THE FRAMING OF IRON AND STEEL SHIPS.

IT has often been pointed out that the modes of combining the materials of the earliest iron ships were copied from the practices which had long prevailed in the construction of wooden ships. That this was the case, so far as these practices were applicable, there can be no question, for the oldest iron ships still afloat exhibit at every part of their hulls the most painstaking imitations of the several components of the structure intended to perform similar functions in their wooden predecessors. It is doubtful, however, whether the transverse system of framing, which was adopted from the first by iron ship builders, was so much an imitation of the framing of a wooden ship as a necessary and inevitable means of stiffening the bottom plating. Mr. Scott Russell was always of opinion that the longitudinal system of framing was the only logically defensible arrangement in an iron ship, and that the transverse system was a legacy from our wood-shipbuilding forefathers. Such an opinion was permissible when the Great Eastern was designed and built, but it cannot stand the test of more recent experience. Had the longitudinal system of framing possessed all or only a fraction of the advantages which were claimed on its behalf by Mr. Scott Russell, the twenty years and more which have elapsed since the Great Eastern was built would surely have witnessed a departure from the transverse to the longitudinal arrangement in the frames of iron and steel ships. But instead of that being the case, we find iron vessels for ordinary trades and purposes being framed to-day in precisely the same way as our fathers framed them thirty and forty years ago. After so long an experience in the construction and behaviour of iron and steel ships as has now been accumulated, the continued prevalence of the transverse system of framing most assuredly points to its adaptability for the attainment of the qualities desired in such vessels. It is quite possible, and indeed very likely, that the longitudinal system is as strong, and for vessels of unusual proportion it may be even stronger than the transverse, but the persistence of the latter arrangement must be due to the existence in connection with it of certain advantages which are not outbalanced by qualities of a contrary character. The transverse system is undoubtedly a cheap and simple one from the shipbuilder's point of view, and that of itself is sufficient to ensure its longevity provided the shipowner does not find the maintenance and insurance of a vessel built to be unduly costly. Underwriters are never slow to discover the existences of conditions antagonistic to their interests; and if a certain system of construction yields better or worse statistical results than others from an insurer's point of view, the difference in the two cases will very soon find expression in the shape of lower or higher insurance premiums. Moreover, the Committee of Lloyd's Register of Shipping learn in due course from their surveying staff how matters stand in regard to the relative efficiencies of different systems of ship construction, as ascertained at the periodical surveys made upon vessels classed in the Register when they return from sea. That the transverse arrangement of framing is still not only permitted by Lloyd's Register, but made the basis of the rules which they have formulated for the construction of iron and steel ships, is the most conclusive proof that the system, after being tried so many years, is not yet found wanting.

The frame of an iron ship was, from the first, so put together and disposed as to be a strong, economically-formed girder, doing duty as a rib to the structure. As a girder it was formed of two angle irons rivetted together back to back in the shape of a ⊤, the web of the girder being deepened in the flat of the bottom by the introduction of a floor-plate, in order the better to support the weight of cargo resting upon it. As a rule this girder was placed transversely across the keel, this being the simplest way of building a ship to the desired shape and an efficient mode of stiffening the skin plating so as to keep it to that shape—not the most efficient mode perhaps, although quite as efficient as any other when the vessel is not unduly long in proportion to her breadth. This being done, the attainment of the requisite longitudinal strength was sought by the use of keelsons, stringers and the other iron equivalents for the keelsons, binding strakes, waterways, clamps, and shelves of a wooden ship. For just as these latter served to stiffen the wood frames, keep them in their relative positions, and thus enable them to develope their full value as ribs to the structure, so the centre and side keelsons, bilge and hold stringers, and the stringers to the several tiers of beams of an iron or steel ship support and bind together the transverse frames, and, in combination with the latter, make a rigid network of framing, capable of resisting stresses in all directions and of further stiffening the plating of bottom and sides so that it may effectually develope the longitudinal strength of the materials composing it.

A truly efficient structure is one in which there is no material that does not contribute support to the remainder, and a properly-constructed ship should fulfil these conditions in all its parts. The bottom deck and sides are, primarily, to keep the water out and enable her to float; but the bottom deck and sides must also supply the needed structural strength, and the deck must be a convenient platform for the purpose of navigation. Bulkheads are primarily intended for the subdivision of the hold, and as precautions in the event of the bottom being broken through at any place; but then bulkheads should also be valuable sources of stiffness, and therefore of structural efficiency. Even the coal bunkers, engine casings, and the most subordinate details in the construction should, so far as is possible, be enlisted into the service of the naval architect and made to contribute strength to the structure. Attention to this important truth has resulted in many considerable modifications in iron and steel ship construction during the past ten or fifteen years. The value of water ballast tanks was demonstrated for some time before the tanks themselves were made part of the hull of the ship, and structural strength was got out of them. But even when inner bottoms were built into steam vessels for water ballast purposes a long time elapsed before anything approaching to the full structural value was got out of the additional materials employed in such cases. Girders were built upon the ordinary floors, and the inner bottom was laid upon these girders, so as to contribute strength only in an interrupted and not a continuous manner. The introduction of the cellular system for framing the bottoms of vessels intended for carrying water ballast, was the first step towards attaining an economical use of the materials worked into a vessel for water-ballast carrying purposes. The cellular system has been adopted in the Royal Navy during the past twenty-two years, for purposes of safety against the risks of warfare, as well as upon account of the economical distribution of materials thereby obtained, especially with the use of brackets in lieu of solid floor plates. Only as high as the armour line, however, is this system adopted. From thence upwards the framing in her Majesty's ironclad ships of war is arranged upon the transverse system. In adopting the cellular arrangement in the mercantile marine the system was, similarly, limited to the extent of the water ballast tanks. From the margin of these tanks upwards the framing is arranged, like that of ordinary vessels, upon the common transverse system. It has been sometimes asserted by advocates of the longitudinal system that the cellular double bottom, now so commonly adopted in mercantile steamers, is an essential feature of that system, and that the growing prevalence of the cellular framing affords a corroboration of the predictions made by Mr. Scott Russell so many years ago. But it must be remembered that the cellular arrangement is adopted for water ballast purposes and for those purposes alone. It is preferred to the old-fashioned ballast tank because the Board of Trade measure cellular bottom vessels for tonnage in a way much more advantageous to their owners, and for this advantage the latter are often willing to pay the higher cost of construction. But considerations of structural strength can scarcely enter into the question, seeing that the longitudinal girders are sometimes fitted in short length, and the transverse frames in such cases are continuous from margin plate to margin plate of the cellular bottom. Usually, however, the longitudinal girders are continuous, and in those cases there can be no question regarding the great longitudinal strength of the arrangement; but whether such additional strength in that direction is necessary or even advantageous in the great majority of vessels, is problematical. On the contrary, it is doubtful whether the loss of transverse strength, due to severing both frames and reverse frames at the margin plates of the cellular bottom is not more serious than is commonly supposed, especially in the large broad steamers which are now getting more and more into vogue. The tendency to build unduly long steamers has given place to one of building unduly broad ones, and so the importance of transverse connections is now deserving of even greater attention than hitherto. At the same time the value of continuous longitudinal framing has correspondingly diminished.

In the earliest iron ships the transverse frames were spaced very closely together as compared with the distance at which they are now commonly arranged. In cases requiring a spacing of twenty-four inches between the frames, according to the practice of to-day, we find that in the early iron ships an eighteen inch spacing was adopted. It was soon found that not only was this close spacing unnecessary, but that it was attended with structural disadvantages even to the extent of loss of strength. When transverse frames are so close together it is impossible to fit butt straps of the necessary breadth, and the transverse lines of weakness in the plating due to the rivet holes for attaching the latter to the frames are increased in number and placed in closer proximity. Moreover, any amount of transverse stiffening beyond that which is necessary for keeping the plating to its shape under all possible strains at sea, is not only useless but a source of weakness, inasmuch as weight is thereby being carried that is not contributing its fair proportion of necessary structural strength. The Admiralty were very bold in their attempts at saving weight in the framing of ships, being doubtless encouraged by the strong desire to add to the weight of armour plating, guns, machinery, coals, &c., which might be carried. Eighteen inches was increased to a two feet spacing of frames, and the latter soon grew into three feet, and even into four feet in some large vessels, within the limits of their double bottoms. So long as these vessels succeeded in keeping clear of the ground, no inconvenience was found to result from the wide spacing of their frames; but it need scarcely be said that great care is necessary when shoring them in dry dock, and touching anything harder than water when afloat and in motion is always attended with much damage to their bottom plating. It was only when the Admiralty constructors exercised their lightening tendencies upon the hulls of the powerful steel unarmoured cruisers Iris and Mercury that they discovered the limits of safety in that direction had been passed. Since then H.M.S. Calypso has been a source of trouble upon a similar account, and in the mercantile marine the effects of an unduly wide frame spacing have been seen more than once during recent years in leaky butts and other equally unsatisfactory indications of an absence of adequate stiffness. It is quite clear that we may go too far, and that we have at times already done so in regard to wide spacing of an iron or steel vessel's frames. Strange to say, however, there seems to be no recognised mean between the 24in. or 26in. frame spacing of an ordinarily transversed framed ship and the 3ft. to 4ft. spacing of the strong frames in a cellular bottom. We have at the present time two types of construction, which received the highest official sanction, for large ocean steamers of from 5000 to 7000 tons register. The transverse system proper is adopted by some of the principal shipowning companies, such as the Cunard and the Peninsular and Oriental, in their finest steamers, and with the very best results. The cellular bottom modification of the system is adopted by some other important lines of large steamers, and the only objectionable experience in connection with the vessels is the leaking at the butts of the bottom plating, and other symptoms which are sometimes exhibited; but these symptoms, when closely examined, indicate a want of local stiffness rather than a deficiency of general structural strength. These symptoms are peculiarly apparent in the cases of steel vessels, which have thinner plates than would be used if iron were the material employed in their construction. An attempt has been made of late to counteract these objectionable tendencies by fitting thicker butt straps, and placing additional rivets in them; but it remains to be seen whether or not this remedy is sufficient to meet the case. When a comparison is made between the appearance of the bottom plating of these modern vessels in dry dock and the bottoms of old ships with a very close arrangement of frames, the difference in the behaviour of the butt connections is very conspicuous in the two cases. The older vessel rarely shows her butts at all, and, indeed, it is often difficult to find them; whereas the modern-built vessel with the cellular bottom often shows every butt of her bilges and bottom with plain and disagreeable distinctness. Such appearances are generally wanting in large vessels constructed on the ordinary transverse system, with frames spaced from 24in. to 26in. apart. But this spacing of frames seems to be unnecessarily close; and it is worthy of consideration whether a slightly wider spacing would not yield more economical results. In the way of double frames, such as are fitted to bulkheads, it is impossible to fit the 19in. butt strap, required for the treble rivetted butt joint of an inch plate, between consecutive frame bars, when a 24in. spacing is adopted, and the same difficulty is experienced throughout the whole length of a garboard strake, in consequence of the presence of the heel pieces at the backs of the frames. By slightly increasing the spacing of the frames, it would be possible to get a more satisfactory butt fastening, and a considerable saving of unnecessary weight would, at the same time, be achieved. Already proposals are being made by an important line of ocean steamers, pointing in the direction we have suggested. There are still opportunities for the exercise of skill and ingenuity in the development of iron and steel ship construction, and good reasons still exist for carefully watching their performances, and applying the results of experience in future designs. It seems evident that in the matter of framing there is yet something to be learnt ere perfection is attained. The frames of vessels constructed upon one system are, it seems, too widely spaced, and those upon another and earlier system appear to be often too close together. It remains for the judicious mean to be determined.

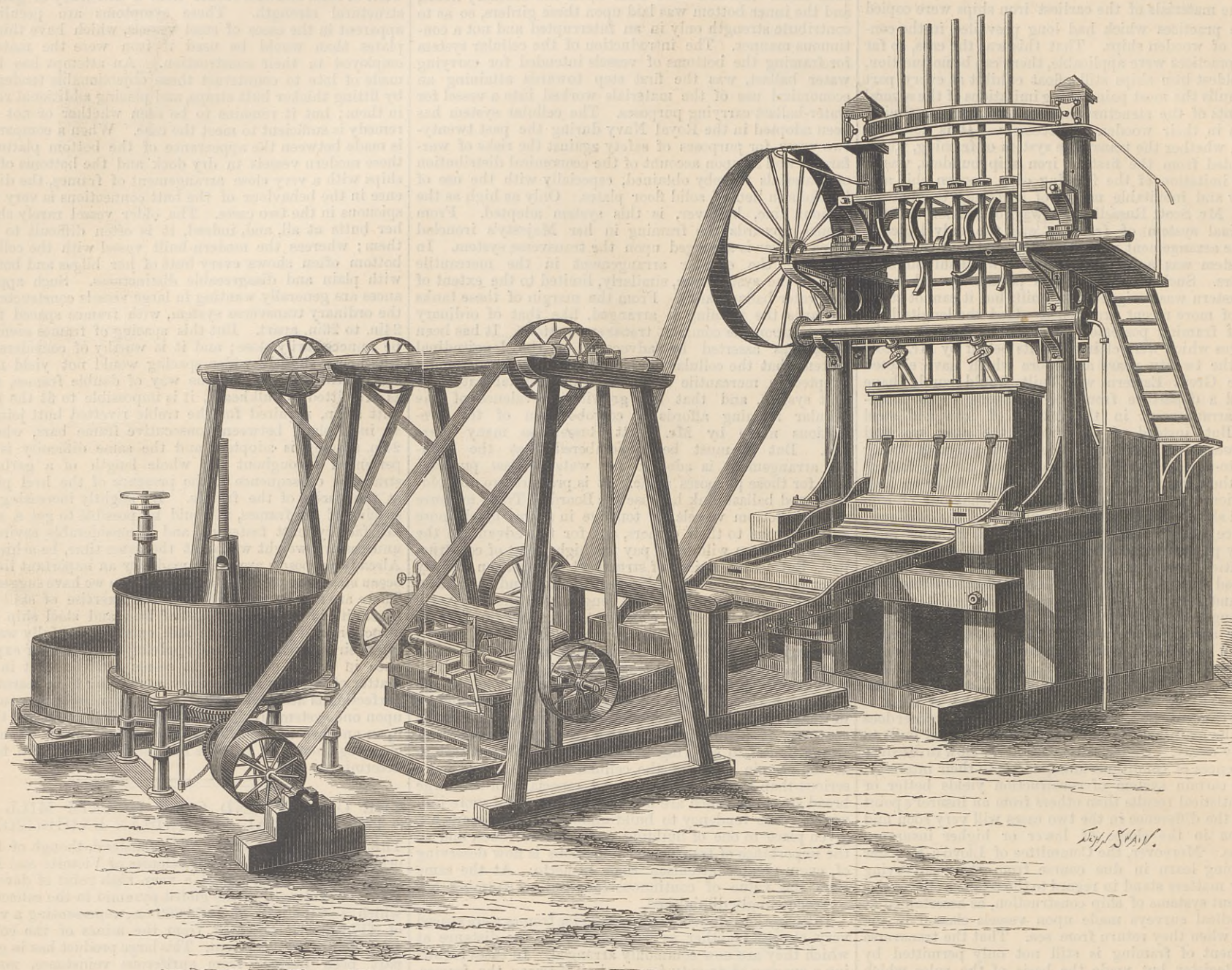
THE QUEENSLAND GOLD QUARTZ MILL AT THE COLONIAL AND INDIAN EXHIBITION.

THE gold mining industry of Queensland, though of later origin than that of the sister colonies of Victoria and New South Wales, has reached a very high point of development, as evidenced in the gilded pyramid in the collection, which is of the bulk of 4,878,660 oz., representing a value of £17,623,234, obtained from the mines of the colony since their commencement. This large product has in great part been derived from auriferous veinstones, mainly quartz, with some proportion of iron pyrites, galena blende, and other sulphides, by the method of stamping and battery amalgamation, although concentrating smelting, by means of lead and copper regulus, have been introduced to some extent for the treatment of the more refractory

THE CRADLE IN USE.

ores. A principal point of interest is the great richness of the ores treated, the average return for the whole of the stone treated being about 1½ oz. per ton, while in many cases it is considerably higher, especially in the more pyritic veins. Prominent among the latter is the Mount Morgan mine, situated about 22 miles south-west of Rockhampton, which is opened in a lode about 300ft. wide, which is freely exposed for several hundred feet on a hill rising 1225ft. above the sea-level. The original pyritic constituent appears to have been converted into a stalactitic brown iron ore, resembling the brush ore of the Forest of Dean, which is reported to be a geyser or hot spring deposit by the exhibitor. This yields by crushing about 7 oz. to the ton. The gold obtained is remarkable for its extreme purity, the milled bars assaying 997-thousandths fine, of the value £4 4s. 8d. per ounce, or within 2d. of the mint price for absolutely pure gold. The other and more im-

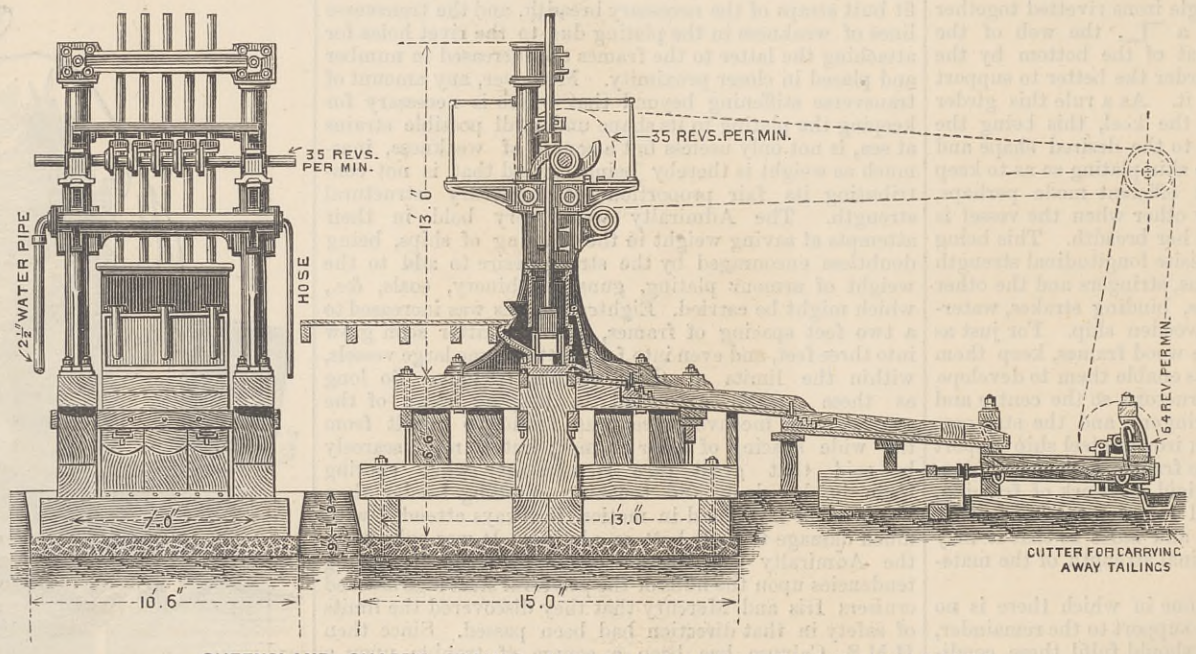
THE QUEENSLAND GOLD QUARTZ MILL IN THE COLONIAL EXHIBITION.



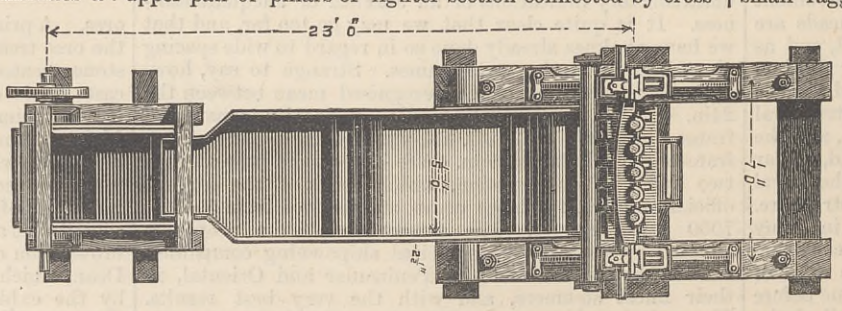
portant gold-fields, as being more fully developed, are those of Charter Towers, Gympie, Ravenswood, Etheridge, and the Palmer, all of which are well represented by samples from their different mines both in the main building and in the collection at the stamp mill house. The Gympie and Palmer districts appear to give the most freely working quartz, that from the others being more or less mixed with lead, copper, and zinc ores. In the Ravenswood district the method of concentration by lead in blast furnaces is practised by a company who exhibit blocks of auriferous lead.

In order to bring this great industry prominently under the notice of the visitors to the Exhibition, the Government of Queensland have erected in the South Promenade a full-sized stamp battery, with the necessary amalgamating plates, and other gold-saving appliances, which are exhibited in action for two hours daily—3.30 to 5.30 p.m—about 200 tons of quartz having been supplied from the different mines of the colony to keep the mill at work during the entire period that the Exhibition remains open. The plant—which is shown in perspective, as seen from the lower end of the building, as well as in plan and elevation—includes a five-stamp battery, with amalgamated copper tables and mercury rippler, a shaking table for saving pyrites, and apparatus for working pyrites, namely, a Boss grinding and two Berdan pans and a settler. These—with the exception of the Berdan pans, which are now in course of erection—have been at work since the beginning of June. The stamp battery is of the type commonly used in California and Australia, with round stamp heads and lifters, which are raised by cams placed on one side, so that the stamp is twisted through about a quarter or a third of a revolution at each lift. The stamps weigh 800 lb., with a drop of 9in., and fall eighty times per minute.

The most distinctively Australian feature in these stamps is the cast iron framing, which is very generally adopted in the best mills, although in many instances wooden frames with wrought iron tension rods, such as are general in America, are also used. The principal element of this is a 10in. tubular column, with a flanged base 7ft. 6in. broad, and about half the full height of the mill, which carries the bearings of the cam shaft and an upper pair of pillars of lighter section connected by cross-girders, with the top girder of the stamp between them. The cams and lifters are accessible by a gallery supported on cantilevers projecting from the lower pillars, and a pair of parallel iron bars are similarly attached to the upper pillars, and support the keys which are passed underneath the lifters when the stamp is "hung up" beyond the sweep of the cam. The cam shaft is driven directly by a belt from the steam engine. It makes from thirty-five to forty revolutions, giving twice that number of lifts per minute. This method of driving is not universally adopted in Australia, as may be seen from the fine working model of a crushing and amalgamating plant exhibited in the Victoria department. This has the lower framing pillars doubled, and the cams are on a second motion shaft, which is driven by spur gearing from a parallel shaft receiving motion from the driving belt of the engine.



QUEENSLAND QUARTZ STAMPS, AND AMALGAMATING TABLES AND RIPPER.



The form of the battery box or mortar will be sufficiently apparent from the cross section in our engravings. The stamp dies are placed about two inches as a maximum below the lower sill of the discharging aperture. The screens used are made of best charcoal sheet iron, about No. 28 B.W.G., with 225 apertures per square inch. The holes are not bored but produced by dishing the metal sufficiently sharply to fracture the bottom of the concavity giving a small ragged hole, which is placed with the burr turned inwards; the scour of the sandy water soon wears it to the proper size. The stamp shoes and dies are of chilled cast iron. Mr. Layden states that very good work has been realised with wrought iron shoes made from scrap bloom; the soft metal gets washed with particles of quartz, and then acts much in the manner of an emery or diamond-faced surface. The battery water is introduced on the side opposite to the feed by india-rubber hoses from a large horizontal pipe carried on brackets projecting from the lower pillars, which receives a supply of from a 2½in. service pipe. The volume of water required is about five hundred gallons per hour for the five heads of stamps. Mercury is used in the battery, and a strip of blanket is placed along the sill of the discharging aperture immediately in front of the screen to prevent the escape of amalgam.

