the deflection is 20 divisions, becoming in five minutes 67 divisions. A strip of plain platinum gave a deflection of 56 divisions, falling in five minutes to 42. It must be admitted that the result obtained with B was somewhat better than this; nevertheless, the effect of the sulphate in reducing the efficacy of the peroxide is sufficiently striking. Still more so is its effect in the case of solid peroxide—lithanode—not in contact with any other simple conductor within the electrolyte. But in order to judge of the effect in this case we must be able to analyse the lithanode chemically at the outset, and also when the electro-motive force between it and spongy lead has fallen to any given extent.

(*To be continued.*)

[1] The Society of Telegraph Engineers and Electricians.

[1] Their work, under this title, is published by Macmillan.

[2] "On the Treatment of Secondary Batteries."

The Metal Trades Displays at Birmingham.—The magnificent Metal Trades' Arch, which formed one of the conspicuous objects on the occasion of the Queen's visit to Birmingham on Wednesday, stands as a striking monument to the unbounded resources of the town. The structure has been made from the plans of Mr. T. W. Camm, of the firm of Messrs. R. W. Winfield and Co., and it is composed of materials supplied by no fewer than thirty leading firms. Of the three arches, the central, or main arch, has a span of 15ft. rising to an internal elevation of 20ft., whilst the minor arches have a span of 6ft. 6in., and a height to the centre of the arch of 15ft. For a fortnight previous to Wednesday, 200 workmen had been constantly engaged in its erection. The Gunmakers' Arch was another striking object of the Queen's visit. It was constructed from designs prepared by Mr. J. S. Holliday, of Birmingham. Composed of all descriptions of implements appertaining to war, the central arch had a span of 24ft., while the width of the whole structure, including two subsidiary arches, was 61ft. The keystone of the central arch rose to a distance of 27ft. 6in., while the height of the superstructure from the ground was 39ft. Among the contributors to the materials used were Messrs. Hollis and Sons, Webley and Son, C. Osborn and Son, Bonehill and Co., Kennedy and Co., Mold and Son, the National Arms Company, and Cooper and Goodman.

THE ENGINEERING TRADES AND THE LONDON CHAMBER OF COMMERCE.

A MEETING was held on Thursday at the offices of the London Chamber of Commerce, King William-street, City, to consider the advisability of forming an engineering and allied trades section of the Chamber. Sir Bernhard Samuelson, M.P., presided.

The President of the Chamber—Mr. Tritton—stated that the basis on which it was established was one which the Council believed insured a thorough representation, and at the same time a means of mutual inter-communication between the different trades and sections of the commerce of London. They had now between 2300 and 2500 members from every important trade, and seventeen trade sections had been formed. Each committee had a chairman and vice-chairman, and the chairman of the committee had a seat at the Council of the Chamber. They had alliances practically all over the world. They were exceedingly anxious to do what they could to further the trade interests of Great Britain in foreign countries by bringing pressure to bear in one or two quarters. They were persuaded that the representatives of foreign Governments did no more abroad to support the trade of their countries than the representatives of our Government did to support British trade. That point had been continually before them, and it was one of which, he imagined, the representatives of the engineering trade would take considerable note, their exports being so large. It was for them now to say whether a section to represent their interests should be formed in connection with the Chamber.

The Chairman then read letters in support of the proposal from Mr. W. J. Ruston—Messrs. Ruston, Proctor, and Co., Lincoln—and from Mr. E. Hutchings, the secretary of the General Association of Master Engineers, Shipbuilders, and Iron and Brassfounders, Manchester. He afterwards observed that, so far as the technical aspect of the question was concerned, there were probably no more powerful organisations in the world than the Institute of Civil Engineers, the Institute of Mechanical Engineers —the president of which, Mr. E. H. Carbutt, he was glad to see at the meeting—and the Iron and Steel Institute; but none of those Institutions had a directly commercial object. What they did was to try and keep this country to the front as the engineers of the world, but while we were in that position the commercial aspect still remained to be attended to, and in connection with that matter he trusted that considerable advantage would be derived by the alliance now proposed with the London Chamber of Commerce.

Mr. Ewing Matheson—Matheson and Grant—said he thought that there were many among the London engineers, especially those who were concerned in foreign trade, who felt the necessity of some such organised body to speak and act on their behalf when occasion arose. There were questions in connection with foreign tariffs, Government contracts abroad, and many other matters with which they as firms or individuals seemed powerless when speaking alone, but concerning which they would, by means of a properly constituted representative body, be able to make themselves heard.

Mr. Carbutt expressed his belief that if the proposed section could be organised on the same strong footing as the scientific institutions connected with engineering, they would be able to induce the Government to do more for them. They did not want our ambassadors or *attachés* to act for them, but they asked that our ambassadors should keep them alive to what was going on abroad respecting matters in which engineers were interested. The Government were doing a great deal in regard to that subject in the reports they were publishing from the consuls, but they always wanted directing. No Government could possess all the requisite knowledge, and if engineers were to do anything it was necessary that they should organise themselves. He was glad that the London Chamber of Commerce had taken up the matter. He then proposed—"That this meeting approves of the formation of a Trade Section in connection with the London Chamber of Commerce, to represent the various branches of the engineering trades."

Mr. James Howard, Bedford, seconded the motion, observing that the proposal had commended itself to him from the outset. He could judge of the influence that such an organisation could exert on foreign tariffs by the experience gained by the Agricultural Engineers' Association, who, through a proper representation of the facts, had prevented in more than one country in Europe either the imposition of new duties or the increase of existing ones. It would be useful also to collect information as to what was going on in several countries which are customers of England for engineers' products. The reports of the consuls were not of the most reliable character, and some of those which had been published seem to have been inspired by persons who were interested in pushing German or American wares.

Mr. George Buchanan, of Bucklersbury, supported the motion, which was carried unanimously.

The meeting then proceeded to the election of a committee of the section, and the following gentlemen were appointed with power to add to their number:—Sir Bernhard Samuelson, Bart., M.P., chairman; Charles Appleby, John Bayley (Brown, Bayley, and Dixon, Sheffield), Alex. Buchanan (Handyside and Co.), Sir Samuel Canning, E. H. Carbutt, Henry Chapman, Major-General Clarke, Alfred Giles, M.P., James Howard, Bedford; Ewing Matheson, G. E. Moberley (Ransomes, Sims, and Head, Ipswich), E. A. Pontifex (Pontifex and Wood), R. C. Rapier, T. H. Richardson (Belckow, Vaughan), Sir R. M. Stephenson, Col. the Hon. Le Poer Trench, R.E. (Edison's Indian and Colonial Electric Company), Joseph Hartley Wicksteed (Buckton and Co., Leeds), E. Williams (Merryweather and Sons).

Mr. C. Appleby proposed, and Mr. Carbutt seconded, a vote of thanks to the chairman.

It was subsequently arranged that unless the secretary of the Chamber, Mr. Kenric B. Murray, should find it necessary to call the committee together earlier, the first meeting should be held on the 28th proximo.

WAKEFIELD WATER SUPPLY.

THE town of Wakefield will this year be placed in possession of a new water supply from the Rishworth Moor, the strata of which consists of shales and millstone grits, and is, in fact, a similar gathering ground to that enjoyed by Leeds, Bradford, Halifax, and Huddersfield. The reservoir for the supply is known as the Ringstone, and is located four miles south-west of Sowerby Bridge. At the end of November it contained 200 million gallons of water. Its actual holding capacity, however, is 300 million gallons, and the surface, when the reservoir is entirely full, reaches a level of 994ft. above the sea. The Ringstone reservoir covers 47 acres. The water is gathered over a distance of nearly five miles by an open conduit which runs along the base of the Rishworth moors—an extensive tract of land forming part of the Savile estates, situate from 1000ft. to 1500ft. above the sea level, and having an average rainfall of about 45in. The conduit in question intercepts and carries to the reservoir all the surface water, which would otherwise find its way into the Booth Dean Clough, a mountain gorge forming one of the tributaries of the river Ryburn. Along the course of the lower reaches of the Clough, as well as further down on the Ryburn, there are several mills. The rights of the owners to a head of water are provided for. By means of a massive bye-wash or channel of escape at the entrance of the reservoir and dams at different points of the catchwater, all overflow water is discharged into the lower reaches of the Clough. The area of the surface whose waters are intercepted and carried away to Ringstone is about 2000 acres, and besides this large expanse there are also about 1200 acres which may be utilised whenever necessary. From the reservoir to Wakefield a distance of seventeen miles has to be traversed. The water will come directly from the west by Sowerby Bridge, Mirfield, Dewsbury, and on to a storage reservoir which is located in a secluded situation on the Tingley side of Ardsley. Mr. Filliter, the engineer, has urged filtration as tending to improve the quality of the water—to make it pleasanter to drink and more agreeable to the eye. The Corporation are accordingly endeavouring to renew their powers for the purchase of land for the purpose of filter beds, leaving for subsequent decision whether it is desirable to incur the additional expense of filtration, according to their experience of the unfiltrated water when it reaches the town. Kirkhamgate, between Ardsley and Wakefield, is the place selected for the probable filter beds. Powers are also being sought to construct a small reservoir to hold filtered water at Lindle Hill, near Alverthorpe, in order that filtration may be continuously performed day and night, irrespective of the variation of the quantity supplied to the town. Whether water be drawn direct from Ardsley or from Lindle Hill, it will reach Wakefield by gravitation, and no pumping will be necessary; in fact, Lindle Hill has a greater elevation by 70ft. than the Field Head reservoir, from which water at present flows to the town. Pumping would only be necessary in case the borough should grow at its extremities. The contractors for the Ringstone reservoir were Messrs. Metcalfe and Sons, Bradford; for the Ardsley reservoir, Mr. Donkin, Newcastle; and for the Moss Moor catchwater, Messrs. Baker and Sons, Chesterfield. The cast iron pipes were supplied by Messrs. Cockrayne, Grove, and Co., Middlesbrough, and were laid by Mr. S. Jowett, Brighouse. The site was selected because of its elevation, and because it formed part of a valley whose conformation favoured the construction of such a reservoir. Operations, however, had not proceeded far when they were stopped by a claim against the Corporation for £70,000 made by Messrs. Holliday, of the Ardsley Colliery, on the ground that the construction of the reservoir would entail loss upon them by preventing the sinking of a contemplated shaft, and because of interference with their rights of way. The matter went for arbitration before Mr. Baker Foster. The umpire's award was made in two forms, but practically the claim was reduced to £9000 for the privileges the Wakefield Corporation absolutely required, and £4000 in addition if the authorities afterwards desired certain advantages not up to that point demanded. The physical defect encountered, which largely brought about these proceedings, was the extension for a very great distance, and far beyond expectation, of old coal workings. This required an alteration of the original scheme, and instead of the supposed necessity for a small puddle-trench across the valley, as is usual in such cases, a ring-trench of puddle has had to be formed round the reservoir, reaching down to the old coal-workings, so as to cut them off effectually from the reservoir. The *Leeds Mercury* says the reservoir is expected to be completed in the course of the summer; and as all the other works are in readiness, Wakefield will soon be placed in the enjoyment of a serviceable water supply, which, it may well be hoped, after all their doleful experiences, will reward the inhabitants for their patience and undaunted perseverance under so many difficulties.

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

A new system of cable railroad.—At Chicago, Ill., the Chicago West Division Railroad Co. is experimenting with a new system of cable traction, on a section 3000ft. long, which is a radical departure from systems now in use. The iron conduit is 7·5in. deep and 6in. wide, laid on the wooden cross-ties; it is held in place by brackets, to which are attached stay rods secured to the track stringers. The cable is a 1in. wire rope with "buttons" 3¼in. diameter, fastened at intervals of 8in., while at intervals of 6ft. are placed buttons provided with small wheels so that the sag of the cable will not drag on the bottom of the conduit. On the car, between the carrying axles, is a "sprocket" wheel 18in. diameter on the pitch circle, with seven sprocket arms; this wheel is ⅝in. thick at the centre, and ⅛in. at the rim, so that the arms can enter 5in. into the conduit through the ⅝in. slot; on the same axle, and bolted to this wheel, is a brake wheel for a strap brake 3½in. wide. When the driver keeps this brake off, the cable merely causes the sprocket wheel to revolve on its journals; as the brake is applied the car moves, and when it is hard on, so that the sprocket wheel cannot revolve, the car is carried on at the full speed of the cable. The details for traversing curves and changes of grade have been fully worked out, as well as the minor details of construction. The sprocket wheel can be raised clear out of the slot and the car drawn by horses. The cost of track, equipment, plant, &c., complete, for heavy city traffic, is estimated at 20,000 dols. per mile.

A large railroad contract.—One of the most important railroad projects is a line 500 miles long, from Minto, Dak., across Dakota Territory to the Great Falls of the Missouri river in Montana, where it will connect with the Montana Central Railroad, thus forming a new route from the mineral regions of Montana, which will be developed by the ramifications of the Montana Central Railroad to St. Paul, Minn., and Chicago, Ill., by way of the St. Paul, Minneapolis, and Manitoba Railroad. This line is under contract to Shepard, Winston and Co., of St. Paul, who will have grading commenced in April.

A new torpedo boat.—General Berdan has submitted a model of his newly-invented torpedo boat to the House Naval Committee. The intention is to render protective netting ineffective. Vertical torpedo tubes are placed on the sides, and the torpedoes are connected to cables hung from the bow. The vessel is provided with a long sliding bowsprit. When this spar touches the ship to be attacked, it is forced back, reversing the engines and firing the rocket charges in the torpedo tubes. The torpedoes start downward, but the cables cause them to assume a horizontal position at such a depth as to be below the guard net, and they then incline upwards and strike the vessel, exploding by concussion. The boat is intended to attain a speed of 25·5 knots per hour.