The surface amalgamators, which have now completely replaced the blanket tables formerly used, are divided into three series separated by two sets of troughs and ripples containing mercury; the first is 22in. long, the second 6ft., and the third 7½ft.; all being of the full width of the battery front, namely, 5ft. The surface of the tables is covered with copper plates electro silvered, and then amalgamated with mercury; upon which the free gold passing out of the battery is stopped by contact with the liquid mercury, and slowly combining with it, is converted into dry crystalline amalgam with about 60 or 70 per cent. of gold. The mercury troughs or ripples placed at each break on the tables are arranged in step-like rows of three square channels, which are filled with mercury; the upper one, known as a centre board well, being provided with a stop or back-plate which forces the stuff, falling over the edge of the board, to pass down through the mercury. The stop-plate is also amalgamated to stop any gold that may be projected. Below each set of ripples a perforated plate is fixed to stop back any coarse material in the battery shoes or pulp.

The crushed material after leaving the last of the amalgamated plates falls upon a concentrator, which is a modified form of the old German percussion table, but with its surface laid horizontally instead of being continually inclined. The horizontal surface is, however, broken by a sharply-inclined part about two-thirds of the way down. The bottom of the table is also slightly dished towards the centre, the lowest part being perforated by a discharging aperture which is regulated by an adjustable valve. The table is suspended by links at the four corners, and is kept in rapid movement by a three-armed crank making 64 revolutions per minute, which forces it back against a buffer-stop attached to a heavy block of wood below the lowest amalgamating table. The heavier materials contained in the stuff passing over the table are forced by the recurrence shocks to deposit under the head and pass out through the valve, while the lighter waste goes over the end and into the launder leading to the tailings pot. The concentrated deposit, consisting largely of finely-divided pyrites, is led into a Boss grinding pan, where it is triturated with some addition of mercury, and finally into a settler with stirring arms, where the last separation of amalgam is effected. The complete plant includes two Berdan pans with spheroidal grinding surfaces, which take the stuff from the Boss pan; but as yet they are only under construction, and are therefore not shown in our figure. The capacity of the mill when in full work is about 10 cwt. per hour, or 12 tons per day, equal to 2·4 cwt. per head per day. The stuff at present under treatment is a white quartz from Gympie, tolerably free from pyrites, with a good deal of associated slatey matter, which is comparatively soft and easily crushed. Owing to the disturbed nature of the working no regular "mill run" can, of course, be expected, the total amount of stuff put through in the two hours' working being only about one ton, equivalent to about 1½ ounces of gold. The subsequent processes therefore of collecting and cleaning up the amalgam and distilling or retorting it can only be shown, if at all, at long intervals; but to compensate for this there is a fine specimen of retorted gold exhibited in the main building from the Day-Dawn and Wyndham Company's mine at Charles Towers, weighing 1707 ounces, and valued at £5923 sterling, representing the yield of fourten days' work with twenty heads of stamps.

The stamp mill with its associated amalgamating and concentrating tables was specially manufactured by Messrs. John Walker and Co., of Maryborough, Queensland, and has been erected by Mr. J. M. Longden, M.I.M.E., the mining engineer to the Commission, who is in charge of the Queensland mining exhibits. The pans and settlers are from the Sandycroft Foundry Company's works, near Chester, and the driving power provided by the Royal Commissioners is furnished by a single cylinder horizontal engine of 8-horse power, by Messrs. Davey, Paxman, and Co., of Colchester. One of the most noticeable features in the mill is the fine system of timber framing employed for the substructure. This is made of the so-called Queensland cedar, a magnificent hard wood, which in many respects resembles teak. The block below the lower amalgamating table which takes the thrust of the shaking table is specially noticeable for its size.

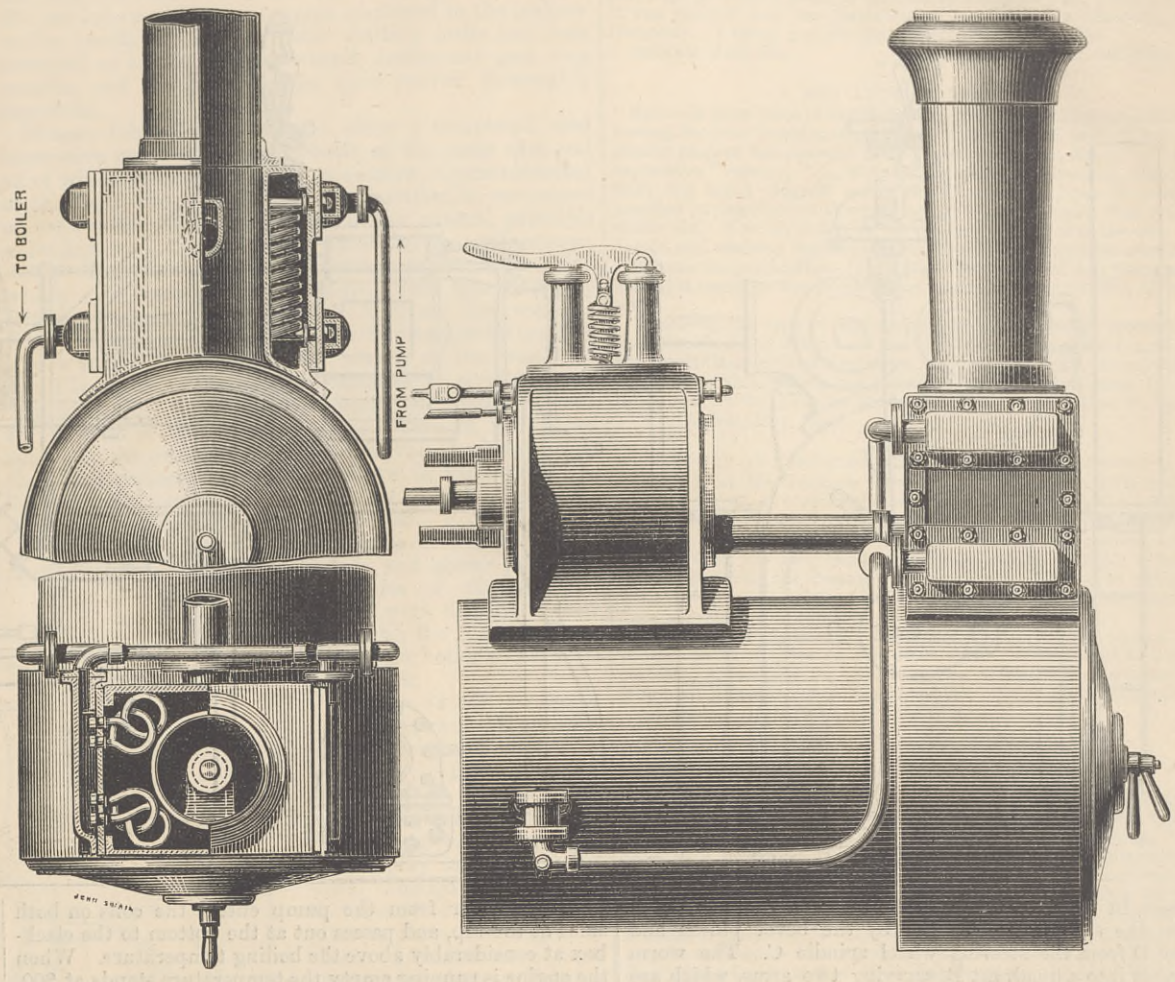
The old method of washing gold from alluvial earth by means of the pan and cradle is also shown in action by a picturesquely-costumed red-shirted digger. The auriferous "wash dirt" operated upon has been forwarded from the Calliope Gold Field, Queensland, and is very rich, containing coarse nuggety gold.

The character of the ores under treatment is displayed in a series of samples in the gallery at the lower end of the stamps. This collection is of great interest, but might be improved by giving the average battery yield of the different ores. Large piles of the same are shown outside the mill building.

Having regard to the large expenditure incurred by the Queensland Commission in their spirited endeavour to bring home the realities of gold ore reduction to the English public, it is to be hoped that all those who are technically interested in the matter will avail themselves of the opportunity afforded to them of studying the working of the mill during the continuance of the Exhibition.

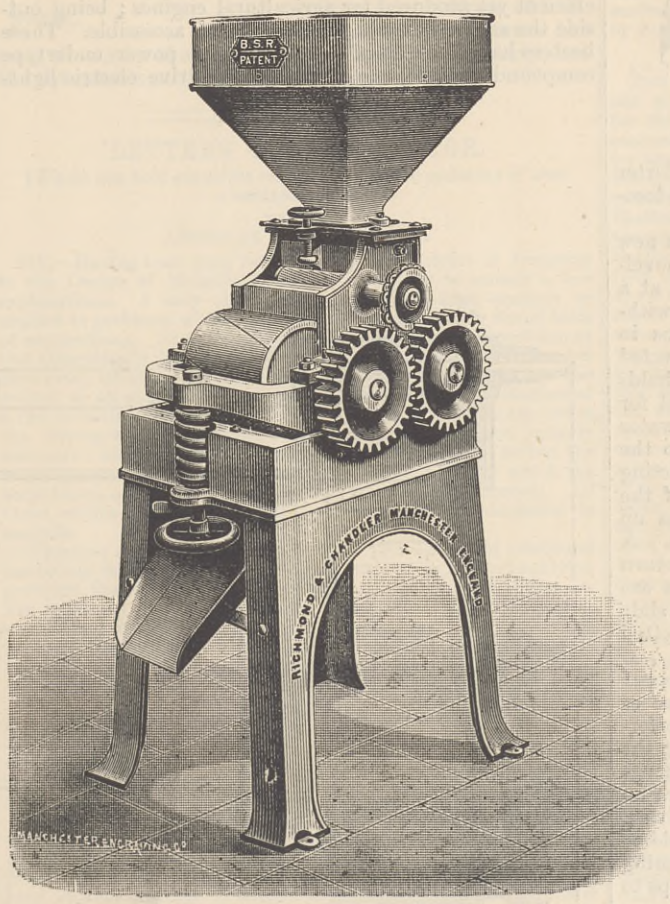
BURRELL AND KIRKALDY'S FEED HEATER.

(*For description see page* 44)



THE ROYAL AGRICULTURAL SOCIETY AT NORWICH.

THE Royal Agricultural Society visited Norwich in 1849, and even at that time the results of its activity were sufficient to justify much satisfaction. In the thirty-seven years which have passed since then, vast strides have been made in the design and manufacture of agricultural implements and machines, and the export of machinery made by agricultural engineers has become a large and important trade. But vast as has been the change—much of it brought about by the incentives of the Royal Agricultural Society itself—we should not be following in the energetic path struck out by those who effected the great changes, if we allowed ourselves to be deceived into acceptance of the notion that we have arrived at perfection in any implement or machine, any more than they, with equal reason but under stronger incentives, allowed themselves to be deceived. We no doubt look over a long period of years when we count up the advances made, and but over a short one when we are thinking of the work of the last five years, or that which remains to be or should be done now; but we cannot remind ourselves too often that when we halt others take advantage. Even as it is, we find competition in directions from which it should be impossible. At Norwich is a large show of implements from Offeverum in Sweden, and numberless exhibits of implements and machines made in America. This we should not allow, or at least we ought not to let it be possible for foreign manufacturers to find it worth their while to do it. Recollections of the state of agricultural engineering, and of the style of the exhibits at Norwich in 1849, remind us of the many and great inventions which the succeeding quarter of a century brought to the front, to the advantage not only of agriculture, but of the engineering industries. Comparison between 1849 and 1886 affords considerable satisfaction; but when we compare 1876 with 1886 we do not feel quite so proud with the rate of progress. There were amongst the Royal Agricultural Society in 1849 men who thought the implement makers had not gone as far as possible, but now men of this sort are not to the front. The Society gives now all the prizes to the cattle; in 1849 prizes were offered for twenty-four different kinds of implements and machines, including £364 in money and thirteen medals, and this was when there were only 145 exhibitors. It is interesting to note that in the report on the 1849 Show in the Society's "Journal" a great deal of the credit for the improvements effected, as shown by comparison with the engines and machines at the preceding meeting at York, is claimed for the Society as a result of its competitive trials and specific criticisms. It was at Norwich that a dynamometer was first used in the trials of thrashing machines, and the best engine was found to consume 11·8 lb. of coal per horse-power per hour. At that time the Royal Agricultural Society had every right to the position it assumed as its own, but now with hundreds of members to its tens at that time, and with about 120 per cent. more exhibitors, and much larger receipts from every source, the Society can only offer one prize. This year that one is insignificant, but next year it will offer one which ought to bear fruit. The forward element of the Society has at last obtained a hearing, and prizes are not only to be offered for pigs, but the pig breeder is to have his thousands of pounds sterling in prizes reduced by a few hundreds as an incentive to traction engine constructors. No doubt that some of the older makers will stand out, and that the improvements which may result from the competition for this prize will be accompanied by much that is useless, and men not the most capable of producing an improvement upon the existing road locomotive will feel the inducement to try, and will smart under the inevitable failure. The success of those who succeed is, however, more important than the discontent of those who fail, even if their number be large; for a success indicates the path for all.



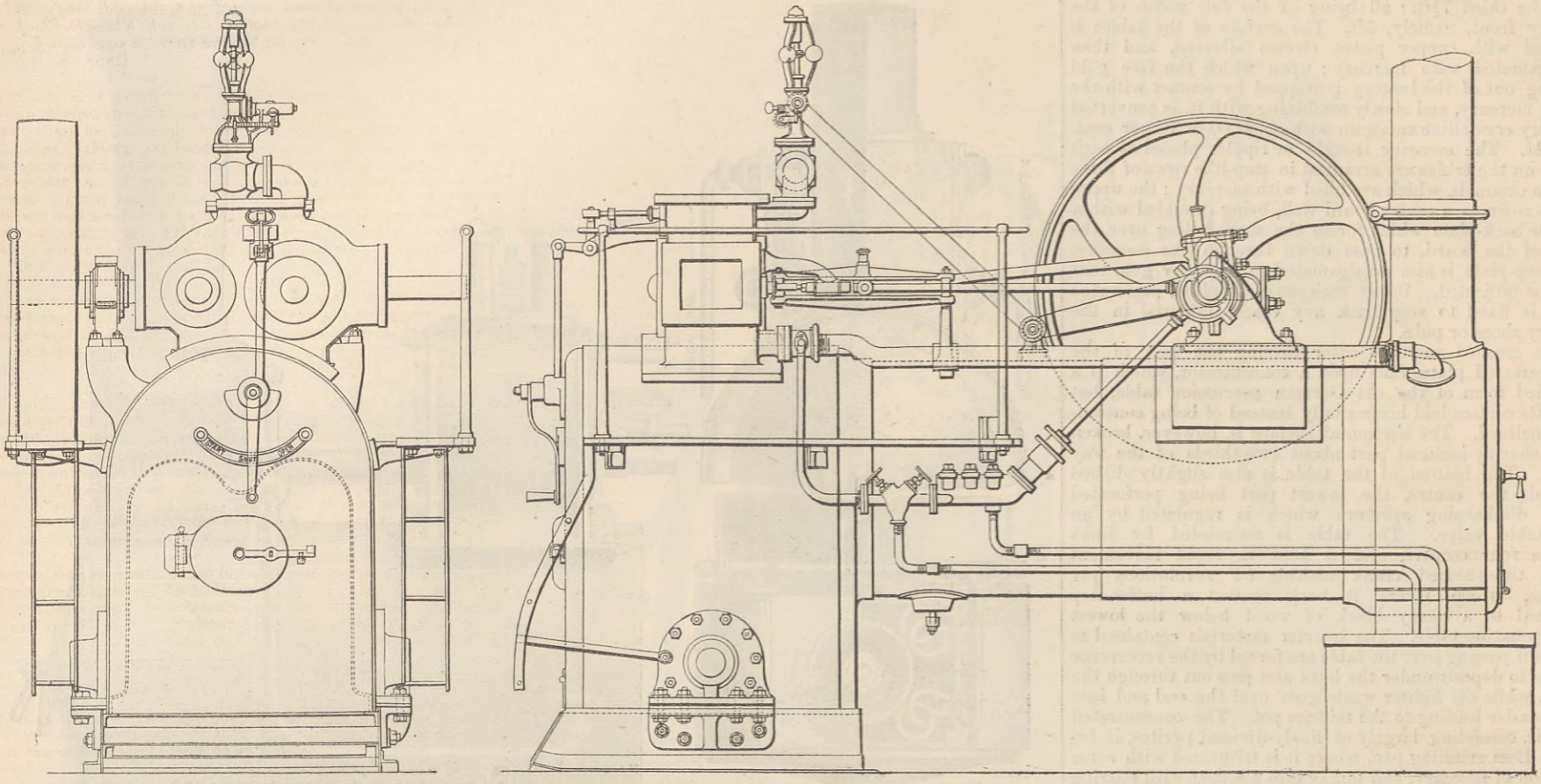
RICHMOND AND CHANDLER'S CORN CRUSHER.

To speak of the absence of striking novelties at Norwich would be too much like a repetition of what has been truly said for several years of Royal Agricultural Society's shows. Novelties are not necessarily permanent improvements; but, on the whole, they represent progress, and for this reason they are generally received with a good deal of favour. Many of the novelties brought out at the meetings of from ten to twenty years ago are not much in use now, but they led to those that are in use, and, what is more, they created the demand which gave to those who made them the prosperity and popularity upon which they are trading even yet. There is a tendency with some of the established manufacturers to look upon novelty as the ladder which has done all that was required of it, and may now be kicked down. The same firms, however, show no tendency to forgetfulness when they do bring out a new thing, however small, neither do they forget to follow the lead in a new direction set up by another firm; but they do not originate as they used to do, and they seem to be oblivious of the decay of firms that have or did cease to attract with the results of energetic pushing forward for a better thing, instead of simply pushing for wider markets for the same thing.

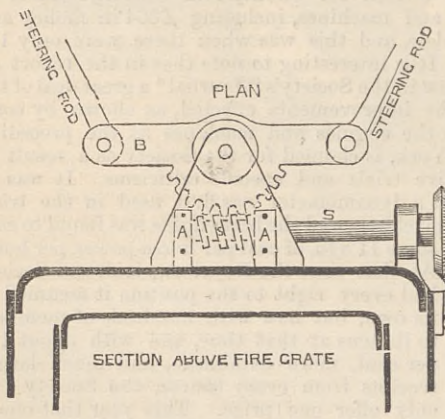
On Stand No. 1, that of Messrs. Aveling and Porter, is a locomotive with a new form of steering gear. It is shown in plan by the accompanying sketch, from which it will be seen that triangular-shaped steel plate brackets, fixed to the front of the outer fire-box, carry two bearings

ROYAL AGRICULTURAL SHOW, NORWICH—GARRETT'S COMPOUND ENGINE.

(*For description see page 45.*)



A, seen in the dotted lines, and between them a worm S^1 on the spindle S^1, worked by the bevel pinion and wheel D from the steering wheel spindle C. The worm S^1 gears into a quadrant B, carrying two arms, which are



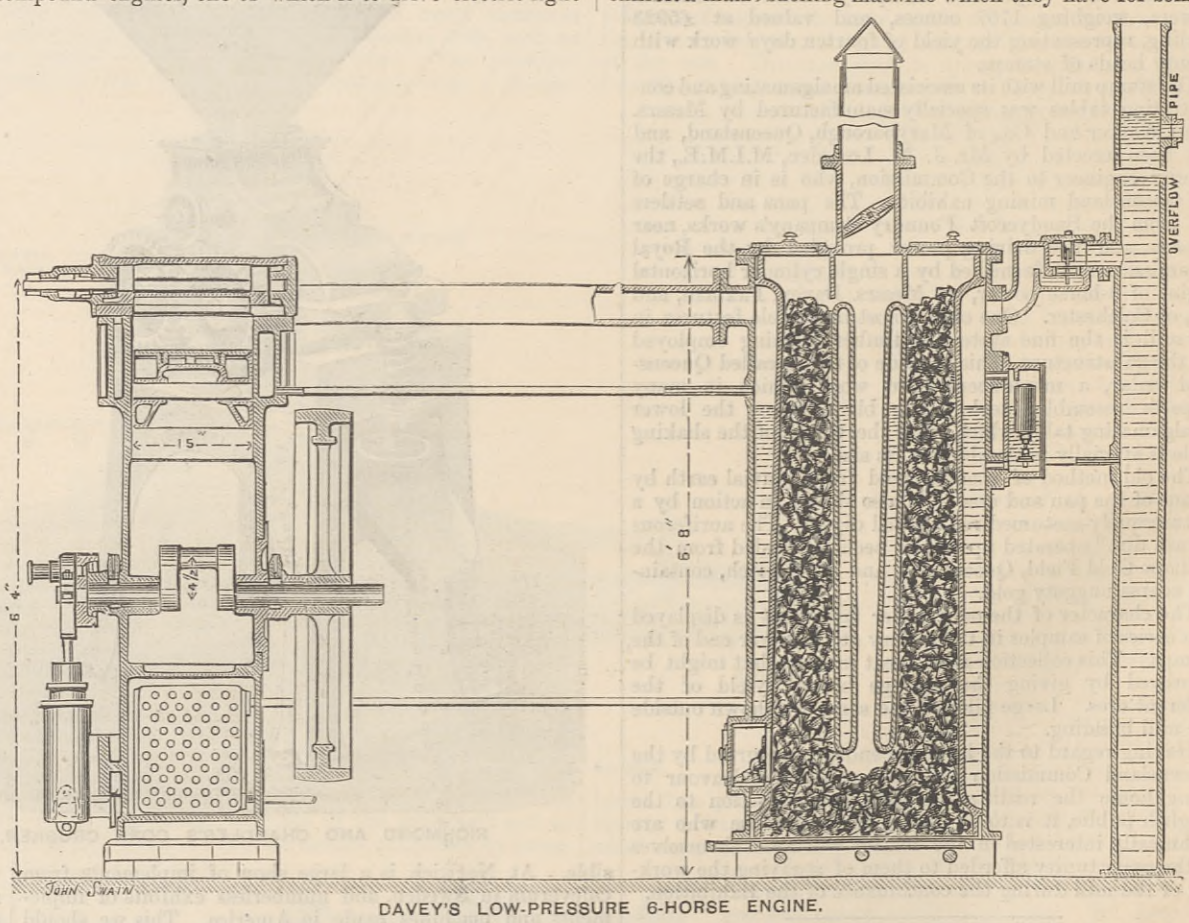
coupled to the fore carriage. Messrs. Aveling and Porter make a very fine show of their road locomotives and locomotive cranes.

Messrs. Hathorn, Davey, and Co., of Leeds, show a new motor of 6-brake horse-power. It possesses several novelties. The engine is made single-acting so as to run at a moderately high speed—200 revolutions per minute—without knock on slack bearings. The crank shaft runs in stuffing-boxes, the space under the piston being connected with the condenser. The bottom of the crank space holds water to a certain height, on the top of which floats oil for the automatic lubrication of the bearings. The water which accumulates in the crank space flows off into the condenser without taking the oil with it. The connecting rod is of wrought iron tube, and the bottom brass of the rod is made with a scoop to lift the oil which passes up through the connecting-rod to lubricate the top pin. A small ball valve in the connecting-rod prevents the return of the oil. In this way the whole of the bearings are automatically lubricated. The valve is an ordinary slide valve on a circular face. The cylinder is steam-jacketted and clothed with silicate cotton.

The boiler also possesses novelties. It is of the hopper type, and is made to work under a positive pressure of $1\frac{1}{2}$ lb. to the square inch. This is effected without interfering in any way with the feed arrangements, by loading the safety valve with a column of water forming the discharge from the condenser. The engraving is sufficiently clear on these and the other points referred to. Messrs. Hathorn, Davey, and Co., also show a self-contained motor, made to work under a slight pressure for the purpose of steaming cattle food, &c., and some of Davey's simple well pumps to which we have previously referred.

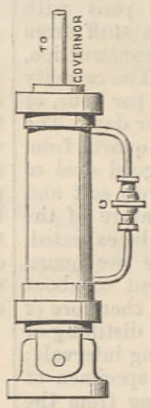
Messrs. E. R. and F. Turner, who exhibit a large collection of engines, all fitted with their automatic expansion gear, exhibit also a drawing of the engine which their firm exhibited at Norwich in 1849. This engine, we are told, was working until quite recently in Ipswich. Messrs. Turner's engine of to-day is a very different thing, but the fact that the old one worked for about thirty-six years has not induced them to return to its design, though the arguments of some of those who are opposed to competitive trials would encourage them to do so.

Messrs. Charles Burrell and Sons, of Thetford, exhibit a new feed-water heater applied to the purposes of a traction crane engine. The heater is an application by Messrs. Burrell and Kirkaldy of that known as Kirkaldy's "Compactum" feed heater to the chimney base of traction, portable, and fixed engines, and in such a manner as to utilise a portion of the heat from the smoke-box. The engraving shows it applied to Messrs. Burrell's 6-horse power crane engine working on the Show ground at Norwich. The cold water from the pump enters the coils on both sides at the top, and passes out at the bottom to the clack-box at considerably above the boiling temperature. When the engine is running empty the temperature stands at 200, and with the work full on it rises to 250 deg. The economy in fuel is obvious, but the saving in wear and tear of the boiler is perhaps a greater consideration. The exhaust steam enters the box at the bottom as shown, and passes round the coils containing the feed-water, then goes into the funnel in the front higher up. A small pipe leading from the box, drains all condensed water back into the tank under the foot-plate. The coils are of the corrugated section, as used in all the other "Compactum" heaters and condensers made by Mr. Kirkaldy, the reputation of which has been now fully established and recognised. This heater possesses many advantages and is expected to prove the most efficient yet produced for agricultural engines; being outside the smoke-box, all joints are most accessible. These heaters have been fitted to two 20-horse power undertype compound engines, one of which is to drive electric lighting machinery, and the other to drive a sawmill. It will be seen that the heater can be applied to any locomotive boiler in connection with the exhaust steam, and it may be mentioned that Mr. Kirkaldy has it in one of its forms already working on one railway.

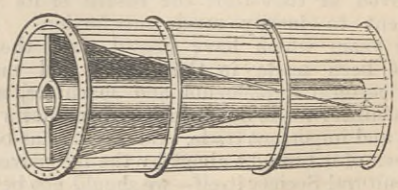


DAVEY'S LOW-PRESSURE 6-HORSE ENGINE.

Messrs. Robey and Co. exhibit an engine fitted with link motion, cut-off gear, and a double action dashpot, as shown in the above illustration. To the top and bottom of the dashpot cylinder are fixed the two ends of a pipe fitted with a cock C. By means of this cock the flow of the oil in the cylinder backwards and forwards is regulated to anything, and by this means the pump and fall of the link is stopped. Whether dashpots for stopping movements of the kind should be used, or whether the tendency to such movements should be stopped instead, is perhaps a matter open to question. In their thrashing machine, Messrs. Robey and Co. exhibit an application of exhaust for the second dressing only. The exhaust fan is placed on the upper part of the side of the machine, where its small size renders it unobtrusive, and where it can easily be made to send the light products of the second dressing either into the air or back to the first dressing shoe for re-treatment. There is no doubt that exhaust action is preferable to pressure blast, and whether adopted for this reason, or for considerations of expediency, it does secure some advantages, such as more uniform separative action, indraught at the sacking spouts, and less dispersion of dust.



Messrs. Clayton, Shuttleworth and Co. exhibit a maize shelling machine which they have for some time manufactured, but with some recently introduced improvements. The chief part of the machine consists of a beater of the section here shown revolving within a cylindrical cage made of round rods rivetted into rings. The dressing is



very simple as the grain itself is easily separated from the shell, which is almost wholly composed of large pieces.

These machines are not, it need hardly be said, of any use in this country, but as there are many colonists in this country this year the machine will interest some visitors. Messrs. Clayton and Shuttleworth also show a very finely finished horizontal engine of about 4-horse power, and fitted with a new cut-off directly acted upon by the governor, and consisting apparently of a slide valve with circular face, or face forming part of a cylinder, as in a Corliss valve, to which motion is given by the governor.

Messrs. E. Page and Co. exhibit, amongst other brick machinery, a potters' wheel, to be worked by hand, but of simple and good construction. A potters' wheel somewhat smaller would make a very instructive plaything for boys.

A mower and reaper knife and finger sharpener of quite new design is exhibited by Messrs. Harrison, McGregor, and Co., of Leigh. Without a drawing, which we do not possess, we could not properly describe it any further than by saying that a swivelling and adjustable arm, carrying a light spindle and small emery wheel, is pivotted upon a stand, and most effectually and with great facility performs its work of sharpening either knives or finger edges, the knife or finger bar being fixed to the stand.

A new corn crusher is shown by Messrs. Richmond and Chandler, the leading feature in which is the mounting of the adjustable roll in a pivotted bridle supported and adjusted by one spring, after the manner of some of the roller mills made for flour mills on the roller mill system. It is a simple, strong, and well-designed mill.

Messrs. John Crowley and Co. exhibit one of Weston's roller bearings for shafting, the rollers in which are of cast iron in short lengths, and threaded on wires of semicircular cages, which form a roller ring, and revolve with but at a slower speed than the shaft. These bearings cost little more than ordinary brass bearings, and without doubt will save a large percentage of the power used in driving line shafts and other revolving parts. Roller bearings are now coming very much to the front, chiefly as a result of their large use in tricycles and bicyles.

The Chadburn and Coldwell Manufacturing Company exhibits for the first time at this show the combined seed and manure drill, which we fully illustrated a short time ago; and Messrs. L. R. Knapp and Co., Faringdon, exhibit the Anglo-American or Canadian seed drill, which to some extent is made on the same lines but before it. Revolving wheel seed distributors are employed, each wheel being capable of drilling at one setting three different quantities, and Messrs. Knapp and Co. have made an improvement by which any of the seed wheels or runs may be thrown separately out of gear, so that headland and corner work may be properly done. Messrs. Hornsby and Sons exhibit a new corn screen in which the lower head of the screen cylinder is mounted with a universal joint on the shaft and is pressed outwards at the top by a guide roller, so that the wires are kept more open at the top than at the bottom, to permit the grains which get carried upward to fall from between the wires back into the screen.

Messrs. Holmes and Sons, of Norwich, show an engine fitted with Starkey's automatic cut-off gear, and a governor with a head spring and cap, graduated so that the governor may be set to control the engine at different speeds, and to cut off at different points for the same speeds.

Messrs. Ransome, Sims, and Jeffries exhibit for the first time a 12-horse compound portable engine. With the exception, however, of its having the two cylinders arranged for compound action, the engine is of the firm's well-known design. They also show a thrashing machine with Holben's self-acting feeder, which consists simply of a revolving cylinder with two beaters above, which reciprocate a number of beater arms having angular motion. These regulate the feeding so that the feeder cylinder may not throw the stuff in in lumps, and does its work, we are informed, with great regularity. The simplicity of the feeder recommends it. It is about a hundred years since the founders of the great Ipswich firm commenced making agricultural implements at Norwich, Robert Ransome having there commenced making cast-iron shares, tempered or chilled, by dipping them in salt water. In 1803 he invented and patented the process of casting shares on chills, and by this invention laid the foundation of his great subsequent success, and of an industry which has been carried on all over the world, and has had more effect on land tillage than any other single invention.

Messrs. Marshall, Sons, and Co. exhibit an 8-horse traction engine mounted on the spring wheels illustrated by the accompanying engraving. In this S S S are the C springs by which the load is carried, the springs being threaded on strong pins, P P, and transmitting none of the tractive effort, this being done by the arms O O, cast into the boss and connected to the wheel rim by the links O O. We are informed that an engine employed in the makers' works constantly hauling and shifting loads has been mounted on a pair of these wheels during the past nine months, and that the springs have proved thoroughly successful.

Messrs. John Fowler and Co. show a compound road locomotive mounted on four wheels of the same size, and all of which are drivers. The movement is communicated to the front wheels in the manner described in our report on the Preston Show, but except in the general principle so far involved, the engine now exhibited is a new arrangement. The whole of the working parts are carried within side frames, and the engine does not visit any working stresses on the boiler, but it is not less complex than that exhibited last year. The advantages for traction engine purposes of having four wheels driven would no doubt be great if they could be obtained by simple means. This can hardly be said to characterise the engine referred to. Several of the engines have now been at work some time, and the owners express themselves as pleased with their performance. A leading feature in their praise is, however, the compound system by which the noisy exhaust is avoided and economy secured.

The Butterley Iron Company for the first time appears as an exhibitor of high-class iron, and shows some fine specimens of flanged and pressed work done by various firms with the Butterley iron as used for boiler and various other work.

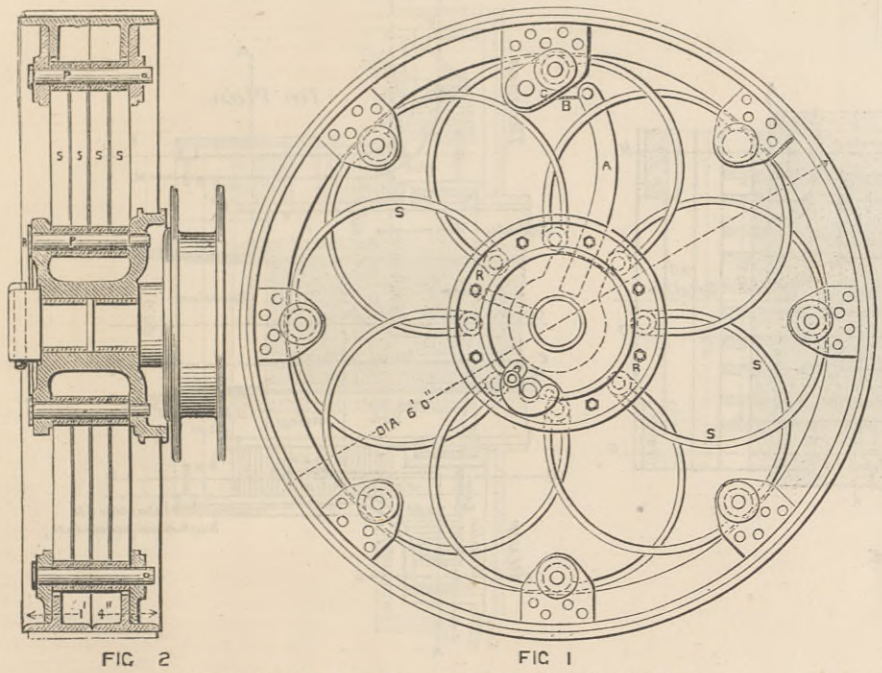


FIG 2 FIG 1

MARSHALL'S SPRING TRACTION ENGINE WHEEL.

On page 44 will be found exterior views of a large compound semi-fixed engine exhibited by Messrs. Garrett and Sons, of Leiston. The engine is intended to indicate 50-horse power, and to perform heavy and continuous work. Though provided with the means of removal from place to place, the engine is chiefly intended as a fixed engine for electric lighting and similar work. It is provided with a governor of the type to which we have previously referred, and with a platform, by which the attendant can reach any part of the engine for oiling without any danger when it is running. The casting which provides an axle socket at the fire-box end, for removal, also forms the means of bolting to an ashpan or base.

Considerable interest has been shown by the exhibitors in the working dairy, but the attendance at the show has been very small.

LETTERS TO THE EDITOR.

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

AMERICAN BRIDGE DESIGN.

SIR,—Having read your review of my "Principles of Economy in the Design of Metallic Bridges," I venture to submit a few explanations. I only object to the abuse of high analysis as applied to problems which are in want of a sufficiently sound basis of suppositions. Even in case of the seemingly simple problem of the theoretically best form of rails, it will be well to remember that every tie at the approach of the driving-wheels sinks into the ballast to an appreciable and variable depth; that the life-time of a rail is limited in the first line by the destruction of its top under the driving-wheels, as the result of strains which are entirely unknown; also that each element of a rail already, before the wheel pressure arrives, is in a state of undulation, of which the amplitudes, and hence the strains, are variable and unknown. All these strains combine with those which alone are admissible to analysis.

Wherever a sound basis of suppositions for analytical treatment can be laid down, I do not at all object to even the highest analysis, provided that the final result leads to a practical improvement. For instance: The more accurate treatment of the conditions of equilibrium of the beam suspended from a catenary leads to savings in the stiffening girders of great railway suspension bridges of somewhat like 20 per cent.; and this was the reason why, in the opusculum, the entry into an admittedly high analysis was ventured.

In the book, the formulæ only for a Bollman truss with an infinite number of panels were given, because this truss consisting of independent systems, the error committed is small. The coefficient of strain length of a Bollman truss of fourteen panels, depth one-eighth of the span, is 11,54, and if an infinite number of panels were supposed, only a little more—namely, 11,66—would be found.

As regards continuous girders, I am quite open to conviction, and I should be much pleased if the necessary data were furnished of an existing continuous girder bridge believed to be most economically designed. With pleasure should I enter into the particular case, and am sanguine to be able to furnish design and estimate of a similar bridge, with independent spans, at least equally economical. In a paper written ten years ago for the American Society of Civil Engineers, and reprinted by Van Nostrand, of New York, I believe I have furnished proofs of this my view, as well as a collection of moduli of elasticity of finished bridge members, compressive as well as tensional, and of usual test specimens, such as found by numerous experimenters and authorities.

The misprint—for it is only a printer's mistake—of the formula alluded to in your review was noticed too late to be corrected, the distance between publisher and author being so great. However, only four lines below the wrong formula—on page 43 of the book—there is again the correct formula—

$$C \cdot h_1 = c \cdot \frac{d^2}{h_1}.$$

Finally, I have to make a correction. The Jirardot bridge, span 328ft. centre to centre, of which the work was done at the late Crumlin works, in the year 1880, is not the first cantilever bridge with independent middle span. The first bridge of this kind, built of wood and iron, was designed on the plan of the Frenchman, Payet, which is analyzed in the "Principles of Economy." It was then called a suspension bridge; it had a span of 240ft., was 23½ft. wide, and in the centre had an independent span which admitted of being opened like the drawbridge of a fortress. The wooden towers were 40ft. high, and the inclined suspension links were prevented from sagging in the same manner as proposed by Messrs. Flad and Pfeifer, of St. Louis, ten years ago. This bridge was made much too light; it only cost £1200 sterling; and though it stood the prescribed tests, it tumbled in the same year, 1825, when it was erected over the Saale River, near Munchen-Nleuburg, in Germany. I thank you for the fair spirit of your review.

Anerley, July 8th. CHAS. B. BENDER.

A NEW TYPE OF DYNAMO.

SIR,—In your issue of the 2nd July, when describing and illustrating the new Goolden and Trotter dynamo, you say: "A very similar pattern has recently been produced by Mr. Kapp." Your expression "recently" is, however, somewhat misleading, because with the rapid progress going on all around us, one is hardly justified in describing a thing as recent which is more than a few weeks old. Now by referring to my books I find that the date of design and working drawings for the first single horseshoe machine falls into the period from July 24th to July 27th of last year, and that this machine was finished and tested on August 28th of last year.

Moreover, the type of field which you call a recent production was described and illustrated last November in a paper I read at the Institution of Civil Engineers, and at that time several large dynamos of this pattern had already been made by Messrs. W. H. Allen and Co. to the order of the Admiralty. GISBERT KAPP.

Wimbledon, July 12th.

GERMAN COMPETITION WITH ENGLISH ENGINEERING.

SIR,—That the Germans have carried off from us 1500 tons of rails for China, at a reduction of 25s. per ton, should be a warning to all our industrial interests. One part of the reduction has probably been in the freight, as the German Government could arrange with the new German steam line to the East for reduced rates. So far as the Germans are concerned, we have to compete with Government railways and now with Government steamships. This is exclusive of bounties.

Nothing but organisation and combination on the part of our people can meet those on the other side. There should be here a National Association for the Promotion of Trade and Industry, of which all interested should be members. HYDE CLARKE.

St. George's-square, S.W., July 12th.

SEWAGE SLUDGE STEAMERS.

THE Barrow Shipbuilding Company, Barrow-in-Furness, has just received an order from the Metropolitan Board of Works for the building of the first of a series of steel twin-screw steamers, to be capable of conveying from the sewage outfalls in the Thames out to sea, 1000 tons of sewage sludge. Competitive designs and tenders were advertised for by the Board in December last, with the condition that "in the event of the Board not accepting any of the tenders, a premium of £500 would be given for the design which may be selected as thoroughly suitable and the best by the President of the Institution of Civil Engineers and the engineer of the Board." Several designs were submitted to the Board by various shipbuilders, and the one selected has been that of the Barrow Shipbuilding Company. The vessel is 230ft. in length by 38ft. beam by 13ft. 10in. depth of hold, built of Siemens-Martin steel, and to class 100A at Lloyd's. She will be propelled by twin-screw triple expansion engines, having cylinders 15in., 22in., and 33in. diameter and 24in. stroke, with a working pressure of 150 lb. per square inch, capable of steaming 10 knots an hour. The arrangements for depositing the sewage sludge are entirely novel and almost automatic. The vessel is divided into compartments, and the cellular double bottom is of such a depth as to allow the sewage to pass out freely, without any pumping, through suitable valves, and to give the vessel proper ballast for the return journey. Arrangements are also made for the proper washing out of each hold. This is the beginning of a movement for improving the sanitary condition of the Thames, and it will no doubt be watched by engineers with much interest.

THE MANCHESTER SHIP CANAL.—The first step towards the actual commencement of this undertaking, the contract for the construction of the canal, and the whole of the works connected with it, has been let to Messrs. Lucas and Aird, for the round sum of five and three-quarter millions, which is £560,000 less than the parliamentary estimates. These works include the cutting of the canal from Manchester to the outlet at Eastham, the building of docks at Manchester and Warrington, the construction of the necessary locks and the swing aqueduct at Barton, and the whole of the railway deviations. It is expected that in the working plant for carrying out this undertaking upwards of 6000 railway wagons and about 300 locomotives will be required, and that employment will be given to about 20,000 workmen. The contractors will start by laying down two lines of railway along each side of the route, and the cutting of the canal will be divided into sections, the work proceeding simultaneously in each section. The contractors undertake to complete the whole of the work within four years after the actual commencement of operations; and if from any unforeseen circumstances the work is not completed in the stipulated time, the contractors subject themselves to a heavy penalty in the shape of the payment of interest at the rate of 4 per cent. per annum on the whole amount of the capital then called up. If, on the other hand, the contractors complete the work before the expiration of the four years, they are to be allowed a bonus on their contract equal in amount to what the company would have paid in interest on the called-up capital during such period as the work may have been completed within the stipulated four years. The raising of the capital will now be proceeded with at once, in the course of a few days Messrs. Rothschild, in whose hands the financial portion of the scheme has been placed, will issue the prospectus of the company to the public.

A NEW METHOD OF ROLLING GLASS.—Hitherto rolled glass has been made by means of an iron roller and table, the roller being made to rotate and at the same time to travel along the surface of the table, so as to press out the molten glass into a uniform sheet. Among the disadvantages of this method are the dulness of that surface of the glass which is in contact with the table, the great waste of material, and the high cost of manipulation. A new method of manufacture, by which the disadvantages referred to are lessened, has been made the subject of a patent obtained by Messrs. Mason and Conqueror. This method of manufacture, as improved by the proprietors of the patent, is conducted in the following manner:—The molten glass is poured on an inclined iron plate, and passes thence between two iron rolls, which revolve uniformly in opposite directions. The sheet of glass thus formed passes down a second inclined plate, and is then transferred to the kiln and piled in the usual way. Or the sheet may be transferred to the annealing kiln by means of a travelling carriage or table, which consists of an iron frame laid with stones, or other non-conducting material, so as to present an even upper surface. The size of this table is regulated by the width and length of the sheets of glass which it is desired to make. The table travels on wheels or rollers under the lower roll of the rolling machine, and by means of suitable gearing is carried forward by the motion of the machine at the same pace as, or slightly faster than, the sheet of glass passing down the second inclined plate. The sheet of glass is thus received upon the travelling table as it leaves the second inclined plate of the machine, without being drawn out of shape or losing its uniformity of thickness, and may either be run with the table direct into the kiln, or by means of a turntable on to which the carriage runs, may be pushed off into the kiln much in the usual way. The advantages of using a turntable are that existing kilns may be utilised without alteration, and that two or more machines may be worked in connection with one kiln. The glass may be rubbed down upon the travelling table, and the ends may be cut off in the usual way.

THE NEW BATTERSEA BRIDGE.—DETAILS.

SIR JOSEPH BAZALGETTE, M.I.C.E., ENGINEER.

(*For description see page 57.*)

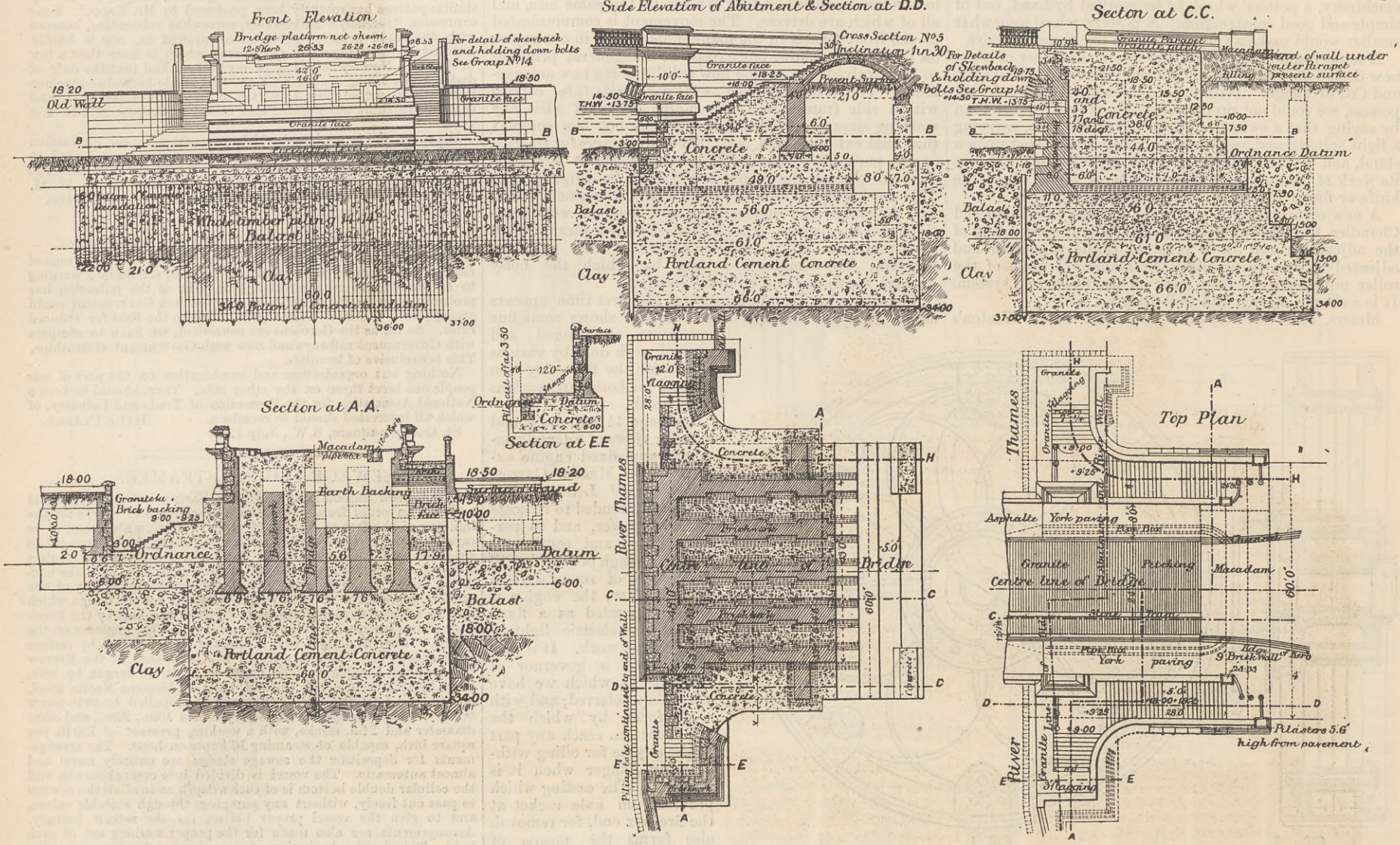
GROUP No 6.

Surrey Abutment

Front Elevation

Side Elevation of Abutment & Section at D.D.