A new trunk railroad system.—One of the greatest railroad deals, and one that has agitated all railroad and financial circles, has recently been consummated. This is no other than the transfer of the Baltimore and Ohio Railroad from the Garretts to Mr. Sully, who now has control of a trunk system aggregating 16,000 miles of track. This system now comprises the Baltimore and Ohio Railroad, the Central Railroad of New Jersey, the Philadelphia and Reading Railroad, the Richmond and Danville and the Richmond Terminal Systems, the East Tennessee, Virginia and Georgia Railroad, and the Georgia Central Railroad. The control of the Baltimore and Ohio Telegraph Company is included in the deal. Ever since the disagreement between the Baltimore and Ohio Railroad Company and the Pennsylvania Railroad Company there have been various rumours of an independent line for the former road from Philadelphia to Jersey City—opposite New York—but now the question of access to New York is settled, as the Philadelphia and Reading Railroad and Jersey Central Railroad will form the route. The transfer has given great surprise, as the road was a family possession of the Garretts, and had always been considered out of the market. It is probable, however, that Robert Garrett will retain the position of President. The transfer having only been announced on March 9th, there is, of course, lack of details but abundance of rumours; all the interested parties are disposed to be reticent, Wall-street is more agitated over this deal than it has been for a long time, partly because the deal is so stupendous and partly because of its wide-reaching effects, the limits of which cannot yet be grasped. The Baltimore and Ohio system comprises 2592·27 miles of track, of which 840·5 are on the main stem. Of actual lines of road the system includes the line from Baltimore, Md., to Wheeling, W. Va., 379 miles; branches owned, 75·75 miles; branches leased, 113·5 miles; other lines controlled by lease or ownership, 1038·04 miles; other lines operated, 86·25 miles; Ohio river bridges, 3 miles; total, 1695·54 miles. The company was incorporated in 1827 in Maryland and Virginia.

Minerals for Europe.—At the tourmaline deposits in Maine are found amblygonite, lepidolite, and spodumene, which minerals contain the largest amount of lithia. A German firm gives orders for twelve tons of the minerals per month, and firms in England and France are making inquiries and procuring samples. Silver and lead ore is mined in Maine.

Poughkeepsie Bridge system of railroads.—The great cantilever bridge now being constructed across the Hudson River at Poughkeepsie, N.Y., will be a greater feature in railroad arrangements than was contemplated. Its construction was intended to afford a direct route between the coalfields of Pennsylvania and the manufacturing districts of New England, without the roundabout way by Albany to the north, New York to the south, or the ferryage at Newburg, where the river alone separated the railroad systems. Since the project became definite and construction has commenced, several short connecting lines have been chartered to unite the bridge with various railroad systems, but a scheme is now on foot, backed by a powerful syndicate, to form a new through route from New England to the West. The syndicate has acquired a controlling interest in the Hartford and Connecticut Western Railroad, and the plan includes the extension of the Massachusetts Central Railroad by the Boston and Lowell Railroad Company and the building of certain links to connect the lines with the bridge; on the west side a line will be built to the Pennsylvania anthracite coal-fields, and connections will be made with the Philadelphia and Reading Railroad, Lehigh Valley Railroad, Jersey Central Railroad, Pennsylvania Railroad, N.Y., Lake Erie and Western Railroad, N.Y., Ontario and Western Railroad, N.Y., Susquehanna and Western Railroad, and other systems. The projected route from New England to the West would be 100 miles shorter than existing routes. Work is progressing rapidly on the bridge piers, and the iron and steel for the superstructure is being delivered. The rival Hudson River Bridge schemes crop up occasionally but the Poughkeepsie Bridge is now a definite item for consideration.

A new system of submarine tunnel.—The Submarine Tunnel and Tube Company, of New York, operating the Hall patents, has been awarded the contract for the railroad tunnel, seven miles long, under the Northumberland Straits between Prince Edward's Island and New Brunswick, and the plans and specification have been prepared. The tunnel consists of an iron tube built up under water as it progresses, and avoiding heavy excavating. The work is done in a large iron caisson, in which is a steam engine and all appliances. As each ring is completed the caisson is moved forward. At first this movement was designed to be by a hauling chain, but hydraulic jacks are now used, butting against the end of the tunnel. The rings are in sections for large tunnels, and the end rings enter the caisson by a stuffing-box, in which the packing consists of a rubber tube, into which water is pumped. This system has been successfully applied to the laying of water mains under water.

Elevated railroads in Brooklyn, N.Y.—Since the opening of the Brooklyn Elevated Railroad there have been numerous schemes put forward, and in some cases work has been commenced, only to be stopped by the inevitable and endless litigation. The commission appointed to consider the question of rapid transit approved certain routes, but did not much help on the practical result. Work has, however, now been commenced finally on the Union Elevated Railroad, and will be pushed to completion. The first section to be built will be from the depôt of the Long Island Railroad to the Brooklyn Bridge, but the tracks will not, at any rate as yet, connect with the railroad tracks on the bridge, as the cars would have to be fitted with cable grips in order to use the present bridge cable railroad over to New York.

Ammoniacal gas locomotive.—An experiment with a fireless motor for street railroads was made at New Orleans, La., March 1st, by the Standard Fireless Engine Company. An extensive plant has been established for the manufacture of the gas, which is forced into reservoirs placed under the seats of the car, and operates an engine driving the car wheels. The operation is controlled from the front platform. The company operates the patents of P. J. McMahon.

Another cable railroad.—The first section of the cable line at Brooklyn, N.Y., has been completed, but the cars are being hauled by horses as yet till the engines have been working for some time, so as to eliminate the chances of any unforeseen hitch. The cars are of Pullman build, very large and roomy, but very heavy, requiring special teams. The grip levers are placed so as not to obstruct the front platform, as they do on the New York line. The line is controlled by the Atlantic Avenue Railroad Company.

Oil production.—A Bill has been introduced into the Pennsylvania Legislature providing that no oil or gas well shall be drilled within 300ft. of boundary lines of property, except on the line, when the yield will be divided. This is to restrict the oil production, as now when a well is sunk near a boundary it drains from the adjoining tract, so that the owners thereof are compelled to sink a well on their side to prevent the production being drained off.

LAUNCHES AND TRIAL TRIPS.

ON March 12th Messrs. Oswald Mordaunt and Co. launched at Southampton an iron sailing ship of about 2500 tons net register, built to the order of Messrs. R. W. Leyland and Co., and of the following dimensions:—Length, about 320ft. 6in.; breadth, 41ft. 7in.; depth of hold, 24ft. 5in. The vessel is full rigged, and built to class 100 A Lloyd's. She has a turtle back aft, long bridge deck amidships for accommodation of captain, officers, and apprentices, whilst crew is housed in fore end of same, whilst on bridge deck a large deck house is fitted for chart-room and wheel house. Iron deck house is fitted forward of bridge for petty officers and galley. Two double powered winches are fitted, and one portable winch for working cargo, &c., long monkey forecastle for working anchors. The vessel has been built under the super intendence of Captain Enright. The vessel was gracefully launched and named Toxteth by Mrs. Green, sister of the Mayor of Southampton.

On Saturday the s. s. Haitan, which has been built by Messrs. Raylton Dixon and Co. for the Douglas Steamship Company, of Hong Kong, left Middlesbrough Dock on her trial trip, which was very satisfactory. She is built of steel on very fine lines, being intended for good speed, and of the following dimensions:—Length overall, 284ft.; breadth, 32ft.; depth of hold, 24ft. Constructed on the three deck rule, she has a clear upper deck of teak, with deck house aft, bridge, and forecastle. Double bottom for water ballast on cellular system throughout. The whole of the 'tween decks from end to end is fitted for passengers. The afterend for 120 second-class. She is specially fitted and ventilated for carrying tea cargoes, of which she can load about 3000 tons, and has large cargo ports in the 'tween decks as well as gangways on deck for convenience of loading. Her steam winches are compound. The engines with which she is fitted are of the latest triple expansion three-cylinder type, capable of developing 2000-horse power, and supplied with forced draught to the boilers. The engines worked perfectly on the trial trip, and produced a speed of over 14¼ knots average.

THERE have been more floods in Queensland, bringing with them loss of life and great injury to property. The *Colonies and India* says the latest reports from the Logan and the Albert Rivers show that in one place about 260 people were reduced to a state of starvation, and were destitute of clothing or shelter. On the Upper Logan the watercourses rose 120ft. The Waterford bridge was all right, but the Logan railway bridge, which cost £12,000, was swept away. Mr. John Brown, sawmiller, was drowned at Swan Creek, near Warwick. The water rose there 30ft. in half an hour. The shores of Moreton Bay were lined with dead cattle, pigs, and fish of all descriptions.

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

(*From our own Correspondent.*)

In reporting upon the present condition of trade in this district it must be remembered that we are nearing the end of the quarter. Such a period is never one when much activity can be expected, particularly as regards shipping orders. There is no denying that the extent of business being done is becoming somewhat less.

The advices from a few of the colonial and foreign markets are, however, of a more hopeful sort, since they speak of stocks running low, and it is considered certain that consumers must go in for replenishment before much time elapses.

Local consumers are taking good supplies of sheets for working up purposes; bars for hurdle and fencing, and other uses; and strips for gas tube and nail manufacture. It is upon this class of custom that some of our works are now mostly dependent, and it is keeping them running with fair regularity. Some nice orders are just now about for sheet and plate iron to be used in the construction of iron railway goods wagons for the Indian railways.

Prices of finished iron are not stronger, but no surprise can be expressed at this, since the rates for pig iron are easier. Best bars keep at £7 for first qualities, £6 for second branded sorts, and £5 as the minimum for common descriptions. Prices of hoops vary greatly, but £5 7s. 6d. to £5 10s. may be mentioned as about a good average. Common strips are £5 to £5 5s. North Staffordshire and Welsh common bars can be bought delivered in this district at slightly under South Staffordshire makers' prices.

Ordinary sheets continue to occupy a better position upon the market than any other branch, and prospects are more favourable for these makers than for any other, though there are indications of increasing competition. £6 is about all that can be got for singles, while doubles are £6 7s. 6d. to £6 10s., and lattens in proportion.

This week's Australian mail is the most satisfactory that has been received for some time past. Advices from Melbourne notify the improved demand for galvanised iron and all classes of iron goods. Heavy sales have occurred in galvanised iron roofing, and all the Staffordshire brands are dearer from 2s. 6d. to 5s. per ton upon the rates ruling at the despatch of the preceding mail, 26 gauge corrugated iron being worth £16 10s. to £16 15s.

The demand for best tin sheets is fairly brisk, and the chief makers are pretty fully employed. They report that customers are in a hurry for deliveries, alike home and export. Orders are just now upon the books for Australia, Germany, Holland, the United States, and other distant countries. Messrs. E. P. and W. Baldwin quote Severn singles, £11; B., £12; B.B., £13; and B.B.B., £14 per ton; while the shield brand is £10 for singles. Siemens steel sheets are £12 up to 24 gauge, and Bessemer ditto, £11. Messrs. Baldwin are just now preparing to enter upon the manufacture of larger sizes of terne and lead sheets than they have hitherto taken up.

The supply of ordinary galvanising sheets on the market is likely to be soon increased. It is understood this week that the Regent Ironworks, Bilston, lately owned by Mr. Geo. Onions, have been purchased by Mr. Thos. Hipkins, of Wolverhampton, and will be restarted upon sheet iron manufacture. The works of the Thos. Bishton galvanising concern at Wolverhampton have been repurchased by their old proprietor, Mr. Thos. Bishton, so that a stoppage will be avoided.

The pig iron trade is perceptibly weaker, more especially imported Midland brands, which have declined generally from 1s. 6d. to 3s. per ton. Northamptons are 38s. to 39s. per ton, and Derbyshires 39s. to 40s., with superior sorts 42s. 6d. Lincolnshires are without much change at 41s. to 42s. The Barrow brand of hematites is almost the only hematite pig upon the market which maintains former maximum quotations, namely, 60s. per ton for forge sorts delivered here. Other vendors are prepared to accept 57s. 6d. per ton. Best Staffordshire pigs are 52s. 6d. now; part mines, 37s. 6d. to 42s.; and common, 30s. to 32s. 6d.

The East India Railway Company is enquiring for some good work, including cast iron plate sleepers, cast steel crossings, Bessemer steel fish-plates, iron panel plates, and the like; and the Bombay, Baroda, and Central India Railway Company require a supply of cast iron sleepers and fittings, and other railway materials.

A contract for 1700 tons of cast iron pipes is about to be given on account of the Aberdeen Waterworks.

Steel castings of a superior description are just now being turned out upon the Bessemer principle by Messrs. F. H. Lloyd and Co., James Bridge Steel Works, near Wednesbury, who also manufacture tool steel of all grades and qualities. The castings include work suitable for hydraulic and general engineering purposes, such as cylinders, cranks of all kinds, crossheads, clutches and crabs, crane wheels, couplings, bevel wheels, spur wheels, and pinions of every description; punching and rivetting bears, &c.; as also forgings for railway and tramway purposes, ironworks and collieries, marine engineers, bridge builders, and wagon and agricultural engineers. Of peculiar merit are the company's steel castings forged for the purpose of giving additional strength and guaranteeing perfect solidity. There is great advantage in forging some of the castings, though it is wholly unnecessary in the majority of the castings turned out. It is claimed, however, by the firm that all the castings they make, whether of soft, medium, or hard temper, would bear forging treatment if required. Indeed, the castings may be smithed or forged as desired.

Messrs. Lloyd and Co. are turning out tubular coils of wrought iron and steel of unusual size and strength for ice-making machines, some of them going a length of 400ft. without any visible joint, and possessing a diameter of as much as 20ft. The tubes used very in size from ¼in. up to 4¼in. internal diameter.

An important paper on "Scientific Ironfounding" was on Saturday read before the members of the South Staffordshire Institute of Iron and Steel Works Managers at Dudley by Mr. T. Turner, Assoc. R.S.M., F.C.S., of the Mason College, Birmingham. After expressing a belief that cast iron from its singular adaptability was not likely to be superseded by the new material steel except for engineering purposes, the author attempted to dispel the fallacy which existed among founders that a hard iron was indispensable to strength. He explained in general terms that hard castings were brittle, and deficient alike in crushing, transverse, and tensile strengths, that at certain degrees of softness the maximum strengths are obtained, and that when very soft the metal, though deficient in strength, yet worked with the utmost facility. By a proper application of this knowledge, the founder might produce his iron at any desired strength. Dealing with the chemical composition of iron, Mr. Turner spoke of the great influence which silicon had upon iron, and said that by a perfect knowledge of the action of this constituent the founder might produce any desired quality of iron economically. From analyses which he made he found that the components of a typical foundry iron were as follows:—Graphite, 2·59 per cent.; silicon, 1·42 per cent.; phosphorus, 0·39 per cent.; sulphur, 0·06 per cent.; manganese, 0·58 per cent. Mr. Turner urged upon ironfounders the necessity of having a sound scientific and mechanical knowledge, and said that there was always a good opening for the supply of foundry iron of a known chemical constitution.