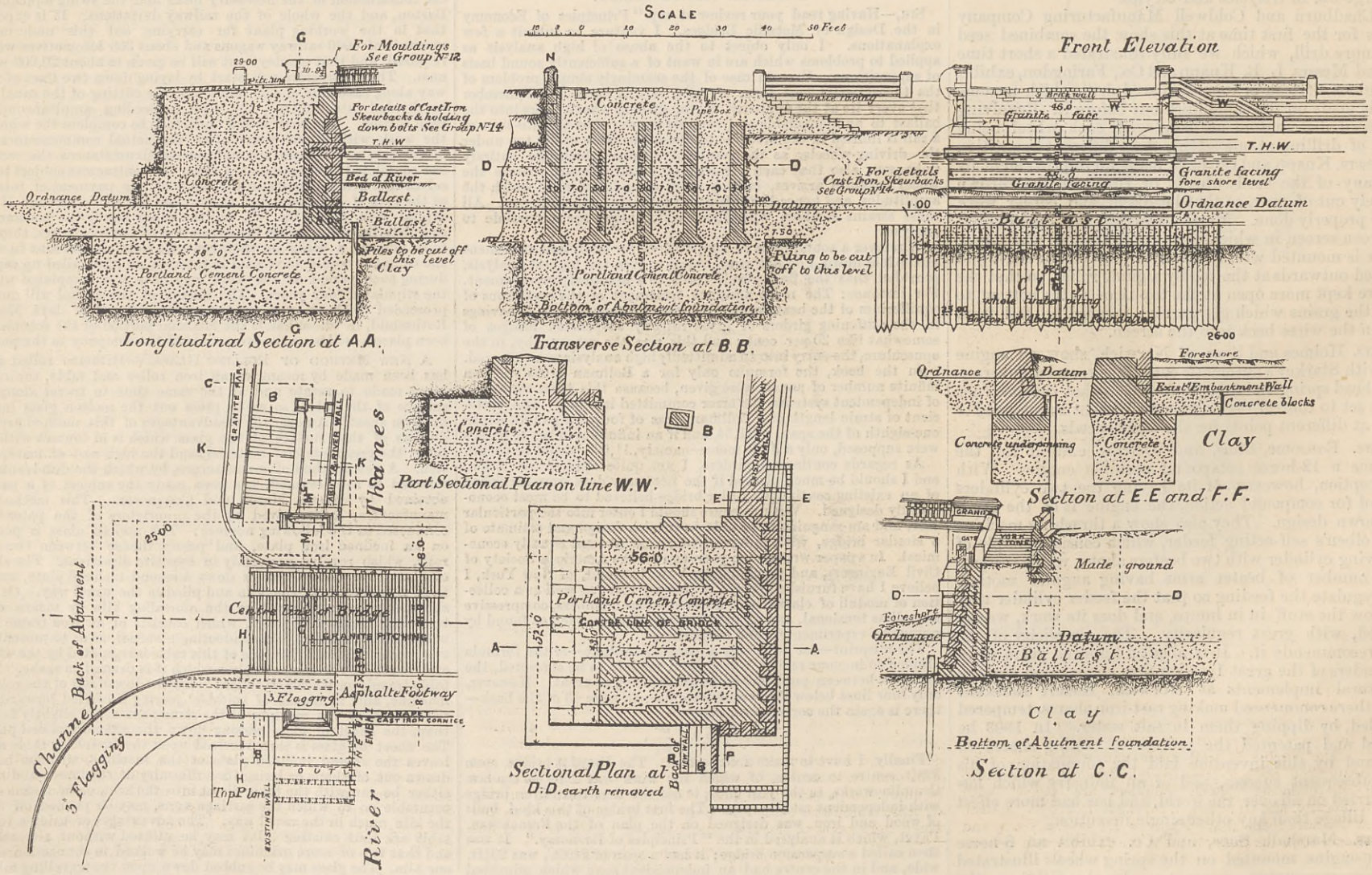
Section at C.C.



GROUP No 8

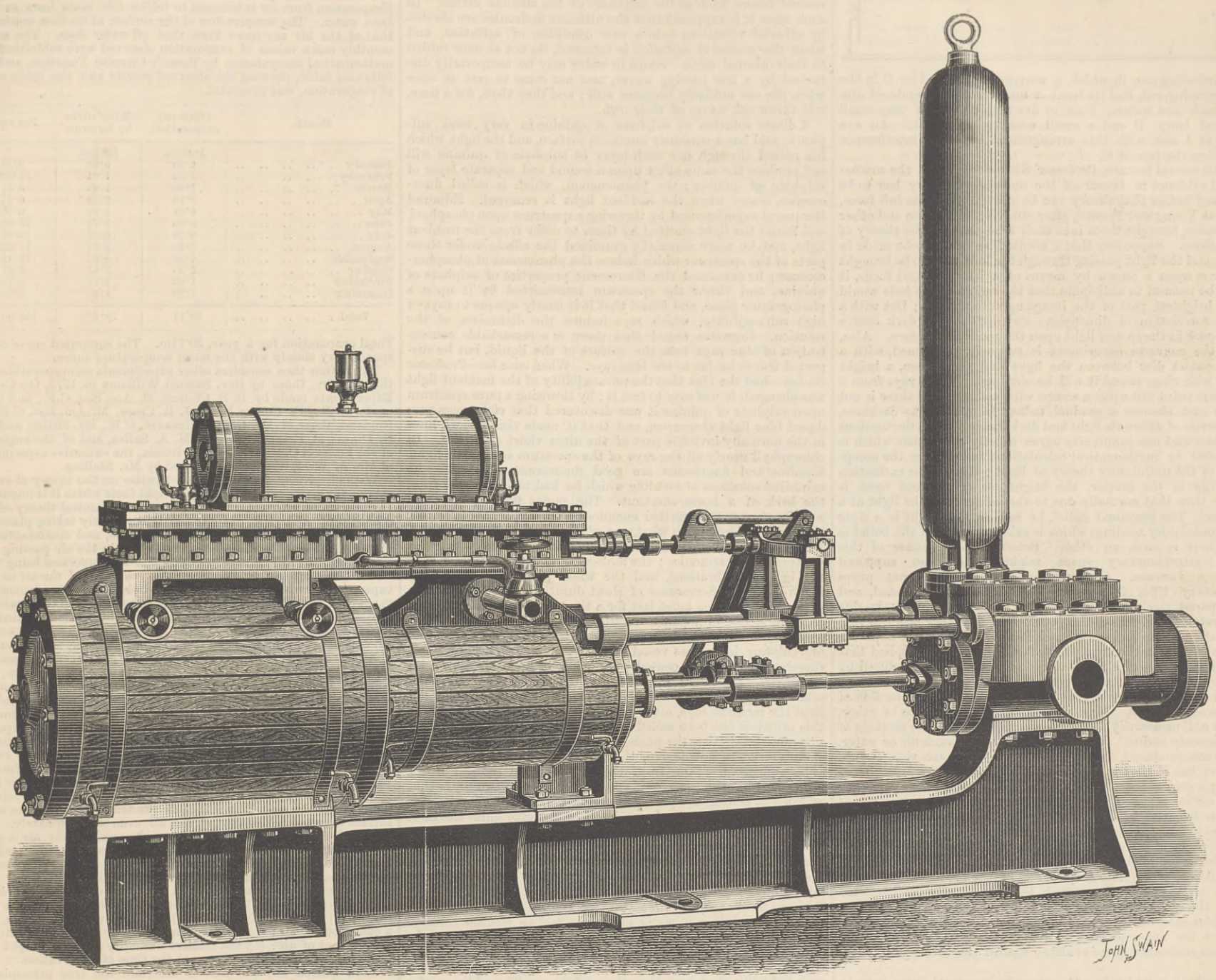
Middlesex Abutment.

SCALE



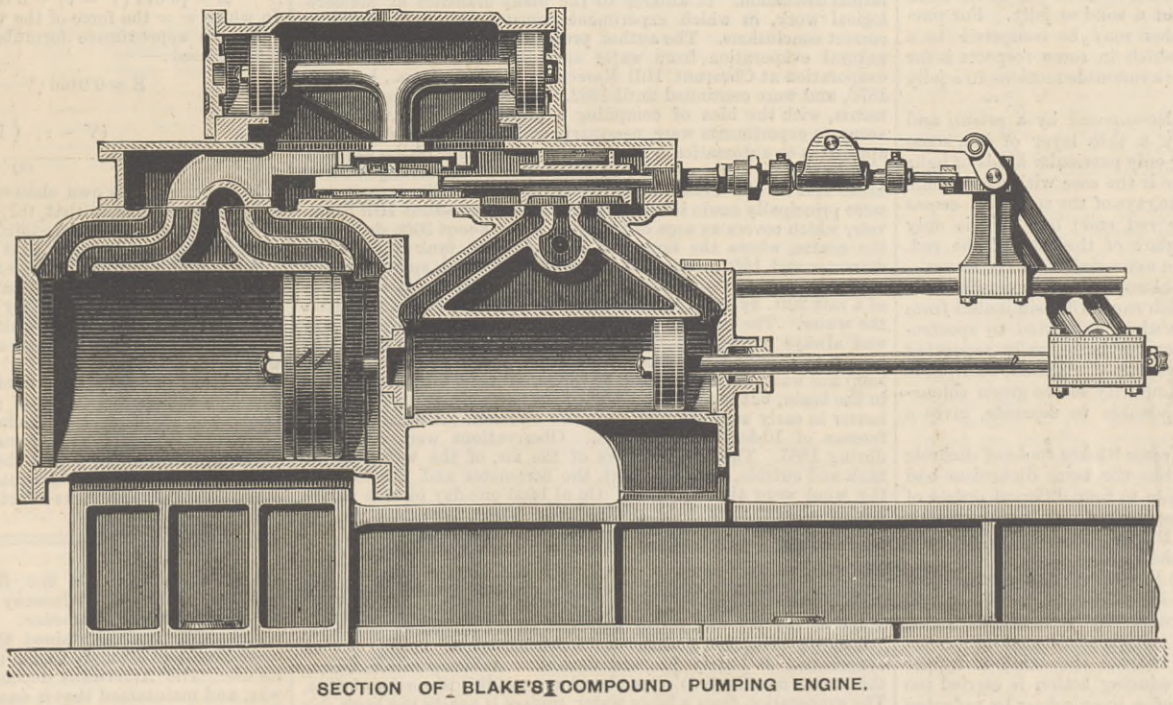
BLAKE'S COMPOUND PUMPING ENGINE.

MESSRS. S. OWENS AND CO., LONDON, ENGINEERS.



BLAKE'S COMPOUND PUMPING ENGINE.

THE pumping engine illustrated by the above engravings has been made by Messrs. S. Owens and Co., of London, under Blake's patent, for a small waterworks abroad, where it will pump about 5000 gallons per hour to a height of 500ft. The high and low-pressure cylinders are 8in. and 16in. diameter respectively. The pump is double-acting, 5½in. diameter. The cylinders and pump have, of course, the same stroke, viz., 24in. The pump valves, eight in number, are of gun-metal, leather-faced, guided in separate gun-metal caps screwed into the pump body, rendering the valves easily accessible. We give a sectional view of the steam cylinder and chest, from which the action of the valve gear will be readily understood. It will be noticed that the engine has three piston rods, the centre one for the high-pressure cylinder and the two outer ones for the low-pressure, connected to a crosshead common to all three; the low-pressure cylinder piston rods passing outside the high-pressure cylinder in pockets, cast on for the purpose. The valve gear is so arranged as to allow the pistons to pause slightly at each end of the stroke, enabling the valves in pump to seat quietly. It will be seen that the slide valve has its motion controlled by a rocking lever moved by the crosshead, this lever giving motion to the small valve, by which steam is admitted to the one or the other of the steam valve pistons by which the main valve is worked. The pump is very simple and strong in design, and the valves are of the simple flat-seated safety valve form, made of great strength and easily accessible from the screw cap holes shown on the top of the pump. The pressure due to the head of 500ft., about 215 lb. per square inch, made it necessary to pay particular attention to these details, and still make them of the simplest kind. The point of cut-off in the high-pressure cylinder is adjustable by means of the stop collars on the positive action slide rod. The engine is well made and works well. The exhaust steam from the low-pressure cylinder may be taken into any type of condenser. Both cylinders are lagged with polished mahogany, and all principal parts got up bright. Messrs. Owens and Co. have made Blake's pumps for several years, and their experience confirms their choice of the direct-acting system.



SECTION OF BLAKE'S COMPOUND PUMPING ENGINE.

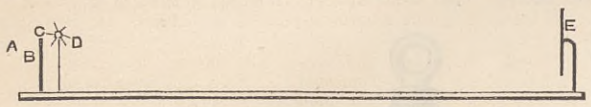
LIGHT.*

PROFESSOR G. G. STOKES, President of the Royal Society, delivered three lectures on "Light," towards the close of the recent Royal Institution session, and he began by saying that the sources of light ordinarily obtainable by us are usually at a high temperature, but in some cases cold bodies are sources of luminosity. During a thunderstorm at night, objects are seen apparently at the same time as each flash of lightning, yet the light from the flash travels straight to the eye, whilst that which first travels to the object, and next travels from the object to the eye, has a path describing two sides of a triangle; hence the motion of light is intensely rapid. In interplanetary space it has longer distances to travel; and Römer, a Danish astronomer, in 1675 first accounted for the variations from the calculated periods of the eclipses of Jupiter's moons by taking into consideration the velocity of light. When the earth is at the part of its orbit farthest from Jupiter, the eclipses seem to take place 16 min. 36 secs. later than when the earth is nearest to Jupiter, all other conditions being the same; so the time stated is that which light takes to traverse the diameter of the orbit of the earth. The velocity in miles, however, was not by this method so accurately ascertained as at present, the diameter of the earth's orbit in Römer's days being considered to be greater than it now is known to be. In 1849 Fizeau made the velocity of light a matter of experimental inquiry; and almost at the same time Foucault also took up the problem experimentally. In more recent times others have improved upon their methods, until at present the velocity of light is estimated at 300,000 kilomètres per second. He gave the velocity in French terms because the figures were so easy to remember. Those figures are so near the truth, he said, that nobody up to the present time has been able to prove whether the estimate is too high or too low.

In the travelling of light through space there must be either a substance starting forth from the source of light or a change of state propagated through an intervening medium. The travelling of a cannon-ball illustrates the former method, and the travelling of the waves of the sea illustrates the latter. In the last case nothing material traverses the surface of the sea to the shore, but a certain "state of things" travels to the sea beach. Another illustration of this is available in the travelling of waves of sound, the phenomena presented by which have been exceedingly useful in helping to elucidate those of light. There is one notable difference, however, between them, because when light passes through a hole in a screen into a room, it does not spread out all over the room in the same manner as sound, and this made Newton reject the wave theory of light. Huyghens, the contemporary of Newton, was the promulgator of the undulatory theory, and that of Newton is now considered to be unsatisfactory. At the beginning of this century it was seen that the undulatory theory of light demanded that light should travel slower in glass than in vacuo, and, according to the emission theory, light travels faster in glass than in vacuo. Foucault by experiment settled this question in favour of the undulatory theory. A whole host of phenomena, said the speaker, have been explained by the undulatory theory, which phenomena have not been touched by the emission theory; those of interference may be selected as special examples. A complete wave of light contains one-half of an opposite nature to the other half, just as, in measuring a wave of the sea, the

* Abstracts of Royal Institution Lectures.

measurement is taken from the top of a ridge to the bottom of the next depression or trough of the sea. The speaker then exhibited by experiment several of the phenomena of interfer-



ence, including one in which a mirror, represented by E in the accompanying cut, had its front or unsilvered face rendered dim with milk and water. Four or five feet off was a very small electrical lamp D and a small concave mirror B. An eye placed at A sees with this arrangement beautiful interference colours on the face of E.

In his second lecture, Professor Stokes said that the mathematical evidence in favour of the undulatory theory has to be examined before that theory can be recognised in its full force, and that Young and Fresnel, after studying diffraction and other phenomena, brought them into their true place by the theory of undulations. Supposing that a needle-hole were to be made in a card, and the light passing through the hole were to be brought to a focus upon a screen by means of a lens of short focus, it would be natural to anticipate that the centre of the hole would be the brightest part of the image upon the screen; but with a proper correlation of dimensions and distances, a dark centre will appear in the spot of light upon the receiving surface. Also, when the converse experiment is properly performed, with a small opaque disc between the light and the screen, a bright centre with rings round it will be obtained. When rays from a luminous point fall upon a screen with a sharp edge there is not in the cast shadow a gradual fading from light to darkness, but a series of alternate light and dark bands; these fluctuations of greater and less luminosity agree exactly with that which is demanded by mathematical calculations based upon the acceptation of the undulatory theory of light; there is no extinction of energy in the matter, the brightness of the first band is greater than that normally due to the influence of the light at a distance. The prevalent belief, he said, is that light is a state of an undulatory medium which is called ether, and the belief is that there is such an ether. Before the acceptance of this belief, interplanetary space might have been supposed to be a vacuum. Observations of Encke's comet prove that every time it returns its motion is accelerated, and that, paradoxical as it may sound, that acceleration is due to its retardation. Does the presence of the ether produce that retardation? He had questioned Professor Adams, perhaps the greatest living authority upon such a point, and he replied that the perturbations of Encke's comet may perhaps be produced by Mercury, or moving bodies near the sun; there is therefore no known absolute evidence that the ether retards the motion of the heavenly bodies. Besides, assuming the presence of ether, it does not necessarily follow that it must retard the motions of the heavenly bodies. When bodies move through air or water, eddies are produced, because air and water are viscous substances; but if they were more slippery bodies, the difficulty of getting a grip of them would increase. There is a kinetic energy in the eddies which is not annihilated. The very existence of ether is believed in only because it gives such a simple and satisfactory explanation of the phenomena of light. The belief in the existence of atoms and molecules of matter which vibrate in this ether is founded upon its agreement with the laws of chemical combination, of crystallography, and of the properties of gases. It may be that there is no such thing as a molecular constitution of the ether; he would express no opinion upon that point, the evidence is not greater in the one way than in the other. In short, the non-resistance of the heavenly bodies, if there be such non-resistance, is no evidence against the theory of undulations.

Ether has a great tendency to return to its normal state. In early days it was taken for granted that the expansion and contraction of the waves of ether were like those of air; and the phenomena of sound were useful aids in the experimental investigation of those of light. In time, however, it was discovered that the phenomena of the polarisation and double refraction of light have no counterpart in those of sound, but have relation to a motion in space transverse to the direction in which the waves are propagated. The vibrations are lateral, and not longitudinal. This leads up to ideas of the ether having a constitution altogether different to that of air, and that it includes a sliding motion, like that of two hands to and fro over each other. Such a gliding motion could take place in a solid or jelly. For purposes of illustration, then, the ether may be compared to a gigantic jelly—an idea, however, which in some respects is far from the truth, but its motions more resemble motions in a jelly than motions in air.

Light warms us, light may be decomposed by a prism, and light may be intercepted even by a thin layer of ink, some layers of coloured inks intercepting only particular kinds of light and transmitting others. The same is the case with glass; blue cobalt glass placed in the path of the rays of the spectrum seems to lengthen the spectrum at the red end; but this is only because it reduces the contrasting glare of the rest of the red. Chlorophyll—of which he had some extracted from ivy leaves—gives a remarkable spectrum, but chlorophyll really consists of a mixture of different substances, which can be discriminated from each other by the bands they give when subjected to spectroscopic examination. The substances can be actually separated by treating the chlorophyll with hydrate of alumina, bisulphide of carbon, and other agents. An impurity in the green colouring matter, which it is almost impossible to separate, gives a dark band in the red.

In his third and last lecture Professor Stokes spoke of dichroic phenomena, remarking that in optics the term dichroism had been greatly abused by its application to four different orders of phenomena, totally distinct from each other, and by the ideas it conveys being rather the reverse than otherwise of the true explanation of the facts to which the word is applied.

By the light of the electric lamp he showed that certain films of aniline dye, of gold leaf, and of oxide of copper have one colour by reflected and another colour by transmitted light. His specimen of glass coloured with copper was, he said, interesting; the heat of the glass furnace reduces the oxide of copper to suboxide, and sometimes the reducing action is carried too far. The specimen exhibited was of a liver colour by reflected light and of a blue colour by transmitted light, due to the production of a thin film of metallic copper. Crystals of permanganate of potash when taken out of their mother liquor have a bronzy or greenish look, and when this reflected light is examined in the spectroscope four particular bright bands appear; in fact permanganate of potash greedily absorbs some rays and rejects others.

Sir John Herschel pointed out that when a pure spectrum was thrown upon paper coated with tincture of turmeric, it emitted a remarkable yellowish light in the violet rays, and that it was a better reflector of that light than was white paper. Sir David Brewster, when experimenting with a green alcoholic solution of chlorophyll, was surprised to find the path of a pencil of rays of sunlight through it to be of a blood red colour by reflected light; he called the phenomenon "the internal dispersion of light." Other curious luminous phenomena are presented by phosphorescent bodies, such as the sulphides of the alkaline earths. In such cases it is supposed that the ultimate molecules are thrown by etherial vibrations into a new condition of agitation, and when the source of agitation is removed, do not at once return to their normal state. Ships in water may be temporarily disturbed by a few passing waves, and not come to rest at once when the sea suddenly becomes still; and they then, for a time, will throw out waves of their own.

A dilute solution of sulphate of quinine in very weak sulphuric acid has a curiously luminous surface, and the light which has passed through one such layer of sulphate of quinine will not produce the same effect upon a second and separate layer of sulphate of quinine; the phenomenon, which is called fluorescence, ceases when the incident light is removed. Edmund Becquerel experimented by throwing a spectrum upon phosphori, and found the light emitted by them to differ from the incident light, and he more especially examined the effects under those parts of the spectrum which induce the phenomena of phosphorescence; he examined the fluorescent properties of sulphate of quinine, and threw the spectrum transmitted by it upon a photographic plate, and found that it is nearly opaque to rays of high refrangibility, which rays induce the dichroism of the solution. Brewster found that there is a remarkable concentration of blue rays near the surface of the liquid, but he suspected this to be due to the blue rays. When once he—Professor Stokes—had the idea that the refrangibility of the incident light was changed, it was easy to test it; by throwing a pure spectrum upon sulphate of quinine it was discovered that violet rays produced blue light thereupon, and that it made visible dark lines in the normally invisible part of the ultra violet spectrum. In chlorophyll nearly all the rays of the spectrum set up red light. Esculine and fluorescine are good fluorescent substances; he exhibited solutions of esculine which he had made himself from the bark of a horse chestnut. The motes floating in these solutions are not altogether enemies to the experimentalist, for they let him know with what part of the spectrum he is working. In these fluorescent phenomena there is a marked absence of anything like harmonics; the molecules do not synchronise with the incident vibrations, and the whole phenomena look very much like phosphorescence of short duration; the agitation set up in the molecules must last for a time very large as compared with the period of a single vibration of light.

He exhibited a simple way of obtaining violet rays, by burning sulphur in a glass vessel filled with oxygen, a light being thereby given which caused a solution of esculine to appear luminous. The light emitted by the fluorescent substance acted upon is always, practically speaking, of lower refrangibility than the incident rays, although lately the rigorous accuracy of this principle has been called into question. Whenever a single substance exhibiting the phenomenon is used, and not a mixture of two or more substances, the colour of the emitted light is almost always the same from the beginning to the end of the active part of the spectrum. A means, to some extent, is thus afforded of testing the purity of the various bodies submitted to the experiment. Purified esculine does not give quite the same colour as a crude sample, which is a mixture of two fluorescent bodies; it emits a purer blue light. Professor Stokes demonstrated this by illuminating solutions of pure and impure esculine, by means of sparks from an induction coil. The latter sample gave a greener light than the former. The colours are liable to be changed by the nature of the solvent. In daylight an esculine solution in water looks blue, and an esculine solution in acidified water looks like pure water. By the light of the induction spark the acidified solution looked the bluest of the two, and the addition to it of a few drops of ammonia made it emit light like that from the other solution. The addition of a little ether to the water solvent will change the colour of the fluorescence sometimes. He finally passed the light of the electric lamp through violet manganese glass, and exhibited the beautiful fluorescence of uranium glass and certain other substances when placed in the beam of coloured light.

EVAPORATION.*

By Desmond Fitzgerald, M. Am. Soc. C.E.

The paper gives a description of practical results and a theoretical discussion. It alludes to the many branches of meteorological work, in which experiments must be made to arrive at correct conclusions. The author presents his conclusions as to the natural evaporation from water surfaces. His observations on evaporation at Chestnut Hill Reservoir, Boston, Mass., began in 1876, and were continued until 1882. On examining these experiments, with the idea of compiling a paper, he found that more accurate experiments were necessary, and in 1884 he devised an apparatus to automatically plot a continuous profile of the evaporation on a sheet of paper. A full description of the arrangement of tanks and of the measuring apparatus is given. The experiments were principally made in the Bradlee basin of Chestnut Hill Reservoir, which covers an area of 85 acres, and is about 20ft. deep near the centre, where the tank was located. The tank was 10ft. in diameter and 10ft. deep, made of staves of wood, spaced an inch apart, and with a thin copper lining inside. This was in the centre of a raft 20ft. by 40ft., the surface of which was about 10in. above the water. The raft was anchored in the basin, so as to float freely and always present its head, which was arranged to break the waves, to the wind. It was expected that this arrangement would keep the water inside the tank at the same temperature with that in the basin, but it sometimes varied considerably, being somewhat hotter in early summer and cooler in autumn. A maximum difference of 10 deg. was observed. Observations were continued during 1885. The temperatures of the air, of the water in the tank and outside, the dew point, the barometer and the force of the wind were also recorded. On at least one day in each month hourly observations were made. The three important factors in evaporation are: the temperature of the evaporating surface, the force of vapour in the air, and the velocity of the wind. The maximum evaporation occurs on a cool day, which has been preceded by warm weather; the maximum recorded by the author being 0·64in., recorded on June 23rd, 1885, when the mean temperature of the air was 10 deg. less than on the preceding day. On December 19th, 1885, with the thermometer at 12 deg. F., an evaporation of nearly ¼in. was noticed. As evaporation during the winter months is so often placed at zero, this is worthy of note. The evaporation from a large water surface is nearly the same day and night; it may be greater on some days from a considerable body of water than from a shallow pool. The author has observed temperatures of the water at the surface of 82·2 deg. and 86 deg. A shallow pool loses this heat much sooner than a large body, following the temperature of the air more closely.

During two months the Lawrence basin of the Chestnut Hill Reservoir was shut off from the city supply for the purpose of making direct measurements of the actual evaporation from a large surface. From September 1st to 22nd the evaporation from the reservoir was 3·83in., and from the tank in the Bradlee basin 3·87in. The evaporation from the tank was therefore taken as representing very closely that of the reservoir. In the winter of 1878-79 the author made experiments on winter evaporation, the general result being 0 02in. per day for the winter average. Many comparative experiments between snow and ice evaporation showed that ice will lose twice as much weight as snow in the same time. Evaporation from ice is believed to follow the same laws as that from water. The temperature of the surface of ice does not follow that of the air any more than that of water does. The actual monthly mean values of evaporation observed were submitted to a mathematical computation by Bessel's Circular Function, and the following table, showing the observed results and the mean curve of evaporation, was presented:—

Month.	Observed evaporation.	Mean curve by formula.	Per cent.
	Inches.	Inches.	
January	0·90	0·98	2·51
February	1·20	1·01	2·58
March	1·80	1·45	3·71
April	3·10	2·39	6·11
May	4·61	3·82	9·76
June	5·86	5·24	13·65
July	6·28	6·21	15·87
August	5·49	5·97	15·26
September	4·09	4·86	12·42
October	2·95	3·47	8·87
November	1·63	2·24	5·73
December	1·20	1·38	3·53
Total	39·11	39·12	100·00

Total evaporation for a year, 39·11in. The computed curve corresponds very closely with the mean temperature curve.

The author then considers other experiments on evaporation. In this country, those by Rev. Samuel Williams in 1772, the Croton Experiments made by B. S. Church, M. Am. Soc. C.E., and those made at Boyd's Corner by J. J. R. Croes, M. Am. Soc. C.E.; in England, those of Mr. Charles Greaves, C.E., Mr. Miller, and Mr. G. Dines; in France, those of M. A. Salles, and of the engineers of the Ponts et Chaussées; and in Russia, the extensive experiments of Mr. A. Wild, which are discussed by Mr. Stelling.

Without presenting an extended treatise on the theory of evaporation, the author describes the principal facts which it is important to understand. In accordance with the dynamical theory of the constitution of bodies, evaporation is constantly taking place at a rate due to the temperature at the surface, and condensation is likewise going on from the existing vapour in the air passing into the water, the differences between the two processes being what we call the rate of evaporation. The capacity of the air to hold vapour varies with the temperature, so that the same amount of vapour in air will have a very different ratio to the total carrying capacity at two different temperatures. This ratio is called the relative humidity. At any given temperature there is a certain amount of vapour which will saturate the air, and any surplus vapour must be condensed. This vapour has, as a gas, a certain pressure, tension, or force dependent entirely upon the temperature, and which may be expressed in inches of mercury. Very accurate tables of the maximum force of vapour for different temperatures have been given by M. V. Regnault. It is upon the amount of vapour in the air that the rapidity of evaporation largely depends. The vapour forming at the surface of water is of the maximum force due to the temperature of that surface. The rate of evaporation depends upon the difference between the maximum force of vapour due to the temperature of the water surface and the force of vapour existing in the air, but it bears no relation to the relative humidity of the air. This is because the temperature of the water surface does not follow that of the air even approximately. The practical determination of the force of vapour in the air is generally made by observing the difference between the wet and dry bulb thermometers, but a more trustworthy method is to take a direct observation by means of some condensing apparatus. The principal points to be considered in the study of the vapour of the atmosphere are: (1) The temperature of the air; (2) the dew point; (3) the force of vapour; (4) the quantity of vapour in, say, a cubic foot of air; (5) the additional vapour required to saturate a cubic foot of air; (6) the relative humidity; (7) the weight of a cubic foot of air at the pressure at the time of observation.

John Dalton was the first to ascertain the true principles of evaporation. The author having been led by his observations to believe that the rate of evaporation was not in exact proportion to $(V - v)$, as generally accepted, made a series of experiments to determine the exact relation. The formula deduced by the author from his experiments is—

$$E = 0{\cdot}014\,(V - v) + 0{\cdot}0012\,(V - v)^2.$$

In which E = evaporation in inches per hour; V = maximum force of vapour at temperature of water; v = force of vapour existing in the air.

A number of experiments were made to ascertain the effect of wind, the result being a modification of the above formula into the following, viz.:—

$$E = [0{\cdot}014\,(V - v) + 0{\cdot}0012\,(V - v)^2]\,(1 + 0{\cdot}67\,w^{\frac{9}{5}}).$$

In which w = the force of the wind at the surface of the water.

For an approximate formula, the following convenient forms may be used:—

$$E = 0{\cdot}0166\,(V - v)\left(1 + \frac{w}{2}\right); \text{ or}$$

$$E = \frac{(V - v)\left(1 + \frac{w}{2}\right)}{60}$$

In the case of his own observations, the author determined by a series of experiments that the velocity of the wind at the surface of the tank was about one-third of that registered by the anemometer, which was located about 30ft. higher.

A series of experiments under the bell of an air pump was made to determine the effect of barometric pressure, the conclusion being that within the ordinary range of pressure the effect would be hidden by errors of observation, and generally that the influence of the atmosphere on the rate of evaporation is in inverse proportion to its pressure.

In regard to the application of the formula, the author considers that if a sufficient number of accurate observations are made, a very exact result may be reached. The computed result for any given hour is possibly more accurate than the observed value.

The author concludes that there is no difference between sun and shade, other things being equal, and that depth has no influence, other than that due to its effect on the temperature of the surface,

* Read before the American Society of Civil Engineers on March 17th, 1886.

The Revolver.—At the Royal United Service Institution, Whitehall-yard, on Wednesday afternoon, a paper on the revolver was read by Major Kitchener. He dwelt upon the importance of revolver training, maintained that the weapon should be carried on service, and strongly urged the necessity of training officers in its use. The Americans depended very much on the revolver in war, and maintained that it was the most valuable cavalry weapon. Russia had adopted an American revolver, and in the infantry all officers, sergeant-majors, drummers, buglers, and clerks were armed with the weapon. In the French Army officers and men were supplied with double-action weapons. In Germany there was a regular annual course of instruction and practice. To his mind it was a question for very serious consideration whether our cavalry, armed as at present, would in a cavalry action be any match for an enemy armed with revolvers, as the Russians now were. Unlike continental armies, we had no course of revolver shooting for officers, and therefore, officially, an infantry officer could hardly be expected either to defend himself or assail a foe. The chairman, Major-General Sir F. Middleton, expressed the opinion that in future warfare the revolver would be used a great deal more than it ever had been.

RAILWAY MATTERS.

ACCORDING to Duncan's "Tramway Manual," which gives the statistical particulars of every tramway opened and at work, there were 327 steam engines employed on tramways at the end of 1885.

THE first eastward bound through train of the Canadian Pacific Railway, which left Port Moody on the 5th instant, at 1 p.m., arrived to time in Montreal at eight o'clock on the morning of the 12th.

A CORRESPONDENT of the Russian journal *Caspian*, writing from Merv, says that the opening of the railway station at that place would be celebrated not later than the 8th inst., as the rails had at the time of his writing been laid to within a few miles of the town.

WE understand that the Great Eastern Railway Company has entrusted to Messrs. Walter Scott and Co., of Newcastle, the construction of about forty miles of railway extension on their Essex lines, and that the amount of work to be done will involve an outlay of about £450,000.

IN a recent discussion by the American Master Mechanics on the question, is it necessary to bead the smoke-box end of tubes of locomotive boilers, Mr. Black said he had formerly beaded the front ends. Of late he had tried concaving the front tube plate about ½in., and found that then it was sufficient to set the tubes in front with an expander. A resolution, "That it is not necessary to bead tubes at the smoke-box end," was adopted by a vote of 46 to 29.

THE *Mark Lane Express* says:—"The abolition of preferential rates for foreign produce on our railways would do more benefit to agriculture than a protective tariff. Farmers should bear this in mind when the subject is again to the front. The railway question is one of more far-reaching importance than many may be disposed to admit, and one which calls for prompt and earnest attention, as it is obvious that when steamship and railway freight rates combined amount to less than the cost of sending native produce to the same markets, the British farmer is handicapped far beyond the direct influence of Free Trade."

AN American railway company has had built by the Schenectady Locomotive Works three 18in. by 24in. cylinder, 5ft. 6in. driving wheel, passenger engines, with boiler carrying 180 lb. working pressure. As the engines have only been in service a short time, nothing definite can be said of the benefit of the high-steam pressure. No trouble whatever has been experienced with the valve and cylinder surfaces, and Mr. G. W. Stevens, of the line using the engines, writes:—"Evidence is given of a fuel record that will not exceed 5 lb. of coal per car mile, with trains of ten cars, equal to 280 tons, exclusive of load, running on a schedule time of thirty-seven miles per hour."

IN concluding a report on the collision, that occurred on the 5th of June at Edgeley junction, which is about 700 yards at the south-east side of Stockport station, on the London and North-Western Railway, Colonel F. H. Rich says, "The system of permissive block working, which allows two trains to be in the same block section, or to approach a junction at the same time is dangerous. I consider that the margin of safety between the signal where a train should be detained until the junction or block section is clear and the fouling point, should not be less than about 400 instead of 42 yards, as in the present case, and a much greater margin of safety should be provided when the trains are not fitted with good continuous automatic brakes."

THE accidents on American railways in May last are classed by the *Railroad Gazette* as to their nature and causes as follows:—Collisions: Rear, 17; butting, 8; crossing, 2. Derailments: Broken rail, 5; broken frog, 2; spreading of rails, 10; broken wheel, 2; broken axle, 5; broken brake beam, 1; accidental obstruction, 2; cattle, 7; land slide, 1; wash-out, 7; misplaced switch, 5; purposely misplaced switch, 1; malicious obstruction, 1; unexplained, 9. Other accidents: Boiler explosions, 4; cylinder head blown out, 1; broken tire, 1; powder explosion, 1; accidental obstruction, 1; total number of accidents, 93. No less than 10 collisions were caused by trains breaking in two; three were due to misplaced switches, and one to cars blown out of a siding by a gale.

SOUTH Staffordshire ironmasters have just now cause for complaint against the Great Western Railway Company in the matter of tariff charges. Some time ago the rates for the conveyance of cokes from Staveley to this district were reduced to all stations on the London and North-Western and Midland lines, but not to stations on the Great Western line. Hence pig iron makers whose works happen to be served by Great Western sidings have to pay from 6d. to 8d. per ton more for Derbyshire cokes than their competitors who are served by the London and North-Western Company. In times like the present this is not an insignificant difference, and it is handicapping pig makers who have only Great Western sidings in competition with other South Staffordshire makers.

THE following are the dates of the introduction of railways in the various countries, from 1825 to 1860:—England, September 27th, 1825; Austria, September 30th, 1828; France, October 1st, 1828; United States, December 28th, 1829; Belgium, May 3rd, 1835; Germany, December 7th, 1835; Island of Cuba, in the year 1837; Russia, April 4th, 1838; Italy, September, 1839; Switzerland, July 15th, 1844; Jamaica, November 21st, 1845; Spain, October 24th, 1848; Canada, May, 1850; Mexico, in the year 1850; Peru, in the year 1850; Sweden, in the year 1851; Chili, January, 1852; East Indies, April 18th, 1853; Norway, July, 1853; Portugal, in the year 1854; Brazil, April 30th, 1854; Victoria, September 14th, 1854; Columbia, January 28th, 1855; New South Wales, September 25th, 1855; Egypt, January, 1856; Middle Austria, April 21st, 1856; Natal, June 26th, 1860; Turkey, October 4th, 1860.

THE *Railroad Gazette* record of train accidents in May contains notes of 27 collisions, 58 derailments, and 8 other accidents; a total of 93 accidents, in which 23 persons were killed and 170 injured. Three collisions, 6 derailments, and 4 other accidents caused the death of one or more persons each; 9 collisions, 23 derailments, and 2 other accidents caused injury to persons, but not death. In all, 13 accidents caused death and 34 injuries, leaving 46, or 49 per cent. of the whole number, in which there was no injury serious enough for record. The 27 collisions killed 8 and injured 85 persons; the 58 derailments killed 8 and injured 62, while in the 3 other accidents 7 persons were killed and 23 injured. Of the killed 17 and of the injured 74 were railroad servants, who thus furnished 74 per cent. of the killed, 43½ per cent. of the injured and 47 per cent. of the whole number of casualties. As compared with May, 1885, there was an increase of 31 accidents, of 15 killed and of 105 injured.

A DEPUTATION from the Cheshire Chamber of Agriculture, the Cheshire Agricultural Society, and other local societies interested in carrying agricultural produce, recently waited upon the directors of the London and North-Western Railway Company to complain of the preferential rates which the company quoted for American and foreign produce over the cost of carriage of Cheshire dairy and other home produce. The directors having listened to the arguments adduced of unfair preferential rates, promised to reply by post. They now regret, after giving the matter full consideration, that they are unable to meet the wishes of the deputation with regard to a reduction in the rates for milk, butter, and cream cheese, but they are prepared to make some reduction in the rates for farm produce such as potatoes, carrots, and turnips, to Liverpool and Manchester. They are also prepared to make reductions in the rates for packed and stable manure, lime, and oilcake. As regards cheese and meat, the rates are in hand for revision. The rate for cheese from Nantwich to Halifax, specially complained of, has already been reduced.

NOTES AND MEMORANDA.

ON the 26th ult. gas was used as fuel for the first time in the Belgian Glass works at Meadville, Pa.

THE six healthiest places last week were Wolverhampton, Huddersfield, Brighton, Sunderland, Birkenhead, and Leicester.

A GAS well near Putneyville, in the county of Armstrong has been burning for the past eighteen years, and its pressure continues. A company has been organised and will sink a number of wells in its vicinity.

THE deaths registered during the week ending July 10th in 28 great towns of England and Wales corresponded to an annual rate of 18·4 per 1000 of their population, which is estimated at 9,093,817 persons in the middle of this year.

THE production of the Silesian zinc furnaces during the first three months of this year was 391,280 centners, against 374,620 centners in the same period of 1885. The sale was 261,640 centners, against 272,460 centners; in value, 4,270,110 marks, against 3,542,779 marks.

IN London 2458 births and 1540 deaths were registered last week. Allowance being made for increase of population, the births were 165 below, while the deaths exceeded by 12 the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 14 9, 15·4, and 15·8 in the three previous weeks, further rose last week to 19·4. In Greater London the rates were 31·4 and 18·9 per 1000.

THE following are given as the fusing points of the alloys constituted in the proportions given and proposed as suitable for electric cut outs. The temperatures are in Centigrade degrees.

Points of fusion ..	95·0	89·5	76 5	68·5	65·5	63·0
Lead	250	397	344	260	249	267
Tin	250	—	94	148	142	133
Cadmium	—	71	62	70	108	100
Bismuth	500	532	500	522	501	500

MR. G. DAEHNE, writing to *Nature* on Ampère's rule, says: "There is another rule, published by Pfaundler if I am not mistaken, which is in so far much simpler, as it does not compel the imagination to fancy movements and actions of the human body which it in reality never could perform:—'Follow the direction of the current in moving the right hand along the wire, but holding it so that the stretched fingers are parallel to the wire and the palm is turned towards the north pole of the magnet. The outstretched thumb then gives the direction in which the north pole will be deflected.'"

DR. JOHN WARD attributes an outbreak of colic on a steamship to contamination of the water supply by zinc derived from zinc plates fixed in the boiler from which this water was condensed. It appears that the intention had been to renew the water supply of the ship at Batavia, but that this was not done from fear that the water at that port was contaminated by cholera contagium, and the supply for the remainder of the voyage was obtained by the distillation of sea water. On testing the water it was found to contain zinc. This brings up the questions, which have been frequently asked and never definitely and satisfactorily answered, as to whether the compounds of zinc taken up from the surface of that metal by drinking-water can be of such a character and quantity as to make the use of the water dangerous to health or life, and as to the circumstances under which such dangerous contamination may occur.

PORTLAND cement, mixed with a solution of calcium chloride, rapidly acquires considerable hardness. Setting begins in three or four minutes, and is attended with an elevation of temperature that may attain to 70 deg. C. A slight expansion is also produced in the course of setting. Cement mixed with calcium chloride softens if it is plunged immediately into water; but after having been air dried for eight or ten days, it may be so immersed without inconvenience or detriment to its cohesion or hardness. Ordinarily damp air has no influence upon the mixture. The fact that, according to the *Journal du Céramiste*, the runners of cement mills are repaired with this chloride-cement mixture is a sufficient indication of the great strength which the compound is capable of acquiring. The stones are put to work within an hour of repairing, and the cement is perfectly resistant, and wears less than lead, which is commonly employed for the same purpose. All joints can be made with great facility, and acquire in a short time extreme solidity with this chloride-cement mixture. The slight swelling during setting is very useful in filling all hollows and making good adhesion. The cheapness of calcium chloride permits the use of the mixture for numerous purposes. When great hardness and quick setting are desired, the cement may be gauged pure; but in general an equal mixture of sharp sand or gravel will be found to answer every purpose.

MM. PILLEUR and E. Jannetaz, according to the *Journal de Physique*, have endeavoured to ascertain whether, when a given point of a conductor having a fibrous texture is heated, thermo-electric currents are produced in it. Their experiments extended to zinc, tin, iron, and copper. The long-grain texture was imparted to them by carefully drawing out. A point A at the centre of the plate is heated, and one contact is made on the other side of the plate, at the end of the line that connects this point with A across the grain; the other, taken at a point C on the end of the line joining the point B along the grain. In all cases a current was obtained from B to C. The strength of the current for the same metal appeared connected with the development of the long grain. Thus, that zinc that had passed four times through the draw-plate gave a feebler current than zinc that had been drawn out six times. But copper with a good deal of long grain, that is much more fragile in one direction than another, gave a feebler current than tin, which seemed to have no appreciable grain. It must, moreover, be observed that this tin had passed six times through the plate; hence the thermo-electric action shows the action of the draw-plate, even when the fracture does not show it. The strongest currents were shown by zinc, and the feeblest by copper. The currents are, however, difficult to observe, doubtless owing to the facility with which they unite across the plates themselves. More powerful effects may be obtained by cutting a knee-piece in the metal-plate, in one branch of which the long grain is across, and in the other in the direction of the length, and then joining the two ends of the knee-piece to the external circuit.

THE art of artesian well-drilling in China is doubtless one of considerable antiquity, wells in that country being successfully bored to great depths with the object of obtaining brine. L'Abbé Huc gives the following interesting description of the process adopted:—"If there be a depth of 3ft. or 4ft. of soil on the surface, they plant in this a tube of hollow wood, surmounted with a stone, in which an orifice of the desired size of 3in. or 4in. has been cut. Upon this they bring to work in the tube a rammer of 300 lb. or 400 lb. weight, which is notched, and made a little concave above and convex below. A strong man, very lightly dressed, then mounts on a scaffolding, and dances all the morning on a kind of lever that raises this rammer about 2ft., and then lets it fall by its own weight. From time to time a few pails of water are thrown into the hole to soften the rock and reduce it to pulp. The rammer is suspended to a rattan cord, not thicker than your finger, but as strong as our ropes of catgut. This cord is fixed to the lever, and a triangular piece of wood is attached to it, by which another man, sitting near, gives it a half-turn so as to make the rammer fall in another direction. At noon this man mounts on the scaffold and relieves his comrade till the evening, and at night these two are replaced by another pair of workmen. When they have bored 3in. they draw up the tube, with all the matter it is loaded with, by means of a great cylinder which serves to roll the cord on. In this manner these little wells or tubes are made quite perpendicular—to a depth of from 1500ft. to 1800ft. French—and as polished as glass. When the rock is good the work advances at the rate of 2ft. in twenty-four hours, so that about three years are required to dig a well."

MISCELLANEA.

THE Council of the Institution of Civil Engineers entertained the representatives from India and the Colonies, on the 7th ult., the entertainment including a river excursion and dinner at Greenwich.

THE towns of Gastein and Gratz will shortly be lighted by electricity. The town of Temesvar, in Hungary, has already for the last two years enjoyed this mode of illumination for its streets and public buildings.

THE Phillipsburg Natural Gas Company's new well on the Ladd farm, in the Sheffield district, was tested on the 2nd ult., and found to be the strongest well yet struck in that region. It has a pressure of 620 lb. to the square inch.

THE Shrewsbury Town Council on Monday decided to experiment as to the feasibility of a new scheme for supplying the town with water. The proposed scheme, which takes the water from the Severn, is estimated to cost £250,000.

AT the international field trial of binders held at Epernay on July 8th, the first prize gold medal was awarded to Mr. Walter A. Wood; M. Albarat, with a French machine won the second prize; McCormick, third; Osborne, fourth; Hornsby, fifth. The Aultman and Johnston machines also competed. The crop was rye, and badly down.

THE Shrewsbury Town Council are deliberating on a scheme for supplying the town with a purer supply of water. At a cost of £25,675, it is proposed to take the water from the Severn a considerable distance above the present intake, so as to escape the whole of the town sewage. A pumping station, service tanks, and wells will be provided, and the water will then be carried by gravitation to the town.

THE whole of Wimbledon Camp is lighted by Defries' safety lamps and safety mineral oil. The burners used are of three sizes—43, 62, and 85-candle power. The result is a brilliant illumination, obtained at a saving, it is said, of four-fifths of what gas would have cost. The lamps are made on the company's new principle, whereby the oil is placed outside and on the top of the lantern. The effect of this arrangement is that the flame is always at the same height, every drop of oil is consumed, and there is no shadow cast.

AN English cooper, named Carlisle B. Graham, thirty-three years of age, has constructed a cask, with a manhole in the top, in which he has safely navigated the Niagara rapids near the spot where the late Captain Webb perished. Graham entered the river a mile above the rapids, and came out five miles below, the time occupied being about an hour. The cask in which he made the descent of the rapids is egg-shaped, 33in. diameter at the centre, 23in. at the top, and 18in. at the bottom, and 7ft. long, with staves of 1¼in. oak, strengthened by hoop iron, weighing 250 lb., and carrying 240 lb.

THE Council of the Yorkshire College have received an intimation from the Institution of Civil Engineers that the Council have granted to the library of the College copies of such volumes of the minutes of "Proceedings" of the Institution as they have in stock, forty in all. The *Leeds Mercury* says that in making this gratifying announcement, the secretary of the Institution says:—"This decision has been arrived at in view of the important work undertaken by the College, and in view also of the interest—personal and otherwise—evinced by many members of the institution in the establishment of the engineering department of that College."

THE *Indépendance Belge* is informed from Berne that the International Railway Conference, now sitting there under the Presidency of M. Welti, the chief of the Swiss Railway Department, is discussing the following subjects—the assimilation of laws relating to the carriage of goods, the simplification of administrative formalities, and the essential bases of international railway law. The Conference, which is attended by representatives of Belgium, Germany, France, Italy, Holland, Luxemburg, Austria-Hungary, Russia, and Switzerland, will last about ten days. One of the principal questions before the delegates is whether goods entrusted to a railway are, during the term of transport, to be considered the property of the consignor or of the consignee.