At a meeting of the Cannock Chase Colliery owners and miners in Birmingham the employers have declined to grant the request of the men for a 10 per cent. advance in wages. A circular has been issued to the colliery owners in the old South Staffordshire colliery districts where ironworks' coal is mined, by the miners' officials, asking for a reconsideration of the wages question, but little is likely to come of the movement.

One of the unfortunate lines on which continental competition in hardwares is based is this week afforded by a traveller of experience, who has made exhaustive inquiries into the system pursued on the Continent, and finds that manufacturers who closely copy Birmingham and Sheffield patterns and numbers are enabled to sell their goods at prices appreciably under those of native articles.

The Admiralty are this week making inquiries for their customary spring supplies of hardwares from manufacturers in the Birmingham and South Staffordshire districts. Sample goods have been sent to the Chambers of Commerce hereabouts.

A case of first-class cultivating tools has been prepared for the Adelaide Exhibition by Mr. Edward Elwell, of Wednesbury Forge, Wednesbury, containing among other articles, hoes, grubbing mattocks, pickaxes, hammers of all kinds, spades and shovels, American axes, American hatchets, lath hatchets, shingling axes, hooks, and bills. The goods are of a style and finish likely to meet with most approval from Antipodean customers.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The close of the first quarter presents a strong contrast to the hopeful prospects with which the year opened. Except that prices have not got back to the old low level, business seems to have relapsed into almost as depressed a condition as ever. For present actual requirements there is comparatively very little iron really wanted, as in most cases consumers are still covered by the deliveries they have yet to come in under contracts placed some time back, and the persistent downward movement of the market during the past month naturally influences them to hold back as long as possible from further purchases. Makers, of course, where they have still deliveries on account of old contracts to keep them going, are following a similar policy from their point of view, and are abstaining as long as possible from showing any anxiety to secure further orders. The market is therefore in this position, that to a large extent, just for the present, makers and users of iron are waiting one upon the other to see who will have to give way first, with this disadvantage, however, to makers, that some of them are not in a very strong position to hold out, whilst there are second-hand holders of iron prepared to come in below their prices, and take what business there is to be got. This is gradually forcing down the prices for which makers have been holding out, and without openly attempting to push sales there is a disposition to entertain offers at considerably under the nominally quoted rates. Buyers are, however, very indifferent, and where offers are made they are mostly for forward delivery, and at prices cut sufficiently low to discount the possible further fall in values. These, however, are conditions on which makers are not prepared to entertain business, and consequently what there is doing is chiefly in small second-hand parcels which buyers are able to pick up cheap to cover any urgent pressing requirements. These remarks apply chiefly to common pig iron. As regards hematites, makers are perhaps in a better position; and although they are undersold by merchants and dealers they show very little disposition to give way to any material extent, but all the same the market is decidedly in the favour of buyers. Finished iron, which never got up to anything like the same extent as the raw material, seems to be gradually losing even what little advance was obtained, and as regards ironfounders, they have been and still are quite as low as ever. Makers of steel castings and forgings have also been unable to follow the advance which took place in hematites, and their position remains as unsatisfactory as ever. Indeed, where they have had to buy at the advanced prices their position has been so much the worse.

There was only a very slow iron market at Manchester on Tuesday, with a continued weakening tendency in prices. Inquiries of any description were very few, and mostly small in weight. In pig iron the business doing was extremely limited, and although nominally quoted rates for local and district brands were about the same as last week, the prices at which orders could be actually placed were low. For Lancashire pig iron makers still quote about 39s. to 40s., less 2½, for forge and foundry qualities, delivered equal to Manchester, but they are open to offers, and to secure orders in the open market they would have to take considerably under their quoted rates. Much the same may be said with regard to district brands. There are still quotations of 39s. to 40s., less 2½, for forge and foundry, delivered here, but these prices are altogether out of the market. Lincolnshire iron can be bought from makers at 38s. to 38s. 6d., less 2½, and even these prices are above what buyers are offering. In outside brands there is continued keen underselling, especially in Scotch, and Middlesbrough is easier to buy, although quoted rates remain at about 43s. 4d. for ordinary truck iron and 44s. for special-named brands of foundry, net cash, delivered equal to Manchester.

For hematites there has been some inquiry, and makers still hold to about 58s., less 2½, as their quoted price for No. 3 foundry, delivered into the Manchester district, but where there is actual business to be done prices are cut down below this figure, and 57s., less 2½, represents more nearly the actual selling price in the market.

In manufactured iron business continues extremely quiet, with prices if anything easier. Common local made bars can be got at £4 17s. 6d. per ton, and good qualities of both Lancashire and North Staffordshire bars only in exceptional cases fetch more than £5; hoops average £5 5s. 6d. to £5 7s. 6d.; and sheets range from £6 5s. to £7 per ton delivered into the Manchester district.

Some slight improvement is perhaps noticeable in the condition of the engineering trades, but it is not of such a character as to make itself appreciably felt, and where there is any new work giving out it is still competed for at excessively low prices. Nut and bolt makers, who are largely dependent upon engineers, in some instances report that trade is worse.

During the past week I paid a visit to the Ordsal Works of Messrs. Hulse and Co., Salford, to inspect several new machine tools they are just completing and which have been specially designed for heavy work in steel. One of these was a patent duplex pit lathe, capable of operating on objects of steel or iron up to 12½ft. diameter and 3½ft. in length, or up to 9ft. diameter by 8ft. long, and admitting 8ft. long between the centres. This lathe is composed of a heavy and powerful headstock, with a large steel spindle and 9ft. face-plate geared at the back, with internal and external teeth, through which is transmitted a great variety of speeds and wheel powers up to a maximum of 200 to 1 in the latter. Supporting the headstock is a deep base-plate, planed and grooved throughout its upper surface to receive the several tool rests provided, and also the sliding bed which is movable along it and carries the loose headstock. A novel feature is introduced in another grooved base-plate inlaid in the deep base-plate mentioned above, and whose upper surface is of the same level, and is grooved like it. This inlaid plate is movable longitudinally within the pit, and may be fixed at any required distance in front of the face-plate. It receives the two slide beds, each carrying a slide rest and tool. These slide beds and their slide rests may be placed across the lathe for surfacing work, or may be fixed in lines on opposite sides of the centres for turning cylinders and for the largest and smallest objects to be operated upon in the lathe. Self-acting motion is imparted to the several slide rests, both for simultaneous and independent action, and it is applicable to each slide rest wherever it may be fixed at the time. This lathe will cover an area of about 420 square feet, and weighs between 50 and 60 tons. It has three heavy slide rests and tools, viz., two duplex supported by the base plates, and a single slide rest supported on the carriage of the slide bed. The duplex tools are calculated for taking the heaviest cuttings off steel castings and forgings, and the lathe all through has been specially designed for use in steel works. Another tool deserving special mention was a large radial drilling machine, also designed for operating in steel. This tool weighs between 20 and 30 tons, and is provided with a large steel spindle powerfully geared and adjustable, so as to drill at an angle with the perpendicular. The drill spindle will operate through a radius of 10ft., and through a height of about 8ft. The main frame which is tall and massive is firmly bolted to a deep base-plate, tee grooved throughout its face. It carries a vertical slide movable vertically by power, and in its turn carries the massive radial arm and drilling headstock. The radial arm is adjustable horizontally around its trunnions by worm gear, and vertically by power readily brought into action or averted. The drilling spindle has a variable self-acting down-feed and likewise a quick-returning upward motion, either of which can be readily applied as required.

The last effort put forward by the promoters of the Manchester Ship Canal to secure the requisite capital for carrying out the scheme places the project on a more business-like footing than it has hitherto been presented to the public. In the private circular to which I referred last week the facts are plainly and briefly stated, and to the inhabitants of Manchester and the surrounding towns and districts it is stated emphatically that the time has come when they must decide whether the Ship Canal shall be made or not; and the directors wish it to be distinctly understood that unless upwards of three millions be raised in Lancashire and the neighbouring counties the Ship Canal cannot be made. The issue is thus placed definitely before the people of Lancashire and the neighbouring counties, and it rests entirely with them and the support they are prepared to give whether the scheme is carried out. If upwards of £3,000,000 is raised locally, it is understood there will be no difficulty in raising the remainder of the capital in London.

In the coal trade a fairly steady business is being done in all descriptions of fuel, the better qualities of round coal are in fair demand for house fire consumption, tolerably large shipments are still being made of the lower qualities, which, supplemented by the local demand for steel and iron-making purposes, is moving off present supplies, and engine classes of fuel are generally meeting with a ready sale. With few exceptions pits are kept on pretty nearly full time, and although prices are not in all cases absolutely firm at full rates, there is no material giving way at present. At the pit mouth best coal averages 9s.; seconds, 7s. 6d.; common house coal, 6s.; steam and forge coal, 5s. 6d.; burgy, 4s. 6d. to 5s.; best slack, 3s. 6d. to 4s.; and common, 2s. 6d. to 3s. per ton, with steam coal delivered at the high-level, Liverpool, or the Garston Docks, ranging from 7s. to 7s. 6d. per ton, according to quality.

Messrs. J. F. Waddington and Co., of Seacombe, have just secured the order for a twin-screw ferry steamer for the new Ferry-station on the Mersey; she will have a saloon on deck, and promenade deck, smoking cabin forward, and will be a handsome vessel.

Barrow.—There is an easier tone in the hematite trade this week, and makers have reduced prices to the extent of 1s. per ton. Mixed numbers of Bessemer iron are quoted at 49s. per ton net, f.o.b., and forge and foundry No. 3 at 48s. per ton. There is, however, business being done at a lower figure than this by speculators who are clearing out their stocks; but this does not materially affect the position of makers, who are busily employed on orders which will furnish them with work for some months to come. The trade in Bessemer iron continues large, and as steel makers are sure to require even fuller deliveries, it is evident that a much larger trade will be done with them during the remainder of the season. Ordinary hematite qualities are in fair average demand. The business doing in both descriptions of metal is mainly on foreign account, and as the home demand has not responded to the full extent to the American improvement, it seems probable that to America and the Colonies we must look for the maintenance of the improvement in trade which has been brought about. The inquiries from these sources are very good, and assurances have been received from all quarters of the continuance of the demand, and of a general improvement all round in the trades which draw their supplies of pig iron from this country. Steel makers are in receipt of numerous inquiries for rails, and they maintain the firm position they have occupied for some time as to prices. £4 7s. 6d. per ton is still quoted as the market price for ordinary heavy sections of rails net at makers' works or f.o.b. Soft billets are in heavy consumption, and makers are well sold forward. Prices are steady at £4 2s. 6d. per ton net f.o.b. Blooms are in demand on American account, but there is not much of this class of steel on sale. The Moss Bay Iron and Steel Company have incurred a loss on the past year of £15,000, thus reducing the amount of undivided profits at the credit of the profit and loss account to £2201. The company have also, however, £7482 at the credit of the reserve fund, making a total of £9683, from which it is proposed to deduct £6000 for depreciation as in former years, leaving the balance to the credit of the reserve fund. The Barrow Rolling Mills Company has recommenced its works at Barrow. One furnace was lighted on Monday and the second will be put in blast in about a month. The Barrow Hematite Steel Company has these works under its management, and when both the furnaces are in blast it intends to put one of the furnaces at the Hindpool Works on blast for the production of spiegeleisen. All the furnaces at Barrow are now in blast except two. Ship builders are in receipt of no new orders, and engineers, ironfounders, boiler-makers, and others engaged in the general trades are doing but a poor business. Iron ore is in steady request, but prices are somewhat easier. They are now quoted at from 11s. to 12s. 6d. per ton net at mines. The Garside Mining Company, whose mines were closed a few months ago owing to a drift of sand filling up the workings, is recommencing operations in the upper seam of metal. Coal and coke are in steady demand at unchanged rates.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The Committee appointed to report on the organisation of the manufacturing department of the army visited Sheffield on Wednesday, the 23rd inst. The members present were the Earl of Morley, chairman; the Hon. Guy Dawnay, formerly Surveyor-General of Ordnance; General Goodenough; Mr. Woodall, M.P., Surveyor-General of Ordnance in the Liberal Government; Mr. Ruston, Mr. Carbutt, Mr. Hickman, Mr. Burnett, and Mr. Albert A'Beckett, secretary. They visited the works of Messrs. John Brown and Co., Messrs. Charles Cammell and Co., Messrs. Thomas Firth and Sons, and Messrs. Vickers, Sons, and Co. The Committee had an opportunity of inspecting the capabilities of the Sheffield firms for the production of military material. At the Cyclops Works the Committee visited the Grimesthorpe forging shops, where marine and gun forgings were in various stages of manufacture, and examined the huge hydraulic forging press which is now rapidly approaching completion. Among other works they saw large forgings for H.M.S. Trafalgar, one specimen being a hollow shaft 60ft. long; and the turret of H.M.S. Renown, building by Sir W. G. Armstrong, Mitchell, and Co., Newcastle-on-Tyne. The Committee afterwards proceeded to Manchester.

A few orders for steel rails continue to drop in, but the railway companies are slow to place their work, evidently in hopes of lower values ruling later. There has been a little less activity in the iron trade; but it is not a reaction sufficient to justify expectations of quotations falling. The Midland Company has placed a small order—some 3000 tons—with Messrs. Charles Cammell and Co., the price being understood to be about £4 7s. 6d. per ton. This company took an order some time ago for 10,000 tons, the quotations being £4 5s. per ton. Both figures are regarded as moderate, considering that the orders have been placed on a rising market. Several tenders are being asked for on colonial account, chiefly for India. There is no cessation in the call for rolling stock, particularly in carriages, and fresh orders have again been received for wheels, tires, axles, and springs.