THE Russian authorities are about to expend considerable sums of money on the improvement of the Black Sea ports. The port of Mariopol is to be thoroughly repaired under the direction of Messrs. Boreicha and Maximovitch, engineers, at a cost of five million roubles. At Odessa the mole is to be levelled and repaved. The foundation of the mole is to be repaired and new breakwaters constructed. The harbour is also to be deepened. These alterations will entail an outlay of one and a-half million roubles. A new port is to be made at Novorossusk for 3,800,000 roubles, and is to be ready by 1888. Various other improvements are to be effected at Nicolaieff, Otchakoff, Yalta, Sebastopol, Taganrog, and in the canal of Kertch-Yenikale.

A NEW sewing machine is being brought out that weighs less than 16 oz., and which can be supplied to the public at the cost of a few shillings. The machine is called the "Moldacot." It has neither wheels nor treadles, being worked by the right hand, while the left is free for the guidance of the material to be operated upon. It is simple in construction, and for ordinary domestic purposes it may be depended upon, it is said, to do the class of work now performed by the manufactures of Transatlantic origin. It is what is termed "lock-stitch," and can be screwed to the leaf of any ordinary table. It can be packed in a little box 8in. long by 2in. wide and 1in. deep. The Moldacot is a German invention, and a company—at 58, Coleman-street—has been formed for the purpose of its manufacture.

A NOVEL system of fire extinguishing apparatus has just been introduced by Mr. William Glenister, chief of the Volunteer Fire Brigade, Hastings, and Mr. J. C. Merryweather, of London. The new fire and life saving machine consists of a tricycle with which the following are embodied:—(1) A hose reel carrying a large quantity of specially constructed hose for winding in a small compass, with all the attachments for working on to a fire from the street hydrants. (2) A light double pump fire engine in collapsible cistern, capable of throwing twenty-five gallons per minute to be worked by two pumpers. (3) A simple fire escape with descending ropes and bag. (4) Jumping sheets formed from the rider's seat. The machine is run at full bicycle speed by two men, and if desired the treadles can be so disposed as to work the fire pump, but for this a special gearing is required. For country districts and suburban towns this machine will probably come into early use.

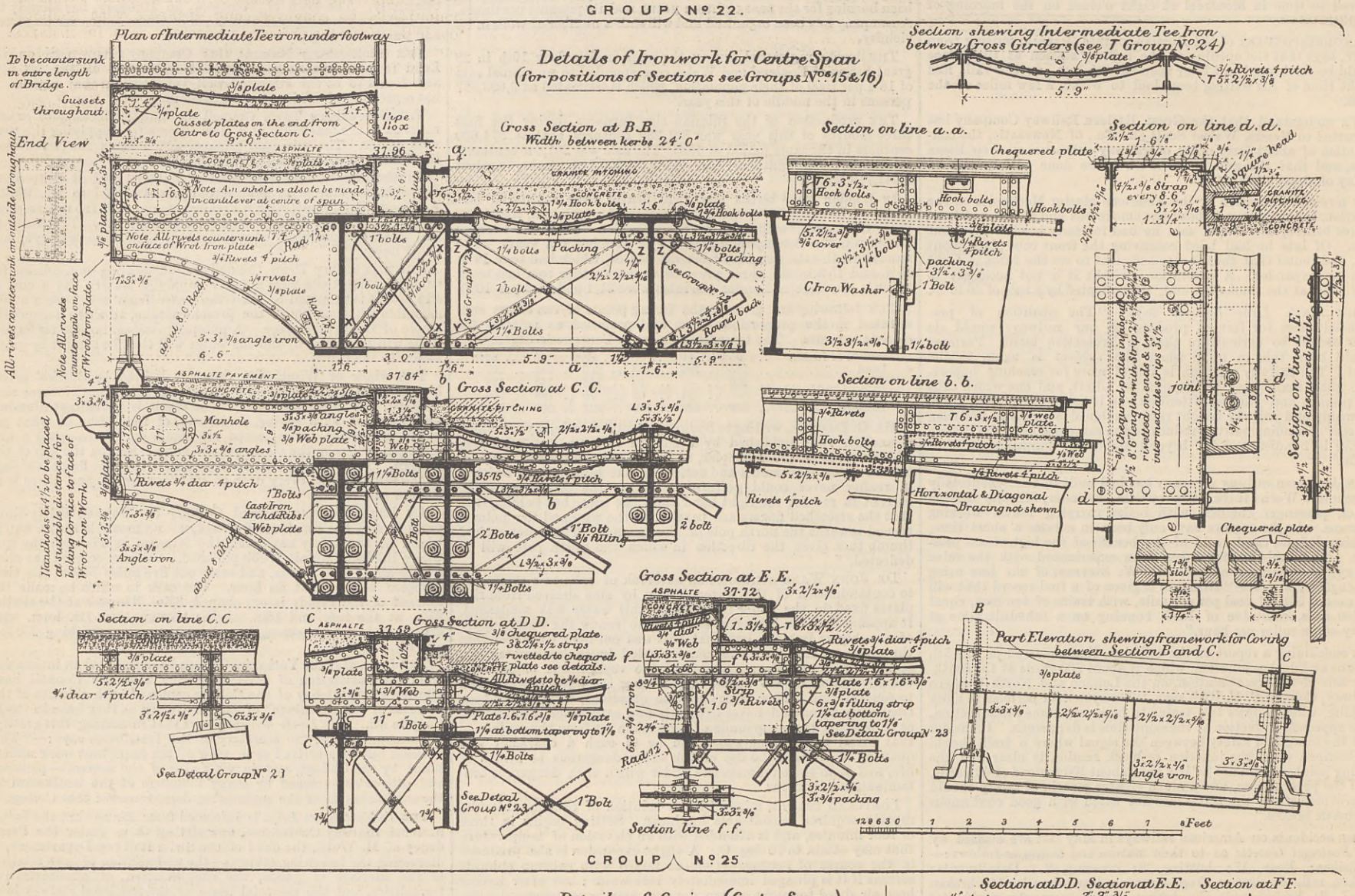
WRITING to *Nature* on the periodicity of glacial epochs, M. Adolphe d'Assier, of Tarascon, Ariège, says:—"The cause of this phenomenon being attributed by the astronomers, as well as by the majority of geologists, to the displacement of the perihelion, whose cycle is 21,000 years, it follows that, according to the actual position of this point, the ice now covering the Antarctic regions had its maximum of intensity at about the year 1250 of our era. For the same reason, the ice of the boreal hemisphere must have offered at this same epoch its minimum of intensity. Consequently the latter must have been increasing since the close of the thirteenth century, while the former must have been receding. The researches of European geologists must have shown a marked extension of the glaciers of Spitzbergen, Greenland, &c., since the beginning of the fourteenth century, and a recession of vegetation from the latitude of Sicily to the Polar Circle. But we in France are not informed of what has happened in the southern hemisphere since the arrival of the first navigators. I would therefore, in the name of science, beg of any British officers, consuls, or scientific observers who are, or may have been, collecting facts at stations near the South Pole, in Patagonia, New Zealand, Tasmania, and elsewhere, to communicate to me directly, or through your columns, any information they may have upon this subject. I wish to know whether, since the first arrival of Europeans in those regions, the ice field has shown a recessive movement, accompanied by an inverse tendency of vegetation."

THE NEW BATTERSEA BRIDGE.—DETAILS.

SIR JOSEPH BAZALGETTE, M.I.C.E., ENGINEER.

(For description see page 57.)

GROUP No. 22.



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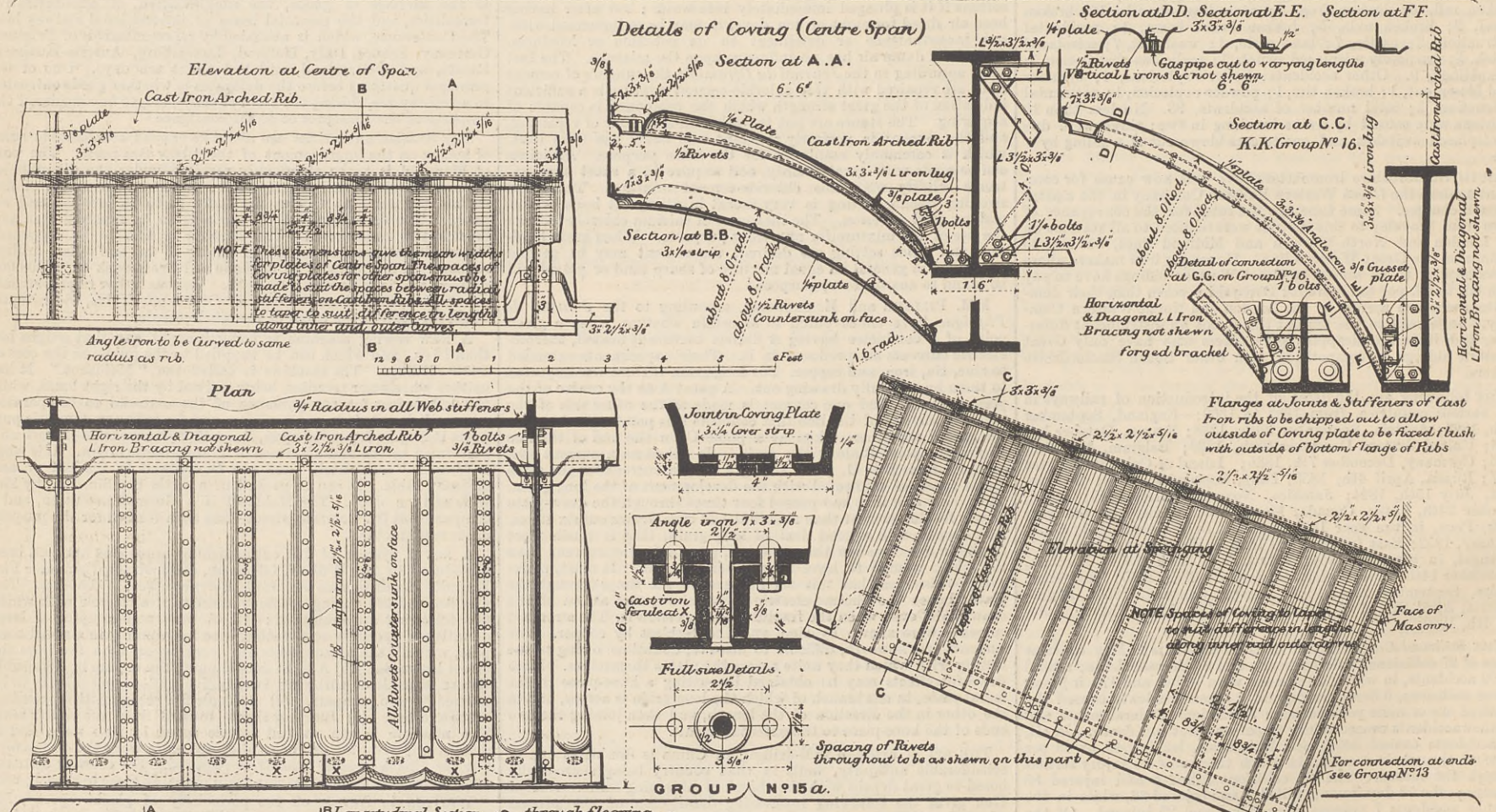

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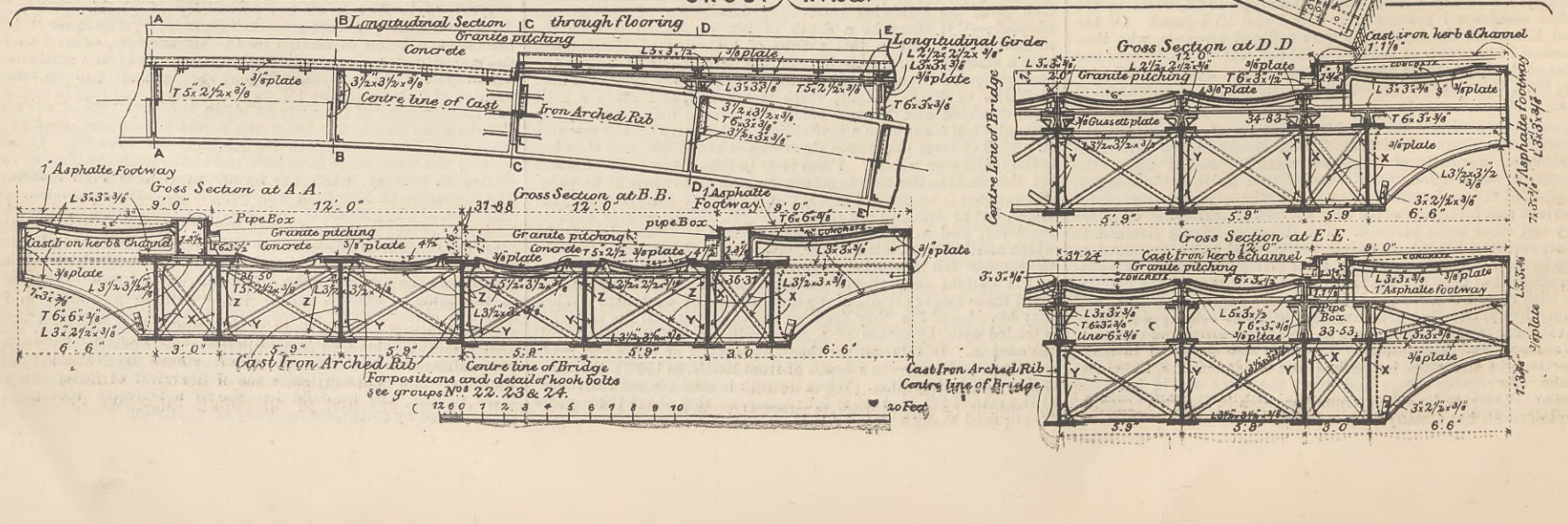

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*** *Next week a Double Number of* THE ENGINEER *will be published containing the Index to the Sixty-first Volume. Price of the Double Number,* 1*s.*

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TO CORRESPONDENTS.

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*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a* 1*d. postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

MECHANIC.—*You will find the information you require in Clerk's "Rules, Tables, and Data," published by Lockwood and Co.*

P. L. (Aberdare).—*The tube plate and the first inch in length of the tubes, is the most effective heating surface in a fire box, because all the flame impinges on that end of the box owing to the draught.*

THE BLOW OF A DOUBLE STEAM HAMMER.

(*To the Editor of The Engineer.*)

SIR,—I shall be obliged to any reader who can tell me what is the difference between the blow given by a vertical 10-ton steam hammer on to a fixed block, and the blow given by two such hammers meeting horizontally.

W. H. W.

Crewe, July 12th.

CIRCULATING PUMPS WITH ONE VALVE.

(*To the Editor of The Engineer.*)

SIR,—Could any of your correspondents inform me if circulating pumps have ever been constructed with only one valve? I believe a pump of this description was fitted to a steamer by a Scotch firm, and if such is the case, I should be very glad to learn by whom and when.

Flushing, July 14th. A SUBSCRIBER.

INJECTORS AT SEA.

(*To the Editor of The Engineer.*)

SIR,—In reply to "Aquarius" in your last issue, there have hitherto only been two objections to the use of injectors at sea, viz., their liability to cease working through the rolling of the vessel, requiring constant attention to re-start them, and the choking up of their cones with salt. Our new self-acting, re-starting injector has overcome both these objections, as it will work continuously without any attention in the roughest sea, and the cones are so made that they are easily removable for cleaning, while steam is up, without breaking any pipe joints.

Manchester, July 14th. GRESHAM AND CRAVEN.

(*To the Editor of The Engineer.*)

SIR,—In reply to "Aquarius," injectors will work on marine boilers. They do not, as a rule, stop work in consequence of choking up with salt, but what does prevent them working, after a time, is that in consequence of a chemical action having been at work between the salt water and the G. M. tubes, they become eaten into small holes inside, which destroys their efficiency. Lining up the tubes with nickel—which is inexpensive—will mitigate this and the machine consequently last longer, and having been at work a considerable time, if, upon examination, the throats of the tubes are found to be eaten into holes, the only alternative is to renew them, which does not cost much, compared with the many advantages an injector has over a donkey pump for feeding boilers. I cannot pretend to say that the above plan would be successful upon all the injectors upon the market, but have personally adopted it—the plan—with the Hancock inspirator, and with much success. S. B.

London, July 13th.

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DEATH.

On the 10th inst., at 88, West Cromwell-road, London, WILLIAM LOW, C.E., and J.P. for the county of Denby, late of Wrexham, aged 72 years. Interred Thursday at 11 o'clock, West London Cemetery. Australian papers please copy.

THE ENGINEER.

JULY 16, 1886.

THE TRANSMISSION OF POWER.

THERE has been a considerable development during the last few years in some of the principal methods of power transmission, and it may be worth while to take stock of recent progress. A marked advance has been made with hydraulic transmission, for though no new principle has been evolved, the use of the accumulator system has been widely extended. Many years before the time of hydraulic cranes as at present understood, water engines of various kinds were worked from the public mains in towns having a high-pressure supply, but the general use of water power conveyed in pipes undoubtedly dates from the introduction of the accumulator system by Armstrong. This method has been adopted much more extensively in England than elsewhere, the most conspicuous examples being, as is well known, at railway goods stations for cranes, and at docks for cranes and dock gates. The convenience with which power can in this way be distributed and applied has proved of the greatest importance in steel works, where the whole of the movements of the converter and the ingot moulds, and many of the motions in the rail mill, are performed by power from the water mains. Indeed, the wonderful development of the Bessemer system, and the cheapening of manufacture by automatic operations, are largely due to the accumulator system. It is in this direction that it has been most applied in foreign countries; for in the manufacture of Bessemer steel there has been a contemporaneous experience, and an all but universal adaptation of the same methods. We believe that Krupp still uses steam cranes at Essen for many of the purposes effected in other steel works by water-power; but this is an exception to the rule. In the United States it is a curious fact that, though labour-saving appliances are more generally sought for and appreciated than in Europe, yet in the matter of cranes it is only in the steel works that hydraulic lifting apparatus have been widely applied. This system of power-transmission has been also utilised for hydraulic tools of the Tweddell kind, a notable example being the dockyard at Toulon, recently equipped entirely on this plan. The distance to which power can be conveyed has been manifested so clearly in the railway, dock, and large manufacturing undertakings above referred to, that the extension of the system to a public supply of power could only be a matter of time. First tried at Hull, its success was somewhat retarded by the limited number of persons who could utilise so convenient a supply of force for their cranes and hoists, but the Hydraulic Power Company in London, which is the outcome of the Hull enterprise, has already attained an extraordinary development. Most people have noticed the pipes of unusual thickness that have been laid down under the streets during the last three years, but comparatively few are aware of the forces that are dealt with. The effective pressure in the London water companies' mains ranges from that of a 60ft. to 100ft. head of water, while the higher pressure in the Hydraulic Power Company's mains is equal to a head of 1600ft., or about 700 lb. to the inch. Few passers-by in the narrow streets of the City and in the precincts of Westminster Abbey are aware of this dormant force beneath their feet. The pumping station is at Bankside, Blackfriars, and about fifteen miles of pipes are laid along both sides of the river and to the principal streets in the neighbourhood within a radius of three miles of the pumps. The power water finds its chief use in hoisting operations of all kinds where the alternative of a steam engine, or even a gas engine, is inconvenient, rendering necessary also the expense of an engine driver. The cost of power for raising one ton 50ft. high is from one farthing to a penny, according to the frequency of the service. But while the hydraulic power is thus cheap and convenient for intermittent service, it cannot be so advantageously applied for rotary machines continuously working. The price charged for the water ranges from 3*s.* to 8*s.* per 1000 gallons, according to the quantity taken; and reckoning the pressure as equal to a 1600 lb. head, this, reckoning the power in foot-pounds, will be found dear compared with the cost of either a gas or steam engine. One principal drawback to the use of water for power is its want of elastic force, so that however small the work to be done, the maximum pressure has to be applied to the end of the operation. It is stated that the Corporation of the City of London intend sinking wells to obtain a supply of water independently of the New River Company, whose right to charge by a rental rate on business premises gives them an enormous price if reckoned by the quantity consumed. In so limited an area as the City, where no natural elevation is available for a reservoir, the plan might be considered, as alternative to an elevated tank reservoir, of giving, by accumulator pressure, a considerable force to the water for power purposes, or, at any rate, sufficient for fire extinction without the aid of a fire-engine.

A company was established a few years ago in New York for distributing power by steam, but we have not heard of its success, nor do we believe it can prove profitable either to the supplyer or user except on a small scale. Steam can undoubtedly be conveyed long distances with moderate loss if the pipes are properly protected—as is, for instance, done at collieries, where boilers on the surface supply engines at a great depth below. But though better than pressure water for giving rotary motion, steam cannot compete with it for general transmission and distribution. The effective distribution of steam power is practically limited to a moderate distance. Thus, in the Midland Counties, workshops are let out at a rent which includes a supply of steam from a central boiler. Against the use of steam are the inconveniences arising from the loss of heat and the removal of the condensed water, the large size of pipes necessary to convey any considerable force if the pressure be limited, as practically it is, to about 100 lb. per inch, and the still larger space occupied by the pipes if enveloped with some non-conducting material. The difficulties would be lessened if proper subways—as made in modern London streets—were generally available.

Compressed air offers, by its elastic force, some of the advantages of steam, and the operations of the company recently formed at Birmingham for the distribution and sale by that means will be watched with interest if the scheme goes on. There may possibly be in the town enough of small users of power concentrated in a small area to whom such power will be useful, but we do not believe the system can generally be successful. That power can be conveyed long distances with moderate loss has been proved by the transmission of it five or more miles for the rock drills and boring machines in the Mont Cenis and St. Gothard tunnels; but in those cases cheap water-power for the compressing machines was at hand, no other means of transmission was available, and no comparison with other systems could be made. Moreover, the pressure in such cases seldom exceeds 50 lb. per square inch, and if for general distribution the pressure be so limited, there is the same inconvenience as with steam, that pipes of large diameter would be required. To compress air to a density beyond four atmospheres requires special machines, involves considerable loss of power and many other inconveniences, which in the case of higher pressures would be increased if distribution over a considerable area were attempted. The net power finally given out in useful work is less in proportion to the fuel consumed in the original motor than either with steam or water.

Electricity is probably the transmission medium which will be most developed in the early future. Considerable attention to this method seems to have been given by Marcel Deprez, in Paris—an account of whose experiments has from time to time been given in THE ENGINEER. Great interest has been excited in France by these experiments, which have been supported by funds provided by Rothschild, who, as chief director of the Northern of France Railway, has also allowed the use of the Paris workshops of that company. But Deprez, who used the telegraph wires along the railway as his conductors, has not yet sufficiently overcome the initial difficulty of taking great force along small conductors, where the resistance increases with the distance, producing heat enough to fuse the wires. According to the late Sir W. Siemens, it was impossible to overcome this difficulty, except at a prohibitory cost. Another aspect of the question, the loss of force at each transmutation—viz., at the dynamo which receives the power from the motor, and at that which delivers it out at the other end of the conductor—has been dealt with by Professor Hopkinson in this country, with the highly satisfactory result of greatly reducing the loss. The Gaulard-Gibbs system of secondary generators, as used in 1884 for the lighting of the Metropolitan Railway, and as now being applied for longer distances, will, if successful, supply one means hitherto wanting for overcoming the difficulties of long transmissions.

Wire-rope transmission has been successful over long distances, but distribution has not been proved profitable to those who embarked money in the enterprise. The most notable instances are those where abundant water-power is available, as at the falls of the Rhone. The machinery necessary to transmute, convey, and distribute the force to numerous users within a mile of the falls, has not yet proved profitable. At Niagara Falls, the surplus power from the turbines which drive the large flour mills there is conveyed by wire rope to adjacent factories, and used to advantage.

There are no other systems of transmitting power in the gross for considerable distances than those we have mentioned—unless, indeed, the potential heat force of fuel were included; and of this the most recent and curious development is the gas brought from the oil wells of Pennsylvania, a distance of some twenty miles, by pipes, to Pittsburgh and the neighbourhood. It is stated that in one steel works alone more than 2000 tons of coal per week have been saved by the substitution of the gas for fuel. In all comparisons between different systems of power-transmission, precedents are misleading, unless the fullest weight is given to the ever varying circumstances of each case.