The Altofts Colliery explosion excited much interest, not only in the colliery districts, but in official circles. It is expected that the new Mines Bill, to be introduced by the Government, will make the use of powder in coal-getting an offence. This anticipation has caused colliery owners and managers to turn their attention still more earnestly to other means of conducting their work. I had one appliance explained to me on Monday. It is called the "patent improved multiple wedge," and can be used for getting either rock or coal. It is claimed for this invention that it is an improvement on the old "plug-and-feather wedge," and that the saving of slack over that got by explosives is from 10 to 20 per cent. The feather, or wedge, of the old plug-and-feather arrangement is divided into two parts, so that they may be driven up separately and alternately, thereby doubling the expansive power obtainable with the same driving force, and also providing for the introduction of a third wedge when required. The hole required is very much smaller than for any other wedge designed for this purpose; it is further stated to be the most powerful and simple in construction known, and to have given satisfactory results wherever tried.

An interesting invention was shown to me at the premises of the Hardy Patent Pick Company, a self-lubricating pedestal. Anyone down a mine must have observed the waste which goes on in lubricating the corves. By this invention one application of oil is sufficient for two or three months. A cup holds from two to three ounces of oil, and it is packed with felt or lambswool. The axle is pressed upon this oil, which is being continually absorbed from the wool to the axle, thorough lubrication being thus effectively secured. It can be readily understood that so long as the oil remains in the cup the axle must be well lubricated. The Nunnery Colliery Company has adopted this contrivance with success, and the company has orders in hand for 1600 sets. It reports a very lavish demand from the East Indian railways for hammers, picks, spades, &c.; and for patent picks from South America and other parts. The Canadian demand for mining tools, shovels, spades, picks, and similar goods, is remarkably gratifying.

Messrs. Charles Cammell and Co. expect to have their heavy new forge machinery at the Grimesthorpe Works in complete working order during the present year. The company has had an exceptionally prosperous year during 1886, its net profits having been £118,072, which with the unappropriated balance brought forward from the previous year, made a total of £140,728 available for dividend. After paying 7½ per cent. dividend on the ordinary shares and the full dividends on the preference shares, there remains sufficient to add £25,000 to the reserve fund and carry forward £38,978. The net profits last year were £104,073, £23,000 was carried to the reserve fund, and £24,431 brought forward. The result is regarded by the shareholders as exceedingly satisfactory.

Mr. Thomas Jessop, J.P., presiding at the annual meeting of the company which bears his name, stated that there had been during the latter part of 1886 a revival in the demand for the old-fashioned steel with which the name of "Jessop" has long been associated; but he stated that the price had not been what they could have wished owing to extreme competition, the American firms themselves cutting in at very low rates. Sheet steel has been so largely in request that the company re-opened the Soho Works in Pond-street. I hear that there is now some languor in the American orders for steel. The new steel department at Jessop's for the production of stern posts, rudders, and other castings for marine purposes, has not been fully employed of late, the British Government not giving out any orders, but other countries are.

A short time since an account appeared in THE ENGINEER of "Mitis" castings in wrought iron or steel. They are now being successfully manufactured by Messrs. Hansell and Co., at their Canal Works. Messrs. Hansell have long been connected with the steel casting trade, and are special licensees, along with Messrs. Seebohm and Dieckstahl, of the several patents held by Mr. Nordenfeldt, of ammunition repute. The demand has been so gratifying that I understand a considerable extension of the plant has been determined upon forthwith.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE is no improvement to record in the Cleveland pig iron trade. Scarcely any business is proceeding, and prices still tend downwards. Encouraged by the gradual fall in values, consumers continue to hold off; and speculators will not operate. At the market held at Middlesbrough on Tuesday last prices were about 6d. per ton lower than they were on the 15th inst. Merchants offer No. 3 g.m.b., for prompt delivery, at 34s. 9d. per ton, and a few sales were made at that figure. Generally speaking, consumers were not willing to pay more than 34s. 6d. for prompt, and 35s. 6d. for delivery over the second quarter of the year. Makers are still occupied with the orders they booked in January; but they will be compelled to enter the market again shortly. Their hope is that a better state of things will prevail when the shipping season has fairly commenced. Forge iron is somewhat scarce, and has not fallen in value quite so much as No. 3; the lowest at which it can be bought is 33s. 6d. per ton.

Messrs. Stevenson, Jaques and Co.'s current quotations are:—"Acklam Hematite," Mixed Nos., 47s. 6d. per ton; "Acklam Yorkshire"—Cleveland—No. 3, 37s. 6d. per ton; "Acklam Basic," 37s. 6d. per ton; refined iron, 50s. to 65s. per ton.

Business in warrants is quite stagnant; the price quoted by sellers on Tuesday was 34s. 9d. per ton, whilst buyers offered 3d. less.

It is expected that the stocks in the entire Cleveland district will show a substantial reduction by the end of the month, but the particular accumulation in Messrs. Connal and Co.'s hands at Middlesbrough is increasing rapidly. On Monday last they held 315,938 tons, being 3248 tons more than a week previously.

The stormy weather of the last few days has greatly interfered with the Tees shipments, which are little in excess of what they were in February. The quantity sent away between the 1st and 21st inclusive was 43,253 tons, as against 41,343 tons last month.

Iron manufacturers still complain that they find customers unwilling to pay the prices lately quoted; and in many cases they have to make substantial concessions before they can secure orders.

The spirits of shipowners and shipbuilders on the North-East Coast are somewhat elated by the statistics of British shipping for the month of February, which were recently issued. It appears that the removals from Lloyd's Register by losses, and by sales to foreigners, are now far in excess of the additions by the building of new ships. Last month twelve steamers of a total capacity of 10,078 tons were added to the register and twenty-seven of a capacity of 21,306 tons were removed. Of wooden sailing vessels no fewer than 145 disappeared from the register. Taking all the vessels belonging to the United Kingdom and Colonies, there was a net loss of more than 27,000 tons during February. It is argued that this cannot go on much longer without an improvement in the freight market. It is clear also that the idle vessels at our own various ports are likely to find employment as soon as the shipping season fairly commences.

Great complaints continue to be made as regards the weighing out of coal cargoes at certain foreign ports. A steamer left Tyne Dock a short time since with coal for the Mediterranean. The quantity certified to be taken out of her at the end of her voyage was 60 tons less than what was put into her in the Tyne. The loss of both coal and freight fell upon the owners. It is difficult to know how to deal with what appears to be systematic dishonesty when it occurs at places beyond the jurisdiction of English law. The only way to meet the case would be for the shipowners to combine and boycott all consignees who conduct their business in this reprehensible way.

The Northumberland coal strike still continues unsettled. The North-Eastern Railway traffic receipts for last week clearly showed the loss of trade from this cause. Passengers, merchandise, and cattle yielded higher figures, but loss of mineral traffic neutralised the benefit entirely, and caused a diminution in the total receipts of £1760. Nevertheless, the current half-year shows an increase of £38,290.

There is no doubt that the Northumberland miners, and especially the non-union men, are now suffering very severely. A new feature has been developed by the women and children at several of the pit villages taking the law into their own hands. The objects of their animosity are the few men who are still at work, not so much in the way of hewing coal as attending to propping roofs, keeping the railways in repair, and otherwise maintaining the pits in working order. Great crowds of women and children have congregated at the pit mouth, in several instances, in order, as they say, to see these "blacklegs" home. They are usually provided with culinary and other instruments, with which to constitute a mock band of music. By aid of these and their own lungs, they manage to make the homeward journey of the unfortunate objects of their wrath sufficiently unpleasant. But they have not been content with such comparatively harmless methods. In several instances serious assaults have been committed, and severe injuries inflicted.

Many of the miners have expressed anxiety that the dispute should be referred to arbitration, but an appeal having been made to the members of the union generally, their replies have shown that so far they are determined to continue the fight and not to arbitrate.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron trade has been quiet and the market depressed throughout the past week. Inquiry for pigs, both for home and foreign consumption, is very slow at the moment, and the values of both warrants and makers' iron have been declining throughout the week. The past week's pig iron shipments were 6110 tons, as compared with 7142 in the corresponding week of 1886. One furnace has been put in blast by Messrs. William Dixon, and the total now in blast in Scotland is seventy-two against ninety-five at the same date last year. Between 2000 and 3000 tons have been added during the week to the stock in Messrs. Connal and Co.'s Glasgow stores, but it is understood that no additions are being made to makers' stocks, which are believed, on the contrary, to be in some instances slightly decreasing.

Business was done in the warrant market on Monday at 43s. 2½d. to 42s. 11d. cash. On Tuesday transactions occurred at 42s. 9d. to 42s. 4d. cash. On Wednesday business took place from 42s. 5d. to 42s. 1d. cash. To-day—Thursday—transactions occurred at 42s. 1d. to 42s. 4d. cash, closing with buyers at the latter price.

The current values of makers' pigs are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 50s.; No. 3, 44s.; Coltness, 55s. 6d. and 45s. 6d.; Langloan, 52s. and 46s. 6d.; Summerlee, 54s. and 44s.; Calder, 52s. and 43s.; Carnbroe, 47s. and 42s.; Clyde, 48s. and 43s.; Monkland, 44s. and 40s. 6d.; Govan, at Broomielaw, 44s. and 40s. 6d.; Shotts, at Leith, 50s. and 45s.; Carron, at Grangemouth, 52s. 6d. and 44s. 6d.; Glengarnock, at Ardrossan, 49s. and 43s.; Eglinton, 44s. and 40s. 6d.; Dalmellington, 46s. 6d. and 42s.

Steel merchants report that business is in a somewhat backward state at the moment; but the steel works are well employed. There is practically no change in prices. From Canada advices are to the effect that it is probable a considerable quantity of steel will ere long be required there for railway bridge building. In the past week 674 tons of basic steel billets made at Glengarnock were shipped coastwise from Ardrossan. The Glengarnock Works, which belong to Messrs. Merry and Cuninghame, are now working double shifts, and it is said the firm have sufficient orders booked to keep the works fully employed for several months. The Siemens works also continue actively employed.

In the past week there was despatched from Glasgow four locomotive engines and tenders, valued at £11,000 for Calcutta, and one at £655 for Adelaide; machinery, £5200; sewing machines, £5672; steel goods, £9200, most of which went to the United States; and general iron manufactures, £20,200, of which pipes, bars, tubes, &c., to the value of £8180 went to Bombay; £3600 to Adelaide; and £2150 to Melbourne.

The coal trade has now largely recovered itself after the colliery strike, and the shipments of the past week were fairly satisfactory. They compare against a week last year when much interruption had been experienced from the weather, and the increase is therefore more apparent than real. Still they undoubtedly show that the trade is returning gradually to its former proportions. At Glasgow, 17,528 tons were shipped; Greenock, 1112; Ayr, 6565; Irvine, 1720; Troon, 3940; Burntisland, 18,513; Leith, 1197; Grangemouth, 8301; Bo'ness, 3082; and Granton, 2293; total, 64,251 as compared with 47,055 tons in the same week of last year. The inland demand is also fairly active and the prices are still maintained at a considerably higher level than before the strike.

An adjourned conference between delegates representing coalmasters and colliers in the districts of Airdrie, Slamannan, and Bathgate, was held in Glasgow at the end of last week, when it was jointly agreed that the pits be kept open eleven days a fortnight, the day's work being eight hours; that fourteen days' notice be given before a strike or cessation of work, or before an advance or reduction of wages; and that the principle of a sliding scale is agreed to, and that a meeting be held to deal with this matter a fortnight hence. As the delegates of these men agreed to these conditions the masters promised them an advance of 6d. a day, to begin from 11th instant.

No arrangement has been adopted between the coalmasters and colliers of the greater part of Lanarkshire; but although certain of the men's agents threaten to bring about another general strike, it is hoped that some such agreement will be reached as that which has been adopted at the other districts named above. In some parts of Ayrshire the miners are adhering to the full policy of restriction, whilst in others they have agreed to be guided by the arrangements that are adopted elsewhere.

It has been agreed at a meeting of the Scottish Miners' Federation to recommend the miners of Scotland to ask the co-operation of the miners of England and Wales in having a general cessation of work for a week or a fortnight during the spring, the intention being to have a brief holiday to allow of the glut of coals being cleared out of the market.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

ANOTHER great colliery speculation is on the carpet, the amalgamation of the Ocean Company with Davies, Scott and Co.—capital £800,000 in shares of £100. This will be all taken up, so that the public will have no hand in it. When formed, the project is to sink in the vicinity of Aberdare Junction. The winning of the 4ft. at the Albion Colliery, and the success of Penrhiwceiber, make the prospect of the new sinking almost a certainty. I was under the impression that the virgin tract would have been taken by one of the neighbouring companies. Now this may lead to rivalry between railway interests; but one thing is certain, that however the mineral is worked off, whether by a connection with the Taff, Barry, or Great Western, the sinking operations will be conducted with skill and vigour.

Welsh coal affairs are occupying the judicial powers. One is now *sub judice*, so I can only refer to it as before the court with thorough confidence in the result—the West Rhondda. The others in which the Plymouth mortgagees are interested, has been decided, £112,000 in dispute. Mr. Hankey has done good public service in keeping on the Plymouth collieries, and a wage expenditure of little short of £100,000 annually has naturally been of great benefit; so it is to be hoped that an amicable arrangement may now be entered upon to work the disputed minerals. The coal trade has not been quite so brisk of late, and Cardiff, Swansea. and Newport have been more or less affected by the severity of the weather, which has told on output as well as upon export, Cardiff in particular.

In consequenee of a falling off in demand, prices of best coals have not been so good, and 3d. to even 6d. a ton abatement has in some instance taken place. Prices vary from 8s. 3d. to 8s. 9d. at present, best screened f.o.b. Cardiff, but secondary can be had at all times from 7s. 6d. Rhondda coals touch the highest figure, No. 3 selling well at 8s. 9d., in some few cases at 8s. 6d. Small steam continues at 4s. 3d. Enormous trains may be seen journeying down to Cardiff, as in a late spurt in the coal trade there was a great excess in production.

The troubles of coalowners came to the front last Saturday at a hearing before the Merthyr Guardians of an appeal by Harris' Deep Navigation against the rating of the colliery. This colliery is rated on 10d. per ton, and the contention was that it could not be let at that. During the whole of the time the colliery has been working, since 1879, it has made no profit. This was the statement of Mr. Brown, the engineer, and Mr. Morgans, the general manager, who further said that the royalties had been reduced this year to 6d., but then he did not think it would pay, leaving shareholders out of sight altogether. The pressure in the pit is enormous, being the deepest sinking in Wales, and this alone entails an expense of £3000 a year. After a careful hearing the matter was adjourned, the chairman, Mr. Rhys, stating that the rating had been arranged by Sir W. T. Lewis and Mr. Hedley, and if they began reducing the assessments there would be no end of appeals. In the Aberdare parish alone last year there has been a decreased rating of £1391 in consequence of the reduced output of coal.

The falling off during the last week is, I think, only temporary. Probably with better weather the clearances from the ports may again increase. Swansea is already looking better. Coke is not in much demand. Pitwood is becoming a drug again.

The inquest upon the sufferers from the Ynyshir Colliery Explosion was opened after the adjournment on Monday at Porth, Rhondda, before Mr. Rhys. Mr. Bosanquet attended from the Home-office, and Mr. Simons is watching the case for the company, Watts and Co.

On the subject of colliery explosions it is becoming a matter of belief with mining engineers that dry coal dust plays a greater part even than gas. The quantities found are never in such large volumes as to play the havoc they do. The pockets or collections of gas set the train on fire, and the great quantities of dry coal dust extend and increase the mischief. Where watering is systematically done explosions of any extent are avoided.

The iron and steel works are moderately busy, though no substantial cargoes are recorded on export lists. The principal railmakers report things as easy in their direction, but, fortunately, varied home demands and some foreign orders keep the mills going. Close attention is being paid to economic working, as it is felt that in that direction a small benefit may be gained, since buyers are slow in conceding any. Prices of rails, about £4 5s, to £4 10s.

The tin-plate works have been rather quiet within the last week, though some of the Swansea firms must have been doing well, as 63,000 boxes were sent away. Prices are the same as I have recorded for some time:—Cokes and Bessemer sheets, 12s. 9d. to 13s. 6d.; Siemens, 13s. 6d. to 14s.; wasters, 12s. 6d.; ternes, 12s. 6d. up to 14s.

Stocks are falling, and one or too Glamorgan works are likely to slacken make. As for the Monmouthshire works, it seems almost impossible to have a general re-start. There is Abercarne, for instance. The men are resolute in refusing to accept Mr. Whitehouse's proposals, and as they get 10s. per week for remaining idle, the obstinacy is likely to become chronic.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

To all appearance the depression, which has for the last few weeks lain upon the Rhenish-Westphalian iron market, is vanishing, and the latter gradually assuming its former normal condition; and this conviction is strengthened by the fact that all industrial shares have of late risen in value. In the business of the week there is little alteration to note beyond what was last reported. The firm tone of the market, in spite of political affairs, has been maintained all through, which creates a feeling that the iron industry has entered a definite stage of improvement. It is true that in some branches a slight reaction for the worse has taken place, but this is only where prices were at first forced up in too great a haste. The tenacity with which the pig iron producers have maintained their prices has caused the wrought iron works to unite in order to be able to do likewise, which has put them into a position to hold their own with enhanced prices against the buyers. The reports from Silesia and the south-west group of works indicate satisfactory prospects for the future. In Silesia the prices have remained firm, though the near prospect of the increased Russian duty on iron which will greatly curtail its export, had of course a rather depressing effect for a time; but efforts will be made to send so much more to Austria and the Danubian States, which will be a compensation; so in the end prices of wrought iron began to improve a little, and increased sales are confidently looked forward to next month. In Belgium the condition of the iron market continues satisfactory, but that of the iron districts of France is unstable. Pig iron is in urgent request in Rheinland-Westphalia, but yet the parcels are only of small bulk and for immediate consumption. The stocks of forge, spiegel, Bessemer and basic pigs have all declined markedly, whilst the production has remained stationary, and the next six months' make of foundry pig has been contracted for, which are satisfactory features in the trade. The prices remain unchanged, as well as those for wrought iron on the base of M. 110 p.t., and the rolling mills are well employed on current sorts. There is no change either as regards thick plates and thin sheets; the price of the latter, however, will in all probability be raised as the building season approaches. Steel of different sorts is still being exported freely, the notations having undergone no change, but hopes of improvement are anticipated when the International Rail Convention, which it is still insisted upon is under negotiation, comes to be a *fait accompli*. At Bromberg—East Railway—the Silesian works tendered for rails as lowest price M. 125, and a Rhenish works 121; at Frankfurt again 120 was the lowest offer for steel sleepers per ton, all at works. The wagon works, machine shops, and foundries are in the same unsatisfactory position as last week, and the brassfounders have during the month been affected like those in other branches by the uncertainty in the political outlook, the prices being such as to leave no profit at for phosphor bronze, M1·60; bronze, 1·50; and red brass, 1·50 to 1·60 per ko.

The coal and coke prices are firm, and the latter slowly advancing.

It appears that by a new regulation of the Coalowners' Association in Westphalia it will now be possible for the majority to dictate a restriction of output, which can be enforced legally, and at a meeting on the 21st inst. it even proposed, as a beginning, to curtail the production of coal as against 1886 by 2·83 per cent. from the 1st of April this year. Any mine exceeding the stipulated maximum output is to be fined 20 per cent. of the Government taxed value of the coal raised, the fund so collected to be applied to the establishment of an hospital for those who have received injuries in connection with the mines. This plan may at last restrict the cut-throat competition now existing, and raise the prices above loss.

It appears that quite recently the Bochum-Union Company Westphalia, has been in negotiation to join the Terni Works, but an arrangement did not take place, so now the company has associated itself with the firm of Tardy and Kenech, of Savona where a large steelworks is to be established close to the harbour of that town; therefore two rivals have lately sprung up where till recently, none was in existence.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, March 11th.

THE American iron market is somewhat dull. The receipts of tin-plate so far this year are 208,000 boxes; Straits tin, 2000 tons; English tin, 50 tons; and Scotch pig iron, 9000 tons; bar iron, 1182 tons; scrap iron, 2828 tons. Very heavy receipts of unwrought steel will be received during the next sixty days. Three large lots of foreign material were unloaded at Philadelphia last week. Brokers here and in the Interior have instructions to secure at certain prices large lots of old rails and steel, but up to present writing have not been able to make satisfactory terms. The movement in metals has been checked. Receipts of domestic spelter since January 1st, 743 tons; lead, 3809 tons, against 1405 for the same time last year. The exports of copper since the first of the year foot up 720,000 lb., against 3,593,342 lb. for 1886, and 5,841,938 lb. for same time 1885. The market is weakening, and scarcely any copper was sold this week. The stocks of lead on March 1st were 927 tons, against 984 tons a year ago. Stocks of spelter, 2412 tons, against 111 tons a year ago. Stocks of foreign zinc, 20 casks March 1st, against 23 a year ago. Antimony, 1 cask, against 126 casks a year ago. Stocks of old rails at New York are 216 tons; scrap iron, 2748 tons; steel rods, 4445 tons; Swedish iron, 2552 tons. Stocks of foreign pig iron at Philadelphia, 1295 tons; Baltimore, 452 tons; Boston, 323 tons; New Orleans, 525 tons.

NEW COMPANIES.

THE following companies have just been registered:—

Abbey Patent Hard Shot Company, Limited.

This company proposes to give effect to an agreement of the 2nd September for the purchase of a patent of Mr. Theodore Cordes, of 31, Exeter-street, Gateshead, for the manufacture of shot (No. 9524, A.D. 1886). It was registered on the 11th inst., with a capital of £5000, in £5 shares. The subscribers are:—

	Shares.
T. Telford, Newcastle	1
W. E. Foggin, Newcastle, wire-worker	1
T. R. Bambridge, Gateshead, engineer	1
W. C. A. Holzapfel, Newcastle, merchant	1
J. Howe, Gateshead, printer	1
R. Foggin, Newcastle, wire-worker	1
A. Rhagg, Newcastle, solicitor	1

The number of directors is not to be less than five, nor more than seven; qualification, £50 in shares or stock; the subscribers are to appoint the first.

Anti-Oxide and Colour Company, Limited.

This company was registered on the 14th inst., with a capital of £50,000, in £10 shares, to trade as manufacturers, vendors, and dealers in paints, colours, and chemical compounds. The sub-subscribers are:—

	Shares.
W. Cooke, Handsworth, manufacturer	1
J. R. Lee, Colmore-row, Birmingham, colour merchant	1
A. N. Lee, Colmore-row, Birmingham, stained glass manufacturer	1
S. Lloyd, Sparkbrook, Birmingham, ironmaster	1
J. Simson, 78, Great Queen-street, colour manufacturer	1
S. W. Wainwright, Colmore-row, Birmingham, cashier	1
A. E. Wenham, Colmore-row, Birmingham, chartered accountant	1

Table A of the Companies Act, 1862, will apply to the company.

Hartmann's Sanitary Wood Wool Company, Limited.

This company proposes to manufacture wood wool and wood wadding in all forms, and surgical or medical instruments, dressings, and appliances, and to carry on the business of pharmaceutical and other chemists. It was registered on the 15th inst., with a capital of £65,000, in £1 shares. The company propose to purchase certain letters patent of Paul Hartmann and Albert Hartmann, and also the exclusive license of Albert Essinger to sell wood wool in Great Britain and her Colonies. The subscribers are:—

	Shares.
Vernon Smith, 37, Tavistock-square	1
E. J. Lezard, 2, Oxford-gardens, W., merchant	1
T. E. Pearl, 42, St. George's-street, Peckham	1
W. Skelhorn, 32, Hatton-garden, jet ornament manufacturer	1
H. Vaudean, 16, Hatton-garden, diamond dealer	1
S. S. Alexander, 51, St. Augustine-road, Camden-square, diamond merchant	1
W. E. Byas, Leyton Park, Essex	1

The first directors are Messrs. Wynn Westcott, M.B., J. T. Powell, M.D., J. White, J. D. Newton, Albert Essinger, and Albert Hartmann; qualification, 50 shares; minimum remuneration, £100 per annum to each director, with £50 additional for the chairman.

Hydraulic Rapid Boring Company, Limited.

This company was registered on the 4th inst., with a capital of £10,000, in £10 shares, to purchase the patent rights of Olaf Terp, for boring and well sinking, together with the general engineer's business of the said Olaf Terp. The subscribers are:—

	Shares.
Olaf Terp, 251, High Holborn, engineer	1
John Drew, 245, High Holborn, contractor	1
T. Richardson, 36, Old Broad-street, merchant	1
E. J. Drew, 5, Winchester-road, Highgate, engineer	1
T. R. Cadman, High Holborn, contractor	1
J. R. Cadman, jun., Bowes Park, N., contractor	1
E. Bishop, Bowes Park, N., builder	1

The subscribers are to appoint the first directors; remuneration, 100 guineas per annum.

Imperial Springs of Germany and Natura Mineral Water Company, Limited.

This company proposes to import mineral waters, and especially from the wells near Niedermendig, in Rhenish Prussia, belonging to Henry Hürter, of Coblenz; also to deal in carbonic or other gas and products derived from mineral or medicinal waters, It was registered on the 16th inst., with a capital of £50,000, in £1 shares. The subscribers are:—

	Shares.
*J. T. Schipper, 10 and 11, King-street, Covent-garden, art publisher	1
*A. S. Norris, Warwick Lodge, Shepherd's Bush-green, merchant	1
T. S. Hopcraft, 31, Palmerston-buildings, contractor	1
P. W. Jamieson, 5, Norfolk-street, contractor	4
*E. W. Williams, East Tilbury, Essex, contractor	1
E. Fanning Gye, 9, Great St. Helens, merchant	1
H. A. Whiteley, 67, Lincoln's-inn-fields, solicitor	1

The number of directors is not to be less than three, nor more than seven; qualification, 500 shares; the first are the subscribers denoted by an asterisk; remuneration, £250 per annum, and a sum equal to one-tenth of the annual net profits after payment of 10 per cent. interest on the share capital.

Leipzig Crystal Palace Company, Limited.

This company was registered on the 15th inst., with a capital of £100,000, in £10 shares, to purchase the Crystal Palace, situate at Leipzig, Saxony, and to continue and develope the same. The subscribers are:—

	Shares.
*E. Becker, Leipzig, banker	1
C. D. Steiner, Teddington, secretary	1
F. W. Miflon, 69, Pulford-street, Pimlico, clerk	1
E. Dreyfus, 8, Vernon-place, Bloomsbury-square, dealer in works of art	1
J. R. P. Gurney, 29, St. Martin's-road, Stockwell, clerk	1
A. Urry, 7, Trafalgar-road, S.E., clerk	1
W. Steinert, 192, Queen's-road, Dalston, translator	1

The number of directors is not to be less than three, nor more than seven; qualification, 50 shares; the first are Messrs. E. Berthold, R. Kaestner, E. Becker, J. Jaeger, and A. Rossbach, all of Leipzig. The board will be entitled to one-tenth of the surplus profits remaining after payment of 4 per cent. dividend, and after 10 per cent. of such profits has been paid to the managing or resident director.

Schmidt-Douglas Electric Company, Limited.

This company was registered on the 12th inst., with a capital of £50,000, in £10 shares, to purchase the business of electrical engineers, contractors, and manufacturing electricians carried on by F. T. Schmidt and R. C. Douglas, at Hustlergate, Bradford, trading as Schmidt, Douglas and Co. The subscribers are:—

	Shares.
*F. Hungerford, Halifax, cotton spinner	1
*I. Hordern, Huddersfield	1
*J. Haley, Cleckheaton, card maker	1
*E. Pye, Bradford, coal merchant	1
J. F. Schmidt, Bradford, provision merchant	1
I. D. Taylor, Halifax, chartered accountant	1
T. England, Lightcliffe, near Halifax, solicitor	1

The number of directors is not to be less than three, nor more than seven; Mr. F. T. Schmidt and the first four subscribers are the first; qualification, 10 shares; remuneration, chairman, £100 per annum, and each ordinary director £50 per annum.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—W. A. D. Whormby, engineer, to the Rattler; J. A. Reynolds, engineer, to the Redwing; F. Worth, engineer, to the Forward; Charles J. Cock, engineer, to the Indus, additional; Leonard Backler, assistant engineer, to the Canada; Francis Ford, engineer, to the Defiance; and R. B. Priston, chief engineer, to the Satellite, reappointed on promotion (to date 3rd inst.).