NAVAL DISPUTANTS.

A SECOND letter from the pen of Admiral Hood appeared last week in the columns of the *Times*, carrying on what may be termed an official defence of the designs of the Nile and Trafalgar. Had the Admiral remained a member of the Board of Admiralty he could not thus have spoken. His departure leaves him free to speak, in common with Sir N. Barnaby. The latter is now "writing a book," and probably thinks it superfluous to indite any more letters until the weightier task is complete. Years ago Sir Edward Reed obtained the liberty which comes by vacation of office, and has made diligent use of his opportunities. That men should thus first of all obtain initiation into high

official duties, and afterwards emerge from behind the scenes to give the public the benefit of their trained intelligence, is an advantage, though it may happen in some cases that they are committed to certain plans which they necessarily defend. But if there is to be a fight, it is more instructive and interesting to witness a battle of the giants than a mere squabble among the dwarfs. In Admiral Hood's communication—intended as a reply to Sir N. Barnaby and Mr. Shaw-Lefevre—we have a reference to the Renown, Sanspareil, Benbow, and Dreadnought, as well as the two forthcoming armour-clads which have occasioned so much controversy. The Admiral commences his defence of the Nile and Trafalgar by saying:—"Their design is merely a reproduction of that of the Dreadnought, which vessel, although built ten years ago, is still considered to be one of the most powerful and thoroughly protected battle-ships in the British Navy; and in the preparation of the design of this vessel Sir N. Barnaby took an important part, and, to the best of my belief, thoroughly approved it." This justification of the new ships, to be finished some four or five years hence, as being in their opinion "merely a reproduction" of something designed fifteen years ago, says little for the progress made in naval armaments since 1870. In the twenty years ending with 1890, all we shall be able to do will be to offer as our newest specimen of a war-ship something with armour thinner and guns lighter than those of the Inflexible, and a speed less than that of the Italia, the latter carrying guns of 110 tons. That the Nile and her consort will have thicker armour, heavier guns, and higher speed than the Dreadnought, is so much gain, so far as it goes, and is the more to be expected, seeing that the new ships will be much more costly than their prototype, and will have an extra displacement of 1100 tons. It may be remembered that the Dreadnought was originally designed as the Fury, her inception dating from 1870. Admiral Hood, while defending the Nile and Trafalgar, objects to the demand for a fresh Committee on Designs, on the ground that a Committee of this nature, appointed in 1871, delayed the building of the Fury "for months," and the practical good was *nil*. But there is the fact that the design of this ship was altered and greatly improved after the Committee had reported, these changes taking effect from 1873, from which period the design of the Dreadnought may be practically dated. The delay is not now the occasion of regret, and the result has been the production of a ship which Admiral Hood so greatly admires, that similarity with her design is deemed by him a powerful recommendation for the Nile and Trafalgar. In other respects the Committee of 1871 has rendered great service to the Constructive Department of the Admiralty, and like service at the present time is greatly to be desired.

Sir N. Barnaby has objected that the use of a single citadel, with turrets in the centre line, as in the Nile and Trafalgar, concentrates the armament dangerously. The meaning of this objection has evidently been misunderstood by Admiral Hood, who looks upon it as limited to the situation of the heavy guns. The brevity with which Sir N. Barnaby expresses himself has led to a misconception on this point. The question at issue is clearly that which we recently adverted to, when we remarked that the space assigned for the rapid firing and machine guns was less in the Nile and Trafalgar than in the Renown and Sanspareil. Two hundred men, it has been stated, will be crowded between the turrets of the new ships in order to work the small guns, and will be unprotected by even the thinnest side armour. If concentrated, the small guns and the men who work them ought to be protected; if not protected, they ought to be distributed. Treating of the question of concentration *versus* distribution in respect of the heavy guns, Admiral Hood falls into a singular error. Expressing his surprise that the designers of such ships as the Admiral class and Benbow and Sanspareil should take exception to the protection afforded to the heavy armament of the Nile and Trafalgar, he persistently treats the Benbow as a single-turreted ship. Classing the Benbow and the Sanspareil together, he says "their heavy armament consists of two 110-ton guns mounted in a single turret protected by 17in. armour." He then makes the objection that "the penetration of the single turret by one heavy projectile might easily incapacitate the further working of the 110-ton guns." Admiral Hood tries to give further point to his argument by speaking of the Benbow and the Sanspareil as being among "the latest productions of Sir N. Barnaby." But the Benbow is not a single-turreted ship. She has two barbettes, each carrying a 110-ton gun. No less important, and scarcely more accurate, is the attempt made by Admiral Hood to controvert the statement of Mr. Shaw-Lefevre as to the want of scientific approval concerning the design of the Nile and Trafalgar. Admitting that Sir N. Barnaby did not approve of the design for these ships, Admiral Hood goes on to say that Sir Nathaniel nevertheless "recorded his opinion" with regard to the design for the Nile and Trafalgar, and also of a competitive design prepared by the Admiralty constructors, "that both designs would be much superior to any French ship built or building." We should like Admiral Hood to investigate this matter a little more closely, so as to discover for certainty whether this "recorded opinion" had any reference whatever to the design of the Nile and Trafalgar. We should not be surprised if Admiral Hood finds that these words have reference to another design, temporarily approved by the Board in consequence of the favourable opinion expressed by Sir N. Barnaby, but afterwards abandoned in favour of the present design. It is doubtless true that Mr. F. K. Barnes and Mr. Henry Morgan at a late period accepted the present design; but if this period be fixed with exactitude, we believe it will prove to have been subsequent to the relinquishment of active and responsible duty on the part of Sir N. Barnaby; and Admiral Hood tries to lead us to the comfortable conclusion that the only difficulty concerning the Nile and Trafalgar consisted in certain "differences of opinion" among the Admiralty constructors "during the preparations of the designs." Whatever may be the merits of those designs, and however excellent the Nile and Trafalgar may prove to be, if completed according to present plans, we venture to say that the designs for those ships were unapproved by the scientific advisers of the Admiralty down to the time when Sir N. Barnaby practically retired. If the responsibility is to be thrown upon the shoulders of Messrs. Barnes and Morgan, that is so far an answer to the appeal we have made to know who is really responsible for these ships. But if this be so, what becomes of Sir N. Barnaby on the one hand, and Mr. W. H. White on the other? The truth appears to be that the Nile and Trafalgar—if we may be allowed to use a homely figure—have neither father nor mother, but they have a couple of very good sponsors, and if we are to seek further for their parentage, we should rather give the preference to Admiral Hood himself. This, of course, can go no further than saying, that the two armour-clads in question embody the ideas of Admiral Hood, who therefore defends their design as superior to any other. He has written a temperate letter, and has a perfect right to his own opinion, strengthened by the high position he has held as the Senior Naval Lord at Whitehall. Our purpose is to put the case fairly, and to be careful as to the facts.

THE FORTH BRIDGE.

A good deal of work has been done on this great bridge during the past two months, and some of it may now be said to make a considerable show. At the South Queensferry main piers the lower bed-plates are now complete, and the south-east skewback and the junctions, as well as 64ft. of the horizontal tube, are rivetted in position. About two-thirds of the bracing girder between this and the south-west skewbacks and that between the south-east and north-west skewbacks are together. Of the Inch Garvie about 140ft. of each of the main horizontal tubes, and the greater portion of the diagonal bracing girders between them, have been put together and rivetted up. At North Queensferry main piers still more progress has been made. All four skewbacks, about 60ft. of the vertical columns, with the struts between them, the two main horizontal tubes, about 26ft. of the first strut of each cantilever, and 60ft. of the bottom members on the north side, have been put together, and about 800 tons of plates have been rivetted. The bracing between the skewbacks is nearly complete. Of masonry and concrete up to the present about 330,000 cubic feet of granite have been delivered, and about 305,000 cubic feet set. About 95,000 cubic yards of rubble masonry and concrete work have been built, and 19,000 tons of cement have been used. Of the steel work, including the horizontal and vertical tubes already in position at the North Queensferry and Inch Garvie piers, 3150 lineal feet of tubes of 12ft. in diameter and 3600ft. of tubes of 8ft. diameter have been fitted and drilled. The average number of men employed on the works has been slightly increased, being now 2180. The process of erection at the three main piers is now well started; and so far, no great difficulties have been encountered. It may be mentioned that the highest wind pressures on March 30th, during a westerly gale between six and nine p.m., were as follows:—No. 1, large gauge, 19 lb.; No. 2, small fixed gauge, 31 lb.; No. 3, revolving gauge, 25 lb.; No. 4, small gauge in centre of No. 1, 28½lb.; No. 5, small gauge at corner of No. 1, 22 lb.

DRAINING TWELVE SQUARE MILES OF FLOODED COAL MINES.

For thirty years past one of the leading objects of the Mines Drainage Commissioners of South Staffordshire has been the drainage of what is known as the Bilston pound. The Bilston pound means flooded mines extending over an underground area of from twelve to fifteen square miles, ranging from Bradley to beyond Portobello in the north, and from near Walsall on the east to Wolverhampton on the west. Submerged in this area is a vast quantity of partly worked coal locally known, some of it, as the "twelve-yard" seam, and much of the rest as the "new-river" seam. To drain off this water the Commissioners in 1883 commenced to put down an engine by Hathorn, Davey, and Co., of Leeds, which was described in The Engineer. It is a compound horizontal with 90in. low and 52in. high-pressure cylinders, and its pumps consist of two 27in. plungers with a 10ft. stroke, both throwing to the surface. At each stroke of the engine 496 gallons of water are raised from a depth of 380ft. and at seven strokes per minute the pumps can raise nearly five million gallons in the twenty-four hours. Levels to bring the water to the pit of this engine have been constructed, and the north level having been finished and a bore made, the engine was started on Thursday, in the presence of several Commissioners and others. If the weather should be fairly propitious, this engine ought, in six months, to unwater the whole of the now drowned-out area indicated. A favourable issue would greatly benefit the coal and iron masters of the Wolverhampton district of South Staffordshire. The engine started pumping yesterday from a small trial boring, and will, it is expected, be working from the permanent boring to-night.

THE "MIDDLEMAN" IN CUTLERY.

Where does the profit go? Knives which can be bought in Sheffield at 17s. a gross are sold at the antipodes at 144s. a gross—*i.e.*, at 1s. each. The pity is that knives can be bought in the cutlery capital of the world at any such price, for quality cannot be given for the money. It was stated some time ago—and this week the statement has been confirmed—that knives which can be readily bought in Sheffield for 3s., 3s. 3d., and 3s. 6d. per dozen, are sold across the sea at 1s. each, and 1s. 6d. each asked for knives which are sold wholesale at 5s. 3d. to 6s. 6d. per dozen. It would seem that the great profits are made on the veriest rubbish, profits ranging from 200 to 770 per cent. But where do they go? The Sheffield manufacturers do not get them, and the Sheffield workman is not waxing rich on any such remunerative returns for his industry. Probably the problem finds its solution in the large tolls exacted by the middlemen, for it cannot be supposed that the antipodean retailer is responsible for the exorbitant charges. Surely manufacturers might find some means of cutting out such middleman! No great enterprise should be needed to let the producer give the go-between the go-bye, and get his goods direct to the consumer at a reasonable price.

LITERATURE.

A Year in Brazil, &c. By H. C. Dent, C.E., F.L.S., F.R.G.S., &c. Kegan Paul, Trench and Co. 1886.

It can hardly be said that little remains to be added to the stock of our knowledge about Brazil. Brazil is a very big country indeed, and many parts of it have scarcely yet been trod by the foot of an Englishman. We are all such slaves of the road, that no one who has not some special object in view willingly leaves the beaten track to encounter unknown dangers and discomfort merely for the pleasure of the thing. Curiosity indeed, love of sport or adventure, the desire to scale a peak or explore a forest, where no one has been before, often do excite a man of leisure and means to feats of this kind; and if he happen to have some literary gifts, even though of no superlative excellence, and should after his return, with becoming modesty and self-restraint, perpetrate a book, the book is certain of a welcome: for some incidents, and information about things and people, from the very nature of the case *must* be novel and interesting, and possibly of even considerable value.

Some of the pleasantest books we have, the by-paths of literature, have in such a way been written. Ambassadors, consuls, civilians, traders, and officers, who have had their chances, have thus put us under obligations for many a delightful hour. Sailors, like Basil Hall and Byron, do not for some reason often come to the front with such a book. Soldiers, perhaps, have hitherto been the main contributors to the book-shelf of lighter travel. Taste, education, and facilities arising from the necessities of campaign in all regions of the world have combined to make many British officers writers of charming books. In these days, however, the man with the best chances is the civil engineer. Continents are being penetrated in all directions in search of best lines for canal, railway, or telegraph wires, or pierced in all sorts of queer out-of-the-way places by the lines themselves, and the engineer, if he can only spare time from engrossing work, may often be at least first in the field, and must have something new to tell; if he can tell it well, so much the better.

The book with which we are now concerned, "A Year in Brazil," is written by Mr. H. C. Dent, C.E., F.L.S., F.R.G.S., &c. It is certainly a weighty book; scales 1 lb. 12 oz.; a pound or so too much, the tired wrist hints, for what Mr. Dent calls "a modest journal, with notes to add to the store of general knowledge." The book consists, as Mr. Dent might say, of 444 pages of letter-press, maps of a large part of Brazil—which Mr. Dent did not see—and a dozen illustrations, within a handsome red cloth cover, ornamented by what seems the end of a leaf of Mr. Dent's favourite bamboo. There is a Dedication, Introduction, Index, 256 pages of Journal, and in 171 mortal pages, three formal Appendices; 18 pages descriptive of the voyage out, 16 of the voyage home, leave to the Journal in Brazil an advantage of about 50 pages in weight over the three Appendices. After these constructional details of Mr. Dent's mode of engineering a book, we will examine the workmanship a little closely.

Mr. Dent for many reasons refrains from treating on the subject of the survey upon which he was engaged, but this is of small concern to readers, for Mr. Dent has many other qualifications for authorship. He writes, with confidence at least, upon many matters. He has made studies in botany, mineralogy, geology, natural history in all its branches, biology, and meteorology. He is statistician, financier, and theologian, and wears "porpoise skin boots with very broad flat soles!" He lived while in Brazil under canvas, in a country town and in Rio Janeiro. Rather more than 100 pages are devoted to an account of camp life in the work of surveying, and of Mr. Dent's residence in a country town. This part of the work, helped along by a rather pleasingly jejune literary style, has the merit of interest to all readers by relating personal experience in a part of the world known to but few English people, and may have a certain value for those who may have to live a similar life. Mr. Dent seems to have had a pressure of hard work under difficulties of climate and country, and perhaps one ought not to be critical about rough notes written under such untoward circumstances. But Mr. Dent's journal notes have such a curious air of the over-refined polish of style that must have rendered them the delight of the family circle in which doubtless they were in the first instance caressingly perused, that it must be confessed he does tempt an outside reader to the indulgence at times of a smile of gentle approval. He writes, for instance, a really excellent account of a local funeral; and we are always interested when he tells us how, though a staunch member of the Church of England, he prevails on himself to attend the service of the Roman Catholic Church! This pious duty, he tells us, with a touch of humour of which he is evidently quite unconscious, he performed on Advent Sunday, "because he had not been to a place of worship for two months, and wished to set an example to his men, who were most punctual in their attendance." This unconscious humour continually pops out in the journal. At the funeral already spoken of, "the odour from the corpse became sickening . . . and in the middle of the service the priests seemed affected by the smell, when one of them pulled out his snuff-box, took a big pinch, and handed it to two others, who did the same." They seem to have been wise old priests, but Mr. Dent gravely comments: "The heartless conduct of the priests was scandalous!" Mr. Dent's "porpoise hide boots, with very broad flat soles," at which the Brazilians made merry, were of great service in the squashy forest lands, where, as he says, on one occasion, "the flooded river revealed a submerged marsh"—a rather hazy description, with a *nuance* of Mr. Dent's favourite hobby, theology; but not even these famous boots were an absolute protection against those awful pests, bush-ticks, jiggers, and bernos. Mr. Dent gives very telling accounts of these atrocious creatures from his personal experience. He says: "I suffered from one of these villains—a berno—under my left knee. . . . . I had heard from my friends of the cruel practice of the natives in applying a burning stick to the wound to kill the worm; so I determined to keep silence about it"—a delicious unconsciousness of humour, which leaves in doubt whether his humane silence is exerted in his own behalf or the worm's; but Mr. Dent himself must finish the story:—"At length the pain became unbearable at certain intervals, when, I presume, the creature was feeding. Probing the wound with a long darning-needle it penetrated over 1in. before I

felt the creature at the end of his burrow. I squeezed the berno out alive, and it turned out to be a very large maggot, three-quarters of an inch long and a quarter of an inch in diameter!!"

Mr. Dent seems to have met with much kindness and hospitality from the people about, and to have won their favour by his own genial manners. He is evidently a kind-hearted, amiable man, and by mingled firmness and justice had no trouble with his workpeople. His cook, Alexio, made a singular display of attachment, for when he came to say good-bye, "he hugged us," says Mr. Dent, "with both arms; his eyes filled with tears; he sobbed, and could not speak." This same Alexio, upon the occasion of some great religious function, sent Mr. Dent a tribute of affection, in the form of five sisters-in-law, a brother-in-law, some *compadres*, and two slaves, to stay as guests during the festival! They all effusively embraced Mr. Dent on the day of departure. The Brazilians are clearly affectionate folk.

Mr. Dent laments his inability to sketch well enough for the *Graphic*. He gives his readers, however, a dozen sketches of scenery, which, as Mr. Dent says, "though without pretence to artistic merit," he assures us are "true to nature." We must be content with Mr. Dent's word for this latter statement; but if we too may lament that Mr. Dent is not great as an artist, he consoles by many specimens of his talent as a painter of scenery in words. After what he rather pompously calls "the ascent of the Corcovado"—a hill of 1400ft. above Rio—he goes on to say: "How can I describe this view? It almost passes description." A description of course follows, and "ripplets break in silver threads on the sandy shore, or dash against precipitous rocks." The sight of dashing ripplets must be quite a novel sensation, and the view from that enormous height of 1400ft. really astonishing, if it be true that one "could just see the cars crawling along the straight, wide road; but the mules were hardly visible, or individuals either, unless they carried open umbrellas." How Mr. Dent must have rubbed his eyes at the sight of mules hardly visible carrying open umbrellas! The cars drawn by these extraordinarily caparisoned mules, Mr. Dent, yielding for once to engineering instincts, tells us, "consist of rows of seats, with reversible backs, to which one climbs by a continuous foot-board on each side; a roof keeps off the rain." These shadowy, economical cars "consist," we learn, with a state of the share market which fairly makes one's mouth water; £1000 in shares actually produced in thirteen years £24,000. The author, in another passage, with a turn of alliteration sometimes dangerous to an expert, speculating on the after fate of species who have worked out the object of their creation (the first shareholders have sold out) says, "they become degraded, degenerate, depauperated." Happy shareholders in Rio have reached—alas! for us who have not—the "depauperated" stage!

The hideous brutality of bullock-drivers excites Mr. Dent to an indignation in which all his readers will heartily join; the description, indeed, is really horrible; but the bull-fight at Rio—Mr. Dent is here quite at his best—seems not to be a very blood-curdling performance.

We have been able to count at least one joke in the book, scored at p. 209, and we are glad to learn that it must have been of a laughable character, for "his companions," we read, "were much amused." That joke must not be spoiled by a second telling here. The one sporting incident, a snake story, is as follows:—"A long, very thin snake, had just seized a large frog, and I wondered how he would dispose of him. I was attracted by hearing the frog's terrified croak, and dismounting from my horse, drew near to watch proceedings. The snake fixed his cold, glassy eye on me as I approached within a yard of him, but continued swallowing the frog, swelling out marvellously as it gradually was disappearing. As the last foot of the frog entered the snake's mouth I gave him a blow on the head, when immediately the frog was disgorged, every bone in his body broken, covered with slime, but still breathing and moving. After killing the snake, I was also compelled to despatch the frog." This truly unique sporting event is matched by the one thrilling adventure on the summit of that lofty hill Corcorado, 1400ft. high. "When I arrived there were three natives in shirt-sleeves and with long sticks. I thought how easily they might go for me, rifle my pockets, and throw me over the wall—a sheer 1000ft.—into the virgin forest beneath. However, they did not perpetrate the ghastly deed (as Mr. Dent did the joke) or I could hardly have written these words." A thoroughly well-threshed-out, thoughtful adventure, with reflections.

One is almost wicked enough to wish that as Mr. Dent has survived the joke, the sporting event, and the thrilling adventure, he may some day try his hand on a poem. We miss this sadly in his present work; but his varied talents are given full scope in the three Appendices, for there we get what seem to be several Sabbath evening discourses, Mr. Dent's reflections on Darwinism, finance and politics—Brazilian and British—denunciations of slavery in copious cuttings from newspapers, many extracts from other people's books, twenty-two pages of real light reading in Mr. Dent's meteorological notes, what seems to be a complete catalogue of a good many Brazilian wild creatures which Mr. Dent did not see, and a fully detailed account of his spoils in the chase of beetles and similar dangerous animals, which now, probably, duly ticketed by more skilful and friendly hands, adorn the family mansion.

Mr. Dent enlivens his style by a little very mild slang, a good deal of reproachable grammar, and a few very bad expressions, such as "niggers," "detestable old hag," &c. But on the whole he may be congratulated on having engineered into the world a book, with gay outside and contents, which we have no doubt will afford a deal of placid pleasure to readers of either sex.

Money-making Men, or How to Grow Rich. By J. EWING RITCHIE. London: Charles and Co., 1, Salisbury-court, 1885.

AMONGST many other well-known men this refers to a few engineers, ironmasters, and inventors, and gives an outline history of the lives of men who have grown rich by thrift, industry, and ability, and is one of the little books that provide boys and men with hints that may affect their lives and lead to fortune. In a large proportion of the cases referred to thrift, unattended with any special ability, has been the chief cause of the fortune amassed, and thus the book may appeal to many who do not find themselves possessed of special genius. There is too much praise of the money-loving and grubbing rather than of money being the results of great achievements, but this may not seem so to all readers.

Notes on the Geology of the Hull, Barnsley, and West Riding Junction Railway and Dock. By Rev. EDWARD MAULE COLE, M.A.

THE Hull and Barnsley Railway runs through a district rich in geological interest as opened up by the deep cuttings of the railway. The post-tertiary and neocomian series, the middle coal measures, the magnesian limestone, new red sandstone, lias, lower, middle, and upper oolites, and the lower chalk are cut through; and although the post-tertiary, middle coal measures, and the lower chalk form the chief of the excavation, the other beds, more especially the magnesian limestone, are opened up on a considerable scale. It would therefore have been a great pity if the information obtained in tunnel and cutting had not been recorded while the strata were yet uncovered by vegetation or blurred by disintegration and weather colouring, and geologists are much indebted to Mr. George Bohn, M.I.C.E., for having secured the services of the Rev. Mr. Cole, by whom the book has been written for Mr. Bohn, and under his supervision. The book is privately printed, but can no doubt be consulted at any scientific libraries, and will be found of much value as connecting the geological features of the district with those where the same strata are met with elsewhere and in different relations.

Canada: Its History, Production, and Natural Resources. Prepared under the direction of Hon. JOHN CARLING, Minister of Agriculture, Canada. Department of Agriculture of Canada, Ottawa. 1886.

THIS handbook, prepared by Mr. George Johnson, of Ottawa, for the purposes of the Colonial and Indian Exhibition, gives an excellent account of the progress and the resources of the great North American Colony. In presenting herself in the empire's metropolis, "she aims at showing that her progress in arts, manufactures, commerce, wealth, education, government, and general development are such as is rightly anticipated from every community sprung from the loins of Great Britain, or influenced directly by the spirit of British enterprise," and in writing this handbook the author's aim has been much the same for the great colony of which he is proud, but in praise of which he deals with facts and figures only, and makes them speak well without unfavourable comparison with the sister colonies in friendly rivalry at South Kensington. The book contains a great mass of Canadian information, including the general and statistic, on climate, geographical extent, history, constitution, population, land, geological survey, public works expenditure and income, trade, commerce, manufactures, agriculture, shipping, transport, cities, minerals, animal life and hunting grounds.

SEWERAGE OF LEICESTER.