SANDBERG'S GOLIATH RAILS.—The *Journal de Liége* mentions that on Tuesday morning Messrs. Cockeril commenced to roll Mr. Sandberg's Goliath steel rails of 50 kilos. per metre, or 100 lb. per yard, for Belgian State Railways. The rails are rolled from ingots weighing nearly a ton, making two rails of nearly 30ft. in length. The fastenings and joints proposed by M. Flamache are being made at the same train of rolls. Tests were being made to prove the strength of the rails, some of which are to be put down at once on the trunk lines between Liége and Verviers, and on the Plateaux de Herve line.

"THE ENGINEER" ON THE DIMENSIONS OF PHYSICAL QUANTITIES.—In a brief book notice —*ante*, p. 387—I commented on the grave error of measuring potential energy in terms of horse-power, comparing it with the allied absurdity of measuring distance in terms of speed. I also cited the following passage:—"Dividing 3,942,400 foot-pounds per minute by 33,000 foot-pounds, we get 119·4-horse power;" and I put beside it the allied absurdity:—"Dividing £500 a year by £50, we get £10 a year." I thought it superfluous to point out the nature of the mistake, but I judged rashly; for THE ENGINEER, in a leader of March 4th, 1887, has made a somewhat excited attack on this and other of my statements, remarking: "We are in doubt whether 'P. G. T.' really has any idea what (*sic*) the expression means." To this charge I plead guilty; for if I were myself to divide 3,942,400 foot-pounds per minute by 33,000 foot-pounds, the result would contain the unit of time alone, and could certainly not express horse-power. It might be angular velocity, perhaps. It is true that if I were to divide 3,942,400 foot-pounds per minute by the mere number 33,000, I should probably obtain the result 119·4-horse power. But THE ENGINEER will ascribe all this to the pedantry of the "professor," for its article goes even farther in absurdity than does the passage quoted above. It leaves out the "per minute" and says the author "is strictly correct (*sic*) when he says that 3,942,400 foot-pounds are to be divided by 33,000 foot-pounds to get the horse-power." Alas for Fourier, and dimensions of physical quantities! I wonder what THE ENGINEER would assign as the result of dividing 10 eggs per minute by 2 eggs. Would it, or would it not, be 5 eggs per minute?—P. G. T.—*Nature.*

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

14th March, 1887.

3859. ESTIMATING LIQUID or SOLID BODIES, &c., W. J. Lovibond, London.
3860. TREATING LEATHER, H. Golding, London.
3861. ATTACHING and RELEASING OBJECTS, S. Betjemann, London.
3862. DISTILLING, W. A. G. Schönheyder, London.
3863. WHEELS for RAILWAYS, &c., T. W. Rammell and R. Capper, London.
3864. PREPARING NETTLE STALKS for SPINNING, T. E. Schiefner, London.
3865. COMBING APPARATUS, T. E. Schiefner, London.
3866. SPINNING MACHINES, T. E. Schiefner.

15th March, 1887.

2616A. SUPPORTING COLLAPSIBLE BEDS, &c., F. H. Street and C. Ellis, London.—*19th February*, 1887.—[*Note.*—This application having been originally included in No. 2616, dated 19th February, 1887, takes under Patents Rule 23 that date.
3867. STOPPERING BOTTLES, &c., T. and J. Brooke, Sheffield.
3868. BRAKES for VEHICLES, H. and F. Oakes, Sheffield.
3869. ANTI-CORROSIVE COATINGS for METALLIC SURFACES, W. R. Hutton, E. Fischer, W. Struthers, and T. J. Smillie, Glasgow.
3870. GUIDE PINS of MOULDERS' BOXES, J. Crossley, Sheffield.
3871. CUTTING PATTERNS of WOOLLEN and other FABRICS with AUTOMATIC FEEDING ARRANGEMENT and ADJUSTABLE KNIVES, T. S. Sykes, Liverpool.
3872. EXPLOSIVE SHELLS, E. St. J. Christophers, Twickenham, and B. Dunk, Isleworth.
3873. BOOTMAKER'S KNEESOCKET, J. Bowling and R. P. Greenwood, Leeds.
3874. METER for TIMING the BOILING of EGGS, J. Jerger and R. W. Stephens, Devonport.
3875. AUTOMATIC EXTINGUISHERS for OIL LAMPS, J. Duggan, Liverpool.
3876. SMALL LOCK STITCH SEWING MACHINES, W. S. Frost, London.
3877. VELOCIPEDES, W. W. Woolidge, Brockley.
3878. ELECTRIC ALARM CLOCKS, H. Boardman, Bradford.
3879. MACHINERY for SLOTTING KEY-SEATING, G. Benson, Stockton-on-Tees.
3880. PEARLING or ORNAMENTATION of SURFACES, M. Bouché, Birmingham.
3881. PRINTING MACHINE for PRINTING DESIGNS upon FOOTPATHS, T. Johnson and G. Gledhill, Halifax.
3882. GRINDING MILLS, R. A. Lister and G. S. Richmond, Dursley.
3883. PICKING STICKS used in LOOMS for WEAVING, C. B. Brook and J. Clough, Bradford.
3884. FASTENING on DOOR KNOBS and holding WINDOW-BLIND CORDS, F. Hinde, Higher Bentham, near Lancaster.
3885. MACHINERY for HARDENING FELT HATS, H. Jepson, Ashton-under-Lyne.
3886. BELTING for DRIVING MACHINERY, F. Gill and T. E. Robson, Durham.
3887. EXPLODERS or DETONATORS for FOG SIGNALS, G. P. Lemprière, Birmingham.
3888. CAP SPINNING and TWISTING MACHINERY, G. Clegg, J. Thomas, and W. H. Harrison, Halifax
3889. CONSTRUCTION of MAIN DRAINS, &c., F. F. Abbey, Huddersfield.
3890. EXTRACTING STEAM, &c., from BUILDINGS, J. Taylor, Bury.
3891. WATERPROOFING of PAPER for PACKING, &c., T. Worth, Droylesden.
3892. DULCIMER BELLS, C. Simmonds, London.
3893. LUG, &c., SAILS, A. Macandrew, Glasgow.
3894. COMBINED NAIL TRIMMER, BUTTON-HOOK, &c., W. T. Taylor, London.
3895. PORTABLE BAND-STANDS, E. Atkey, jun., Newport, Isle of Wight.
3896. PINHOLE TOBACCO PIPES, J. Long, London.
3897. QUILTS, I. Davis, London.
3898. VELOCIPEDES, H. Rollbühler, London.
3899. AMBULANCES, A. Fitzwilliam, London.
3900. COMPOUND STEAM ENGINES, &c., T. J. Simmons, London.
3901. MACHINES for CLEANING BOTTLES, M. Hickey, London.
3902. STUDS for SOLITAIRES, F. C. Stevens, London.
3903. LAMPS for BURNING VOLATILE OILS, A. H. Griffiths and A. Robins, London.
3904. BARRELS, R. Stone, London.
3905. COMBING MACHINERY, H. H. and A. H. Illingworth, London.
3906. GRAIN-BRUISING, &c., MACHINES, H. Dietz, London.
3907. GLASS-LINED METAL ARTICLES, T. E. Halford and R. Morant, Chiswick.
3908. FLUID PRESSURE MOTORS, J. H. Bosustow, London.
3909. SPLITTING ALMONDS, &c., J. L. Collier, London.
3910. WHEELS for ROAD CARRIAGES, &c., W. Bown, London.
3911. HINGES, E. W. Jones, T. H. Norman, and G. Smith, London.
3912. LOCKS for DOORS, J. J. Bourne, London.
3913. TORSION SPRING, B. D. Shaw and A. W. Hayward, London.
3914. DESPATCH TUBE SYSTEMS, A. J. Boult.—(*J. F. McLaughlin, United States.*)
3915. DESPATCH TUBE SYSTEMS, A. J. Boult.—(*J. F. McLaughlin, United States.*)
3916. SAW SETS, T. Williamson, London.
3917. TELEPHONE REGISTERS, C. Witternberg, London.
3918. SHOW CASES, &c., F. Sage, London
3919. VELOCIPEDES, A. J. Boult.—(—. *Haase and —. Stamm, Germany.*)
3920. IGNITING EXPLOSIVE CHARGES, A. J. Boult.—(*L. Bagger, United States.*)
3921. STOWING, &c., SHIPS' BOATS, J. B. Wilson, Glasgow.
3922. INSTANTANEOUS SHUTTERS, J. R. Gotz, London.
3923. LUBRICATING BEARINGS, F. W. Durham and T. H. Shaw, London.
3924. MEASURING, &c., PAPER.—(*The Fabric Measuring and Packaging Company, United States.*)
3925. BOLSTERS, &c., H. H. Lake.—(*J. Booth, United States.*)
3926. SEWING MACHINES, H. H. Lake.—(*The Essex Embroidery Machine Company, United States.*)
3927. PAPER-PULP SCREENS, C. Russell and P. H. Cragin, London.
3928. SEAMING MACHINERY, H. H. Lake.—(*C. A. Shaw, United States.*)
3929. LOCK NUTS, A. B. Ibbotson, London.
3930. DRYING, &c., TEA, J. Doughty.—(*F. W. Plows, India.*)
3931. TIN-OPENER, &c., T. and J. W. Marns, London.
3932. TRANSFERRING COAL, &c., from ONE LEVEL to ANOTHER, P. G. B. Westmacott, Newcastle-upon-Tyne.
3933. ELECTRIC SIGNALLING INSTRUMENTS, T. Nordenfelt, London.
3934. GAS-MOTOR ENGINES, S. Griffin, London.
3935. STEERING of CYCLES, &c., J. G. Jelley, London.
3936. LOCKING HINGE, &c., E. L. White, London.
3937. TREATMENT of FIBRES for PULP, A. Wilkinson, London.

16th March, 1887.

3938. CHIMNEY COWL, W. H. Day, Isle of Wight.
3939. SHORTENING the FERRULE JOINTS of FISHING-RODS, F. W. Adye, St. Albans.
3940. RAILWAY CARRIAGE ROOF LAMPS, H. Defries, London.
3941. RATCHET DRILL BRACES for ENGINEERS, J. Thorp, Aston.
3942. NEW LOCK BOLT, &c., A. A. Bayliss, Wolverhampton.
3943. MEASURING ELECTRIC CURRENTS, W. H. Douglas, Birmingham.
3944. STEAM GENERATOR FLUES, T. Oldham, Manchester.
3945. SILENT TIRES for ROAD VEHICLES, J. Macqueen Longsight.
3946. HEELS for BOOTS, &c., J. Baldwin, Bradford.
3947. GAS MOTOR ENGINES, H. Campbell, Halifax.
3948. CORRUGATED FLUES and FIRE-BOXES, H. P. Fenby Leeds.
3949. VENTILATOR, G. Quinn, Glasgow.
3950. GOVERNING the FIRE in STOVES, J. Inshaw Aston.
3951. SAFETY BOLT, A. Barber and G. Walker, Bradford.
3952. ENVELOPES, J. L. Greaves, Bakewell.
3953. REVERSING GEAR of STEAM ENGINES, W. H Tonkin, Manchester.
3954. CANAL LOCKS, J. Rowley, Manchester.
3955. DIVIDING and MEASURING DOUGH, J. O'Connor, Dublin.
3956. CAR STARTERS, A. J. Boult.—(*B. C. Pole, United States.*)
3957. SEWING MACHINES, W. F. Hart.—(*C. S. Larrabee and B. Fischer, Germany.*)
3958. CAST METAL PIPES, T. Chilton, Manchester.
3959. SLEEVE CLASPERS, H. H. Holt, London.
3960. TELEPHONES, A. J. Boult.—(*A. M. Phelps, United States.*)
3961. VENTILATING APPARATUS, E. M. Young and G. B. Moss, Lincoln.
3962. MARKING off LINE on the SIGHT of a RIFLE, R. H. Munro and F. J. Rooker, London.
3963. PRODUCING MOTIVE-POWER, H. Tapp, London.
3964. REFRIGERATORS, H. J. West, London.
3965. STAMPING PAPER, W. Jones, London.
3966. SHOWER APPARATUS, J. Tattersall, Keighley.
3967. PICKERS, J. Dawson and H. Armistead, Blackburn.
3968. CHAINS for VELOCIPEDES, W. Shave, Berkshire.
3969. NOSE-BAGS, G. P. Lemprière, Birmingham.
3970. CARTRIDGE-LOADING MACHINE, H. I. Dixon and G. Simpson, Sheffield.
3971. SCARF-PIN PROTECTOR, G. W. Pridmore, Birmingham.
3972. PENCIL SHARPENER, G. Asher and J. Buttress, Birmingham.
3973. GLAZED ROOFS, W. Duncan, London.
3974. CHILLED CASTING for ARMOUR PLATES, S. Siemang, London.
3975. CAST IRON, S. Siemang, London.
3976. GAS-BURNERS, C. M. Walker, Surrey.
3977. PENHOLDERS, W. E. Hunnex, London.
3978. PURIFYING COAL GAS, G. Anderson, London.
3979. TEA CANISTER, M., C., F., A., F. Billing, and T. B. Burdett, London.
3980. LADY'S RIDING SKIRT, C. W. Davis, London.
3981. CLEANING CORN, E. Edwards.—(— *Laurent frères and — Collott, France.*)
3982. VELOCIPEDES, G. G. and H. R. Tandy, London.
3983. FIRE GRATES, A. M. Clark.—(*D. P. and A. K. Lewis, United States.*)
3984. MAKING CIGARETTES, P. Vauselle, London.
3985. CARTRIDGES, G. A. Farini, London.
3986. TRAP to CATCH ANIMALS ALIVE, J. O. Spong, London.
3987. PREPARING VARNISH, J. A. Bigsby, London.
3988. FLUID PRESSURE MOTORS, W. Donaldson, London.
3989. THREE CYLINDER ENGINES, P. Brotherhood, London.
3990. MICRO-TELEPHONIC TRANSMITTERS, C. Clamond, London.
3991. GRINDING METALS, J. Hampton and S. Partridge, London.
3992. AXLE-BOXES, J. Donnelly, W. McLaren, and A. Trask, London.
3993. HANDLES for CUTLERY, S. Staight, London.
3994. COLOURING MATTERS, H. H. Lake.—(*A. Leonhardt and Co., Germany.*)
3995. DISINTEGRATING GRAIN, G. Little, London.
3996. RAIL JOINTS, A. W. Itter, London.
3997. COMBINED SNOW PLOUGH and MELTER, J. H. W. Stringfellow, London.
3998. APPLICATION of ELECTRIC LIGHT, F. J. Chary, London.
3999. HEATING AIR for FURNACES, E. Albin, London.
4000. CLIPS for NECKTIES, A. E. Beck, London.

17th March, 1887.

4001. SHOP WINDOW FITTINGS, E. H. Ledger, Birmingham.
4002. OPERATING DERRICK CRANES, R. L. Hattersley and R. Hall, Keighley.
4003. HINGES, D. J. Fleetwood, Birmingham.
4004. WATER HEATERS, C. A. Haworth and I. Mason, Manchester.
4005. ARTISTIC POTTERY, A. Fielding, Longport.
4006. PREPARING MALLEABLE IRON, D. McCorkindale, Mossend.
4007. KNUCKLE JOINTS, J. Aylward, Coventry.
4008. WHITE LEAD, W. D. Weissenburg, London.
4009. SAFETY LAMPS, B. E. Clarke, Heeley.
4010. CONVEYING TELEGRAPH WIRES, A. F. Stoddart, Bristol.
4011. WASHING MACHINE, J. Gullery, Belfast.
4012. SECURING CORKS in BOTTLES, F. Foster, London.
4013. MUSTY BREWERS' CASKS, C. Lesne, London.
4014. FOLDING CLOTH, C. King and S. Oldershaw, Leicester.
4015. RECORDING CURRENTS of ELECTRICITY, T. Parker and J. H. Woodward, Manchester.
4016. WALKING-STICKS, S. Simmons, London.
4017. RING DOUBLING FRAMES, H. Rothwell, Manchester.
4018. REMOVING VAPOUR from CARRIAGE WINDOWS, A. Page, Leeds.
4019. SYRINGES, J. Challender, Manchester.
4020. UMBRELLA HOLDERS, H. T. Munns, Birmingham.
4021. HEATING AIR, W. P. Thompson.—(*I. D. Smead, United States.*)
4022. SODIUM, C. Humfrey, Liverpool.
4023. BURNING OFF OIL PAINT, W. H. Swingler, Birmingham.
4024 UNDERGROUND or SURFACE RAILWAYS or TRAMWAYS, J. Urie, jun., Glasgow.
4025. SEWING MACHINES, A. Anderson and R. A. F. Pollock, Glasgow.
4026. CHANGING the LEAD of the BEATERS of a CENTRIFUGAL MACHINE whilst in MOTION, A. R. Tattersall and J. Kerr, Belfast.
4027. MEASURING of ALTERNATING or INTERMITTENT ELECTRO-MOTIVE FORCE, R. Dick and R. Kennedy, Glasgow.
4028. METALLIC HINGES, G. J. Dean, Glasgow.
4029. METERS for REGISTERING the FLOW of LIQUIDS, C. C. Barton, London.
4030. ADVERTISING PRINTED or other ADVERTISEMENTS, G. J. Rhodes, London.
4031. REVOLVING FLAT CARDING ENGINES, J. Shepherd and H. Midgley, London.
4032. HOLDER for BRUSHES of ELECTRO-MOTORS and DYNAMO-MACHINES, M. Immisch, London.
4033. CASEMENT STAY, R. Ninnes, London.
4034. EARTHENWARE, &c., PIPES, J. G. Killey, London.
4035. COMBINATION BOLTING and LOCKING DEVICE, F. J. J. Gibbons, London.
4036. EXTRACTING TANNIN from BARK, C. C. Horsley, London.
4037. PUMPING LIQUID, J. Murrie, Glasgow.
4038. CAMP or FIELD OVENS, J. Downham, London.
4039. CANOPIED STOVE GRATES, T. Watson and T. P. Moorwood, Sheffield.
4040. GUARD for DRUMS in THRASHING MACHINES, G. H. Shaw, London.
4041. VESSELS used as MEASURES for SEEDS, J. Beeston London.

4042. Vessels used as Measures for Seeds, J. Beeston, London.
4043. Vessels used as Measures for Seeds, J. Beeston, London.
4044. Candle Shades, &c., W. Farquhar, London.
4045. Reciprocating Saws, J. Tille, London.
4046. Window Fasteners, P. A. Chinnery, London.
4047. Lubricators, R. J. Elwell.—(*H. Murray and A. Paterson, India.*)
4048. Washers, &c., for Tube Stoppers, J. R. Fothergill, London.
4049. Stirrups, A. Maclure, London.
4050. Cartridges, A. Greenwood.—(*The Schweizerische Industrie Gesellschaft, Switzerland.*)
4051. Carpet, &c., Looms, M. C. Crompton and H. Wyman, London.
4052. Lighting of Billiard Tables by Gas, G. J. Panzetta, London.
4053. Smelting in Blast Furnaces, E. Fisher and J. P. Cramp, London.
4054. Coating Pieces of Metal, &c., F. Elmore, London.
4055. Weighing Machines, A. J. Boult.—(*C. Dornbusch, Saxony.*)
4056. Ejector Mechanism of Hammerless, &c., Guns, W. Anson, London.
4057. Magazine Fire-arms, A. Greenwood. — (*The Schweizerische Industrie Gesellschaft, Switzerland.*)
4058. Strainers used in Making Paper, J. Thompson, London.
4059. Rotary Grinding, &c., Apparatus, J. Heath and F. Joslin, London.
4060. Portable Pumps, A. G. Melhuish, London.
4061. Stoppering Bottles, &c., A. S. Tanner and A. P. Godart, London.
4062. Porous Pots, C. D. Barker and F. C. Hills, London.
4063. Treatment of Milk, W. L. Wise.—(*C. A. Wahlin, A. Forssell, and F. L. Enguist, Sweden.*)
4064. Crushing Mills, J. W. Chenhall and F. Clench, London.
4065. Means for Extinguishing Oil Lamps, J. Prosser, London.
4066. Valve Gear for Steam Hammers, A. Davy and W. J. Benton, London.
4067. Utilising Waste Metal Tubing, J. T. Onions, London.
4068. Funnels for Filling Lamps, &c., J. A. Medlen, London.
4069. Ruling Machines, A. G. Dawson and F. E. Adams, London.
4070. Combined Engines and Dynamos, M. H. P. R. Sankey and P. W. Willans, London.

18th March, 1887.

4071. Blind Pulley, G. Rieunier, Shropshire.
4072. Turning Leaves in Books, &c., R. Shanks, Aberdeen.
4073. Strainers, H. J. Rogers, Watford.
4074. Insuring the Accurate Grinding of Drills, R. Hodson, Blackwall.
4075. Salt Grater and Holder, C. Gaul and T. Wolstenholme, Bradford.
4076. Valves or Plugs for Outlets of Tanks, J. Davy, Skipton-in-Craven.
4077. Hinges for Doors, &c., E. T. Hirst, Leeds.
4078. Spinning Tackle for Fishing, S. Allcock.—(*A. Ehmant, Paris.*)
4079. Protection of Houses, J. Enright, London.
4080. Machines for Braiding Garments, &c., J. Shuttleworth and V. Ashworth, Halifax.
4081. Four-wheeled Velocipede, M. Doubleday and H. A. Bettney, Lenton.
4082. Working Model of Co-ordinate Planes, C. E. Haggerty, Middlesbrough.
4083. Skid and Brake for Wagons, &c., G. Bramall, Oughtibridge.
4084. Automatically Moving Eggs out of Boiling Water, J. Holt and J. B. Brooks, Birmingham.
4085. Machines for Brushing Articles of Hosiery, &c., S. J. Pegg and J. T. Edmonds, Leicester.
4086. Producing Sound Copper Castings in Sand, &c., Moulds, R. Murray, Glasgow.
4087. Seats, A. Paget, Radmoor.
4088. Obtaining Aluminate of Soda, G. Milligan, Oxford.
4089. Railway Fog Signal, G. F. Attree, Brighton.
4090. Date Indicators or Calendars, J. J. Raggett, Birmingham.
4091. Novel Methods of Advertising, W. H. McDougall, Bonnyrigg.
4092. Knobs, E. Phillips, Birmingham.
4093. Fasteners for Wine Cases, &c., W. and G. Saltmarsh, London.
4094. Buckles, T. Evans, Birmingham.
4095. Velocipedes, R. E. Phillips.—(*A. H. Overman, United States.*)
4096. Differential Lubricating Apparatus, P. Hubert, London.
4097. Bridges for Elevated Railroads, &c., G. H. Pegram, London.
4098. Frillings, R. and L. Azulay, London.
4099. Driving Shears for Clipping Horses, &c., W. Clark, London.
4100. Ruler, J. Stebbing, London.
4101. Balancing Slide Valves, G. H. Wilisch and C. H. Scott, Sheffield.
4102. Rocking or Oscillating Horses or Chairs, E. Davies, London.
4103. Handles for Cutlery, &c., T. H. Heard, Sheffield.
4104. Making Metallic Transverse Railway Sleepers, D. Evans and J. H. Wicksteed, London.
4105. Making Metallic Transverse Railway Sleepers, D. Evans and J. H. Wicksteed, London.
4106. Couplings for Railway Rolling Stock, T. D. Swift, Liverpool.
4107. Fountain Pens, J. Schmackelsen, London.
4108. Bottle Stopper, R. and A. Miles, Stourbridge.
4109. Burglar Alarms, R. Haddan.—(*G. Schleicher, United States.*)
4110. Hat Suspenders, J. Reid, Glasgow.
4111. Hot Air Engines, R. S. Lloyd, London.
4112. Electric Lamps, H. Weber and R. Schefbauer, London.
4113. Barbed Wire Fencing, H. Bönten, London.
4114. Protecting Batteries, L. R. Davis and M. Shearer, London.
4115. Rapid Firing Guns, J. Rogerson and A. Downie, London.
4116. Electric Incandescent Lamps, A. F. St. George and C. R. Bonne, London.
4117. Winding Cloth on Rollers, J. Cowburn and C. Peck, Manchester.
4118. Gas Burners, H. Tallmadge, London.
4119. Chains, A. Spencer, London.
4120. Chains, A. Spencer, London.
4121. Chains, A. Spencer, London.
4122. Controlling Pressure, J. I. Thornycroft, London.
4123. Valve-gear, H. B. Merton, London.
4124. Checking Payments of Money, J. Simpson, London.
4125. Waist-bands, C. Lunn and H. P. Robinson, London.
4126. Electrolysis, M. and E. Bernard, London.
4127. Drilling Machines, N. C. Pond, M. O. West, and E. Simons, London.
4128. Suspending Articles, C. S. Proctor and S. Compton, Newcastle-on-Tyne.
4129. Taps, E. Perrett, London.
4130. Spools, S. H. Hodges, Somersetshire.
4131. Shoe Machinery, W. Ross and J. Bilbie, Middlesex.
4132. Railway Couplings, J. P. Ketteringham, J. Farrell, P. W. Mulvihill, and S. J. Perrault, London.
4133. Sulphur, J. Y. Johnson.—(*C. Dubois, France.*)
4134. Steam Engines, C. W. Thompson, London.
4135. Transmitters, H. J. Haight, London.
4136. Hoof-pads, E. F. Collins, London.
4137. Securing Rope, &c., J. I. Hopper, London.

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4138. Electric Circuits, A. C. Cockburn, London
4139. Over-boots, W. Beasly, London.
4140. Stamping, H. C. Gover, Highgate.
4141. Cigarettes, W. Taylor, London.
4142. Tune Playing Tops, W. H. Duncan, Coalbrookdale.
4143. Protector, C. Rubens, London.
4144. Stone Breakers, R. Broadbent, Manchester.
4145. Knitting Machines, J. M., J., A. J., and S. A. Gimson, and W. J. Ford, Leicester.
4146. Harmoniums, I. and T. Binns, Manchester.
4147. Fire-extinguisher, T. Witter, Manchester.
4148. Maintaining a Constant Plane in Steamers, A. H. Broadbent, Fairfield.
4149. Playing Reed Instruments, W. G. Ackerman and G. H. Best, Bridport.
4150. India-rubber Horsestocking, &c., J. H. Elvery, Dublin.
4151. Fire-proof Floors, &c., J. M. Robertson, Glasgow.
4152. Abolishing the Use of Laces in Footballs, J. Kneen, Warrington.
4153. Mechanical Telephone, T. H. Churton, Leeds.
4154. Cisterns, W. H. Wildig, Chester.
4155. Carding Machines, J. Nasmith, Manchester.
4156. Winding Yarn, I. C. Schofield, Elland.
4157. Lace, &c., E. Cope, Liverpool.
4158. Combs for Lace Machines, E. Cope, Liverpool.
4159. Fluid Motor Cylinders, C. Stout, Crosby.
4160. Gas Bags, C. G. Beechey, London.
4161. Lamp Stoves, E. A. and J. D. Rippingille, London.
4162. Cases for Files, W. P. Thompson.—(*J. C. Lang, United States.*)
4163. Fixing Blinds, &c., to Rollers, E. Summerfield, London.
4164. Cattle Cribs and Sheep Troughs, J. Batchelar, London.
4165. School Desks and Seats, A. Drysdale and G. Gilmour, Glasgow.
4166. Lawn Tennis, &c., Rackets, R. F. J. C. Allen, London.
4167. Rolling and Unrolling Maps, &c., T. P. Johnston, Glasgow.
4168. Raising, &c., Liquids, J. H. Johnson.—(*F. Romain, France.*)
4169. Applying Adhesive Substance to Paper, O. D. Orvis, London.
4170. Revolving Heavy Masses of Material, F. Berry, Sheffield.
4171. Securing the Cords of Blinds, J. R. Earnshaw, London.
4172. Opening, &c., the Twist in Fabrics, R. R. Roberts, London.
4173. Self-acting Mules, W. Royle, London.
4174. Holding Neckties in Position, E. C. Walker, Old Charlton.
4175. Balancing, &c., Windows, &c., J. J. Bourne, London.
4176. Making Jam by Steam, J. Whittaker, London.
4177. Attaching Neckties to Collars, G. Morgan, London.
4178. Rotary Album, T. W. Nagington and W. H. Waring, London.
4179. Manufacturing Carbon Conductors, T. V. Hughes, London.
4180. Combined Weighing and Advertising Machine, W. S. Oliver, London.
4181. Cranks, G. Sant and S. Farnsworth, Derby.
4182. Railway Carriages, H. H. Lake.—(*C. W. M. Smith, United States.*)
4183. Heating Horticultural Hot-beds, J. Siem, London.
4184. Breaking in Horses, H. H. Lake.—(*L. Guinet, France.*)
4185. Stop-cocks, R. Thompson, London.
4186. Screw Wrenches, H. H. Lake.—(*M. H. Seymour, Canada.*)
4187. Stop-valves, F. W. A. Kirsten, London.
4188. Washing Machine, S. M. Walcher, London.
4189. Tennis Racquets, J. F. Gilmore, London.
4190. Freezing Apparatus, H. Gonne, London.

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4191. Rolling very Thin Gauges of Iron, L. and W. R. Lysaght, and J. Lakin, London
4192. Automatic Car Brakes, A. P. Massey, London.
4193. Building Glasshouses, H. Stevenson, Knebworth.
4194. Water-closets, W. Skinner, Sheffield.
4195. Cases for Storing Bottles Containing Aerated Water, W. Bannister, Skipton-in-Craven.
4196. School Desks, &c., W. Woolard, Stevenage.
4197. Hot-water Boilers, W. L. Milne, London.
4198. Adjusting Drawing Paper to Sketching Boards, W. W. C. Verner, London.
4199. Chlorine and Hydrogen, A. and L. Q. Brin, London.
4200. Automatic Vacuum Vent-peg, S. G. Mason, Moseley.
4201. Nitric Acid, J. Taylor, Glasgow.
4202. Washing Racks for Photographic Negatives, G. F. Blackmore, London.
4203. Preparing a Dry Saccharated Extract of Tea, T. Kerfoot, Manchester.
4204. Cramps, W. Hayhurst, Burnley.
4205. Engine Packing, D. G. Cresswell, Manchester.
4206. Electric Low-water Alarm, — Scholes and — Whitehead, Manchester.
4207. Steam Jet Condensers, J. Hall, Manchester.
4208. Steam Engines, J. J. Carpenter, London.
4209. Railway Carriage Coupling, O. Lewis, Carnarvon.
4210. Foot Stool, J. Glendenning, Norwich, and W. C. Parker, Darlington.
4211. Musical-boxes, J. Billon-Haller, London.
4212. New Game, W. T. Black, Northampton.
4213. Electric Portable Lamp, A. Friedländer, London.
4214. Telegraphic Indicators, J. G. Alison.—(*E. Lambinet, France.*)
4215. Velocipedes, T. Ashburn, London.
4216. Cartridges, O. Rowe, London.
4217. Sand Blasts, G. R. A. Gutmann, London.
4218. Treating Hollow Metal Cylinders, W. Hope, London.
4219. Accumulators of Electricity, C. Desmazures, London.
4220. Measuring Electric Currents, J. W. King, London.
4221. Suspending Cuffs in Position, F. W. Mugford, Wanstead.
4222. Reel Holder, J. Frank, London.
4223. Combined Thimble and Scissors, H. S. Paget, Harrow-on-the-Hill.
4224. Ornamental and other Designs, &c., A. Oldroyd, London.
4225. Electricity Motors, G. Hookham, London.
4226. Metallic Signal and other Posts, C. Potter, W. H. Deakin, and W. Holland, jun., London.
4227. Submarine Vessels, G. Poore and W. C. Storey, London.
4228. Extraction of Aluminium, C. Netto, London.
4229. Blow-pipes, K. Roser and W. Holzhauer, London.
4230. Umbrella Fasteners, R. Haddan —(*H. Rosenberg, United States.*)
4231. Wood-planing and Turning Machines, H. G. Lehmann, London.
4232. Boiler Water Alarm, F. R. Stevenson, London.
4233. Breaking and Crushing Quartz, J. W. Chenhall and J. Richardson, London.
4234. Concentrating Ores, J. W. Chenhall and J. Richardson, London.
4235. Automatic Couplings, C. Lock, London.
4236. Floor-cloth, &c., J. Tait, London.
4237. Horseshoes, J. Bigg, London.
4238. Drilling Machines, S. Beeching, London.
4239. Driving Gear for the Valve Motion of Motor Engines, C. D. Abel.—(*Blohm and Voss, Germany.*)
4240. Transmitting and Receiving Apparatus of Printing Telegraphs, W. S. Steljes, London.
4241. Pyro-sulphates, H. Baum, London.
4242. Artificial Majolica, &c., M. Hoffmann, London.
4243. Colouring Matters W. Majert, London.

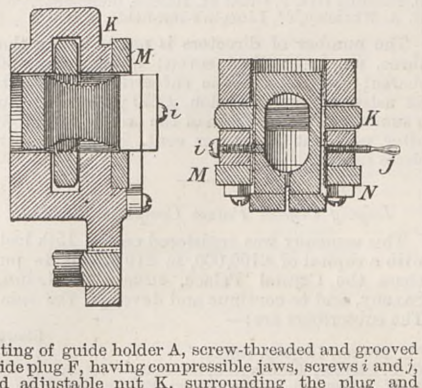
SELECTED AMERICAN PATENTS

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

356,462. Adjustable Guide for Band Saws, *C. Gail, Chicago, Ill.—Filed July 23rd*, 1886.

Claim.—(1) A saw guide consisting of guide holder A, screw-threaded and grooved guide plug F, having compressible jaws, screws *i j*, bearing in grooves in the plug, and the adjustable nut K, surrounding the plug, and operated as described. (2) A saw guide con-

356,462

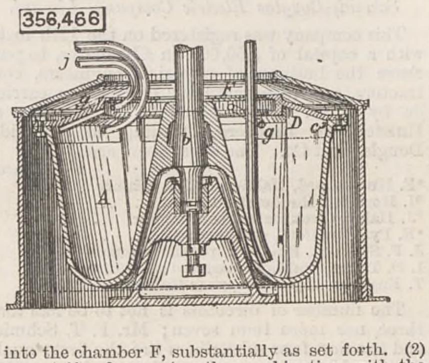


sisting of guide holder A, screw-threaded and grooved guide plug F, having compressible jaws, screws *i* and *j*, and adjustable nut K, surrounding the plug and extending beyond the circumference of the holder A, as set forth. (3) In a saw guide, the combination of the holder A, the movable wearing plate or ring M, and clamps N with the guide plug F and means for adjusting it, substantially as described.

356,466. Centrifugal Creamer, *R. C. Hansen, Uttersler, and M. H. Brunn, Horslund, Lolland, Denmark.—Filed May 14th*, 1884.

Claim.—(1) In a centrifugal separator, the combination, with the rotating vessel A, made open at the top, of a cover D, secured to the open top of the vessel A, and provided at its eye with the annular chamber F, trough-shaped in cross section, and arranged with its open side toward the axis of rotation, and a pipe *g*, extending from the outer wall of the chamber F along the under side of the cover D, and terminating near the outer wall of the vessel A, whereby the heavy liquid is conducted from the periphery of the vessel

356,466



A into the chamber F, substantially as set forth. (2) In a centrifugal separator, the combination, with the rotating vessel A, of a cover D, provided at its eye with the annular chamber F, trough-shaped in cross section and arranged with its open side toward the axis of rotation, a pipe *g*, extending from the outer wall of the chamber F along the under side of the cover D, and terminating near the outer wall of the vessel A, whereby the heavy liquid is conducted from the periphery of the rotating vessel into the chamber F, and a stationary discharge pipe or conduit *f*, projecting into the chamber F, whereby the liquid is removed from said chamber, substantially as set forth. (3) The combination, with the drum A, having an internal annular depression c^2, of a cover D, provided with an annular chamber F, and a pipe *g*, extending from the chamber F toward the depression c^2, substantially as set forth.

356,468. Machine for Welding Pipe, *C. P. Higgins, Philadelphia, Pa.—Filed June 18th*, 1886.

Claim.—(1) In a machine for welding rectangular pipe, the combination of a pair of external flanged rolls embracing and supporting the exterior surfaces of the pipe to be welded with a mandril having its acting surfaces composed of a pair of cylindrical rolls having their axes located in a common plane with and parallel to the axes of the exterior rolls. (2) In a machine for welding rectangular pipe, the combination of a pair of external flanged rolls embracing and

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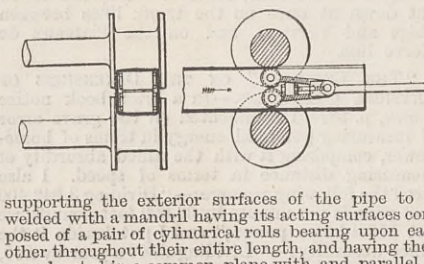
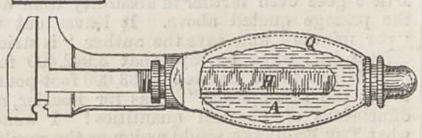


supporting the exterior surfaces of the pipe to be welded with a mandril having its acting surfaces composed of a pair of cylindrical rolls bearing upon each other throughout their entire length, and having their axes located in a common plane with and parallel to the axes of the exterior rolls. (3) In a machine for welding rectangular pipe, the combination of a pair of external flanged rolls embracing and supporting the exterior surfaces of the pipe to be welded with a mandril having its acting surfaces composed of a pair of cylindrical rolls, and mechanism, substantially such as described, for adjusting said rolls toward and from each other, and having their axes located in a common plane with and parallel to the axes of the exterior rolls.

356,566. Combined Oil-can, Wrench, and Tool for Bicycles, *D. C. Wilgus, Los Angeles, Cal.—Filed May 17th*, 1886.

Claim.—In a combined wrench and oil-can, the oil-can and wrench-handle consisting of the flat hollow

356,566

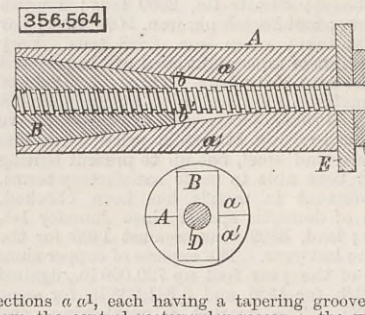


case A, the threaded sheath H, attached to and forming part of one side of the case, and the spring plate Q attached to and forming the other side of the case.

356,564. Wedge for Mining Coal, *J. O. Watson and C. A. Sipe, Fairmont, W. Va.—Filed February 17th*, 1886.

Claim.—An improved article of manufacture, a wedge for breaking down coal, consisting in the cylinder A, formed of the two semi-cylindrical independent

356,564

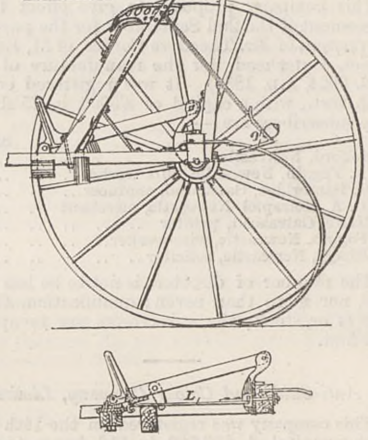


sections *a* a^1, each having a tapering groove *b* b^1 to form the central rectangular recess *e*, the wedge B within said recess, and having a rectangular shape in cross section and a longitudinal threaded aperture, the loose washer E on the shaft, and forming a bearing, as set forth, the collar F on the shaft adjacent to the outside of the said washer, and the set screw for the said collar, substantially as set forth.

356,596. Horse Hayrake, *P. P. Mast and G. W. Startzman, Springfield, Ohio.—Filed March 17th*, 1886.

Claim.—(1) In a wheeled hayrake, the rocking rakehead having the wheels journalled on its end and the draught frame hinged to the front of said rakehead near its end, in combination with the central rod or brace L, connected with the rakehead and draught frame, substantially as described, whereby the springing or yielding of the head in a backward direction is prevented. (2) The rocking wheeled axle having the teeth attached in combination with a draught frame jointed thereto, the central rod or brace, and a slotted

356,596



connection at one or both ends of said brace, as described. In a rake, the rocking axle, the operating arm applied thereto, the draught frame jointed to the axle, the lever mounted on the draught frame, the bar connecting said lever with the arm on the axle, and the rod or brace connecting the axle with a plate to which the lever is pivotted, whereby the parts are maintained in position to secure the proper action of the lever. (4) In combination with a rake-tooth passing therethrough, a support for the clearing device, consisting of plate O, bent midway of its length to an angular form, one end provided with the longitudinal slot to receive the tooth and the opposite end curved outward to ride upon the tooth.

356,597. Buffer for Gas Compressor Valves, *M. L. Mitchell, St. Louis, Mo.—Filed October 22nd*, 1885.

Claim.—(1) In a gas compressor having a dome or chamber, the combination of a buffer secured in such dome or chamber with a discharge valve adapted to move toward the said buffer, such valve having a recess or depression therein corresponding substantially to the buffer head, and adapted to receive such buffer head when the valve moves up to the same, substantially as described. (2) In a gas compressor having a dome or valve chamber, the combination of a buffer located within such dome or chamber with a discharge valve adapted to hold and retain a portion of the liquid admitted by it to the chamber and to present the retained liquid to the head of the buffer, whereby the valve is prevented from coming in con-

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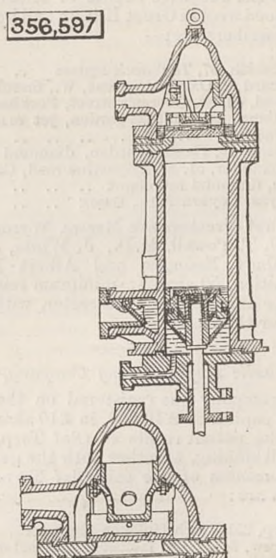

tact with the buffer head until it has displaced the liquid retained by the valve, substantially as and for the purpose set forth. (3) In a gas compressor using a cooling, sealing, and lubricating liquid, the combination of a buffer secured within the discharge valve chamber with a cup-shaped discharge valve having therein an oil receptacle corresponding substantially to the shape of the buffer head and adapted to hold a liquid whereby a cushion for the buffer may be formed of the liquid contained in such receptacle or recess, which is thus made to neutralise or render noiseless the concussion occasioned by the forcing of the valve up to the buffer head, substantially as decribed.