THE sanitary difficulties of Leicester have been very great for a number of years. Leicester, as some of our readers are no doubt aware, was one of the first towns in the kingdom to adopt on a large scale the purification of the sewage by the lime process. The works established under the late Mr. Wicksteed in the year 1854 were considered to be models of their kind at the time. A company was established and large works were erected, but from a financial point of view the company was a failure, and the Corporation, under an agreement entered into with the company, took over the works, and have carried on the process ever since themselves. Nearly if not all the various processes which have come out from time to time for treating the sewage of towns chemically have been tried at Leicester, and in many instances a great deal of noise has been made in the leading papers of the country with reference to many of these trials. As the town has increased, however, so rapidly, *i.e.*, more than doubled its population since the works were established, so have the difficulties increased of sufficiently purifying the sewage to prevent any nuisance arising to the river.

As far back as 1870 Mr. Latham was called in to report upon the subject, and he recommended an irrigation scheme; but for some reason or other nothing was done. Then in 1873 the Council offered premiums of 200 guineas and 100 guineas for the best designs for dealing with the case. Mr. Everard, C.E., of Leicester, received the first premium, and Mr. Gant, of Swansea and Nottingham, the second, for the best out of seven designs sent in at the time, and the Council were disposed to undertake at that time the carrying out of Mr. Everard's scheme; but the Local Government Board's inspector, whose opinion upon the occasion of his holding an inquiry on another subject was asked, gave an unfavourable one upon it, and nothing was done. Two or three years later the late borough surveyor propounded a scheme differing from any of those previously proposed, and Sir J. Bazalgette was called in to report thereon. Sir Joseph Bazalgette practically adopted the scheme, and was prepared to support it. The cost was estimated at £300,000, including the purchase of about 700 acres of land in the valley of the Soar. This sum, however, did not do more than provide for one intercepting sewer in continuation of the existing main sewer in the town, and did not provide for any improvement in the town itself.

The Council were very favourable to the scheme, and were in 1877 prepared to go to Parliament for powers to carry it out; but when it was found that it was not as it was supposed to be, a gravitating free outfall, but that a portion of sewage had to be pumped—although only a few feet—difficulties arose and action was taken. The question has necessarily cropped up from time to time as the difficulties kept increasing. In the meantime also fresh suburbs have sprung up just outside the existing borough, which have created nuisances on the borders thereof, necessitating action on the part of the Council to protect themselves from these suburbs, although for some time it has been considered and discussed in the Council that the best way of dealing with these would be by including them within the new borough boundary, and for some years back a committee has been sitting to consider this question. In connection therewith a drainage scheme was prepared to embrace the whole district by the present borough surveyor, Mr. Jos. Gordon, M. Inst. C.E., but as the committee did not lodge any Bill in Parliament, and the nuisances arising from the suburbs had become so great, action had to be taken against one of them, resulting in an inquiry before the Local Government Board's inspector, in June, 1884, and the district referred to, viz., that of Clarendon Park and Knighton, propounded a drainage scheme of their own, and got the sanction of the Local Government Board to carrying out of the same. This action, however, on the part of the Corporation brought about a retaliation on the part of the other suburbs proposed to be taken into the extended borough, and the Belgrave Local Board, supported by landowners and others lower down the river, lodged a complaint with the Local Government Board against the pollution of the river by the Leicester authorities. This led to an inquiry in September, 1884, ending in the Corporation of Leicester being considered at fault, and required to take some immediate steps of a radical character to remedy the nuisance complained of. The borough surveyor was then instructed to report upon the whole subject, and he presented to the Highway Committee of the Council a report in November, 1884, dealing with it in a variety of ways, giving at the same time an estimate of the cost of each scheme, ranging from £116,000 to £229,000 exclusive of purchase of land, but in all these schemes he provided for a large measure of improvement of the sewers of the town as now existing beyond what was contemplated in Sir J. Bazalgette's scheme.

These schemes were all very much debated in the committee having charge of the work, and were finally reduced to two, upon which the surveyor, in March, 1885, was requested to more especially report, and ultimately a Local Government Inspector was asked to look over these two schemes, and to give his opinion. He gave his opinion in favour of what is now known as the Beaumont Leys scheme. The Council therefore entered into preliminary arrangements for the purchase of 100 acres of land, at the price of £13,000, of the Beaumont Leys Estate, and for leasing the remainder of it, viz., 1275 acres at the price of £2 5s. per acre per annum for thirty years, making altogether 1375 acres. This agreement was duly approved on the 9th February this year. The sewage will therefore be elevated from the new pumping station on to the highest part of this land, a direct height of 162ft., the total lift, including friction, being 173ft. The length of the rising mains is about 1½ miles. Mr. Gordon estimates the cost of new pumping station, engines, and rising mains, and laying out of the land, at £100,000, and this work has been ordered to be proceeded with at once. In connection herewith, however, he has been of opinion that the whole question of the improvement of the town sewers themselves should also be dealt with, inasmuch as the adoption of any new system of sewerage would be likely to influence the position of the pumping station, and he designed a new system of main trunk sewers at an estimated cost of £132,600, which was laid before the Highway Committee in January last. A further special meeting was called to discuss the question, and it was finally recommended to the Council for adoption.

On the 25th of May the report of the Highway Committee was presented, giving details of the cost in sections, and recommending its adoption. Powers also were asked at the same time for the preparation of the details of the new pumping station and sewage disposal scheme, and for the necessary borrowing powers to be applied for to the Local Government Board. The Council, after a lengthy discussion, referred the question of the town sewers to a committee of the whole Council. That committee, after hearing the views of the surveyor fully set forth, and discussing the whole subject very fully at two special meetings, adopted the scheme in its entirety for recommendation to the Council.

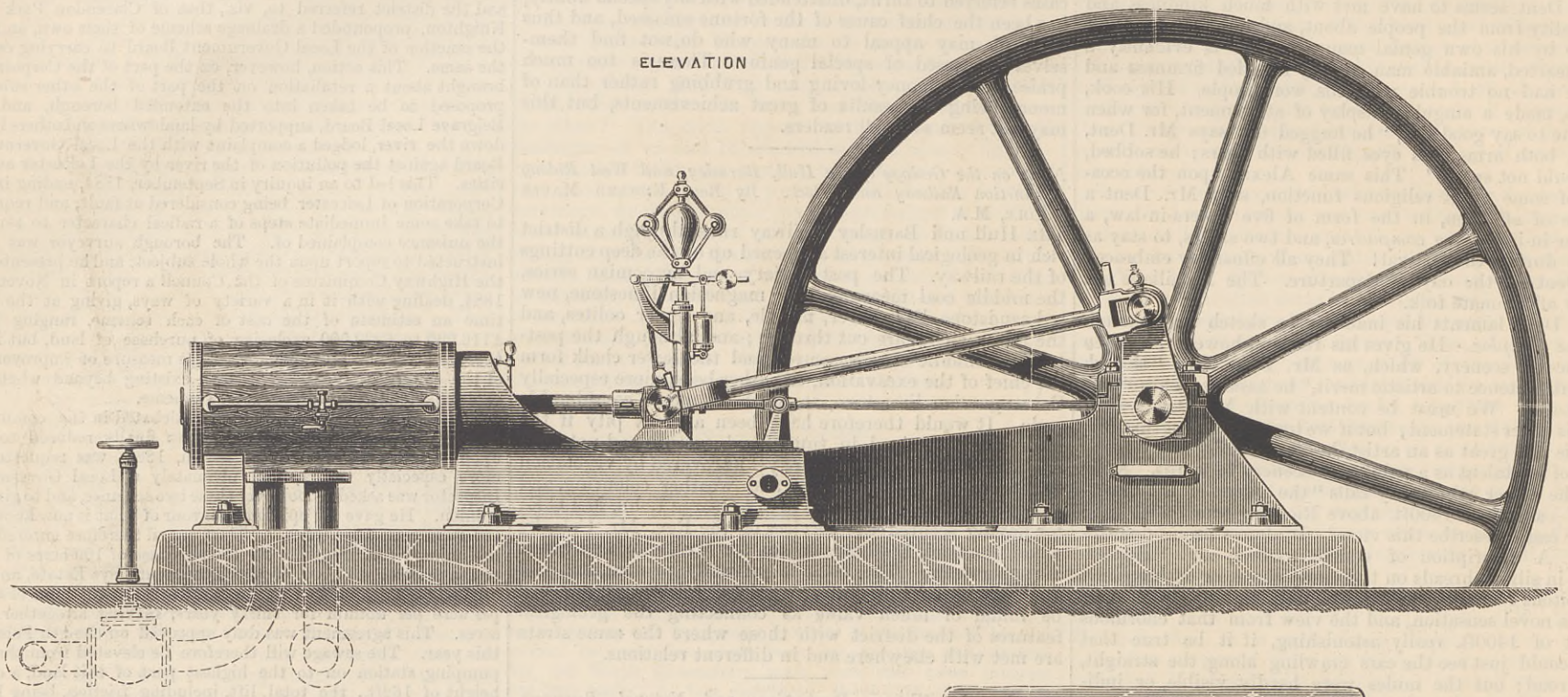
At the quarterly meeting of the Council on the 29th of June last, this recommendation was confirmed almost unanimously, there being only one dissentient. Under these schemes it is proposed to carry out nearly sixteen miles of main trunk and outfall sewers, there being a free outfall for each side of the river for storm waters to a point in the river about three miles below Leicester, and just below the village of Thurmaston, which will discharge all storm waters from the area at present built upon within the borough up to a rainfall of 2in. in twenty-four hours, so that other storm overflows provided within the precincts of the borough for more extensive rainfalls than these will only come into operation in exceptional cases. The present average daily sewage flow in dry weather is from eight to eight and a-half million gallons. This for a population of 132,000 is very largely in excess of the sewage proper, and as it is not desirable to pump any more of the subsoil water finding its way into the sewers than can be avoided, to so great a height as 173ft., on to a clay subsoil, it is expected by the execution of the new trunk sewers and the abandonment of the existing low-level main sewer, to be laid at a higher level, that a very large proportion of this subsoil water—from two to three million gallons, probably, per day—will be got rid of.

The total expenditure involved in these two schemes—£232,600—is undoubtedly very large, but the inadequacy of the present sewers of the borough, and the difficulty of effecting any improvement in the river by present arrangements, fully justifies such an outlay, as it is confidently expected by the Council, on the advice of the surveyor, that the periodical flooding of the cellars of the town will be completely remedied by the new main trunk sewers, and the river restored to its original state of purity by the abstraction of the sewage from it. The largest sewers are 7ft. 6in. by 6ft. 6in., 6ft. 3in. by 4ft. 2in., 6ft. by 4ft., 5ft. 3in. by 3ft. 6in., down to 2ft. 3in. by 1ft. 6in., egg-shaped, with gradients ranging from 1 in 150 to 1 in 1700 within the borough, and for storm sewers beyond the borough, 2ft. per mile and 1 in 3000. The works are to be proceeded with as soon as ever the preliminary steps have been gone through with the Local Government Board.

In connection with the extension of the borough, already partly alluded to, and in consequence of other suburbs having prepared schemes of their own, and applied to the Local Government Board for sanction to carry them out, it may be remarked that it was thought necessary to hurry forward the scheme for the inclusion of these suburbs by going to Parliament. The further expenditure involved beyond this now resolved upon by the Council, to include the suburbs referred to, is £45,000, and the whole of the works which have now been resolved upon are so designed and laid out that they contemplate the taking in of these outlying districts, notwithstanding that after a thirteen days' fight in Parliament in April this year, the Leicester Corporation scheme was lost for the present. It can, however, it is thought, only be a question of time; and it would have been folly to have ignored these districts in the designing of any scheme for Leicester; and in fact, by the report sent you, it has already been decided to confirm an agreement entered into with one of these districts, which proposed to spend £17,000 on its own account, to take its sewage into the borough. The Council have spent something like a quarter of a million of money on flood prevention works, and have still £50,000 to spend on this account; so that whatever its alleged faults, it is a very spirited Council with regard to public works.

EDINBURGH EXHIBITION—HORIZONTAL ENGINE, WITH AUTOMATIC CUT-OFF.

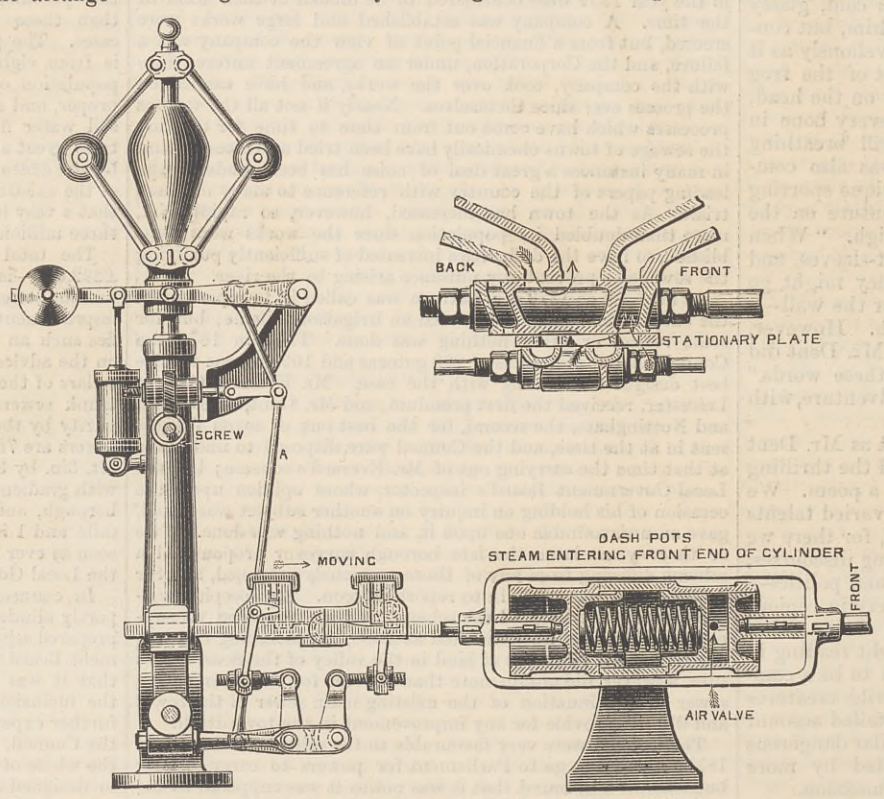
MESSRS. D. STEWART AND CO., GLASGOW, ENGINEERS.



THE EDINBURGH INTERNATIONAL EXHIBITION.

No. VI.

The horizontal engine exhibited by Messrs. D. Stewart and Co., Glasgow, and already briefly alluded to in our general survey, is intended chiefly to show the arrangements adopted by this firm, for regulating speed in quick running engines for places where a steady driving is much required, such as spinning mills and weaving sheds. The arrangement, it may be stated, is the same for single-cylinder engines as for the high-pressure cylinder of compound engines. In the engine exhibited the cylinder is 19in. in diameter, and the stroke is 42in. It is fitted with Dobson's cut-off gear—see the annexed engravings. The engine runs at 70 revolutions per minute, the estimated horse-power being 150 indicated. The fly-wheel is 14ft. diameter and 17in. width of rim. The valves are flat, and easily adjusted, and can be regulated so that compression and exhaust may take place at the points found necessary for smooth and economical working of the engines, while at the same time the lead remains constant, and the cut-off is regulated automatically from 0 to ¾ stroke, the speed varying for a few seconds only after a change of load has taken place. The steel catch-pieces work in guides, which compel them to rise and fall vertically, so as to insure perfect and uniform bearing surfaces. By this means, with constant lubrication, it is found that greater endurance is obtained than is possible with one catch moving in the arc of a circle when disengaging the other. The latter arrangement, bearing only on a line, causes the catching edges to be rapidly worn and rounded, thereby affecting the distribution of steam. With Messrs. Stewart's arrangement, engines have, we are informed, worked in several instances three years without readjustment of the steel catch-pieces. The main slide-valve serves simply to regulate the exhaust and compresssion, the admission and cut-off being regulated by a cut-off plate acting upon a stationary plate on the back of the main valve. When the cut-off plate or valve is in the central position, both ports are closed, and when the cams release the catch-pieces, the cut-off valve is always brought back to its central position by means of a double-action dashpot. The governor acts directly upon the cut-off motion. At the same time, it acts indirectly by means of a sensitive friction clutch, which, immediately any slight variation takes place in the speed of the engine, puts a small shaft in motion which produces a temporary shortening or lengthening of the connection between governor and cut-off motion by means of the toggle-jointed rod A, below. With regard to economy resulting from this arrangement



DOBSON'S CUT-OFF GEAR ON STEWART'S ENGINE.

Messrs. Stewart and Co. have given us the following figures from a compound coupled engine, designed to indicate 500-horse power, and running at 55 revolutions, the cylinders being 22in. and 38in. by 54in. stroke. The steam was supplied by two Lancashire steel boilers of 80 lb. working pressure, and fitted with an economiser:—

Duration of experiment	73 hours.
Average indicated horse-power	376 H.P.
Average boiler pressure	76 lb.
Total coal burnt	49,568 lb.
Ashes ... ... 11·3 per cent., or	5590 lb.
Feed-water used	461,183 lb.

This, it will be seen, gives a consumption of coal per hour of 1·806 lb. per indicated horse-power, or, if ashes be deducted, of 1·602 lb. The consumption of feed-water per indicated horse-power per hour is 16·78 lb., and this includes all steam used in jackets, &c., and for donkey pump for feed and filling cistern. The coal, it may be added, was Ansin dross—French—and the quantity above stated includes all required for banking fires at night and getting up steam in the morning. These figures, as supplied by Messrs. Stewart and Co., show a very low steam consumption, and afford another of many recent proofs of the decreasing steam consumption effected by most of the makers of English engines.

In the machinery in motion section, Mr. Thomas Swan, of Jarrow-on-Tyne, shows a working model of the new "Universal" valve gear patented by him. The situation chosen for the exhibit is somewhat unfavourable to ease and accuracy of working, as the model is chiefly of wood, and the vapour of the machinery court affects the settings and general movements of the parts. This, in fairness to the inventor, should be taken account of by anyone closely examining the model. The exhibit, however, illustrates the principle of the gear in a very intelligible manner. Illustrated circulars, prepared by the patentee for distribution, show the gear applied in a great variety of ways to engines of land, marine, and locomotive kinds, fully establishing its claims to the title of the "Universal" valve gear. The accompanying sketches—Figs. 1, 2, 3, 4, 5, and 6—illustrate several of these applications. From them it will be gathered that the gear may be fitted to work in any position from one excentric, or it can work from the main connecting rod or crank. The motion of the valve spindle is the resultant of two motions—one giving the travel necessary for the opening and shutting of the ports, the other an amount equal to twice the lap. Both motions are got from one excentric, its circular motion being broken up, as it were, into two linear components at right angles. By means of one of these components a link, like that of the ordinary link motion, is oscillated round a point at or near its centre, while that point is itself moved by the other component in the same direction as the valve spindle. The motion of the link is transferred to the valve spindle by a connecting rod, whose link end can be moved to any

EDINBURGH EXHIBITION—SWAIN'S VALVE GEAR.

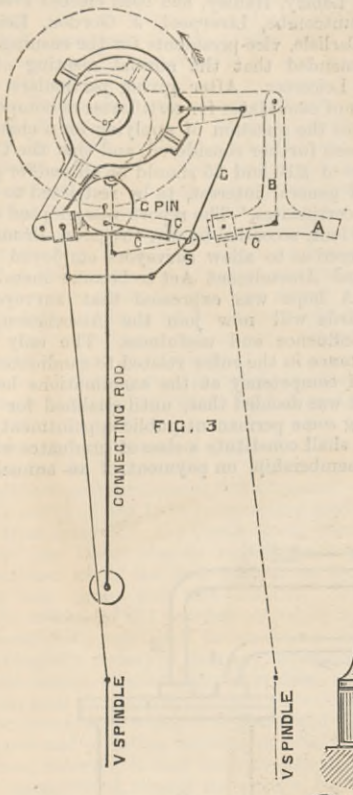


FIG. 3

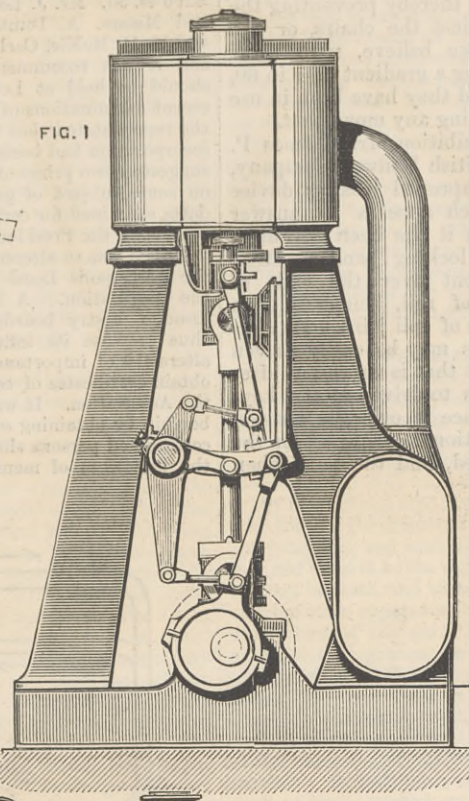


FIG. 1

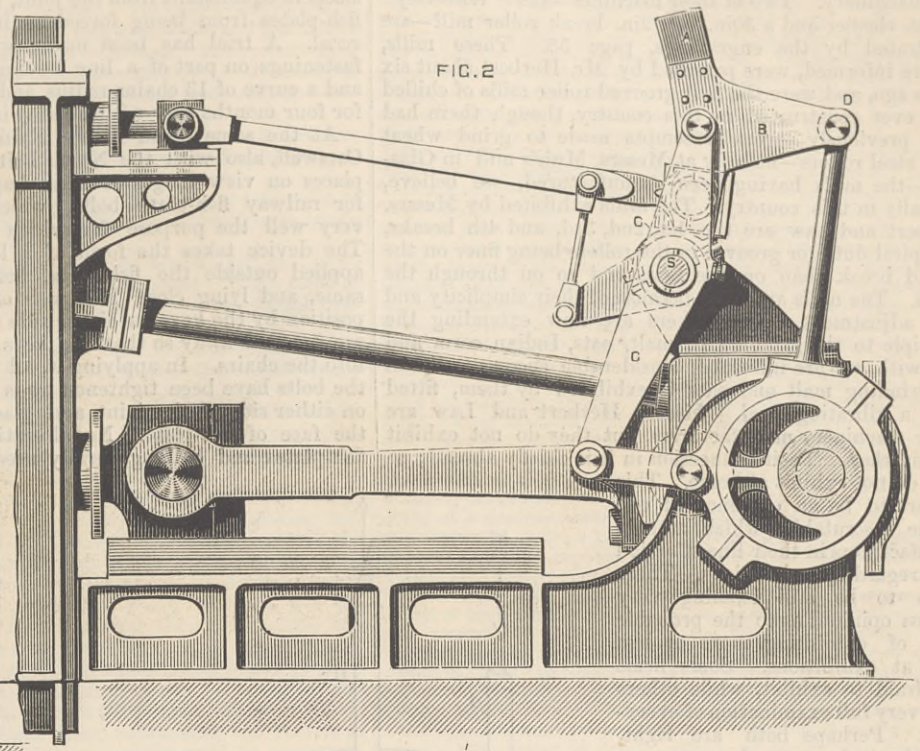


FIG. 2

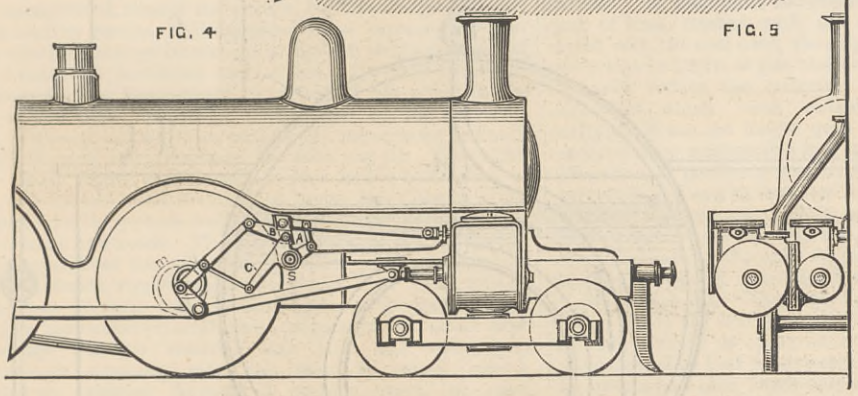


FIG. 4

FIG. 5

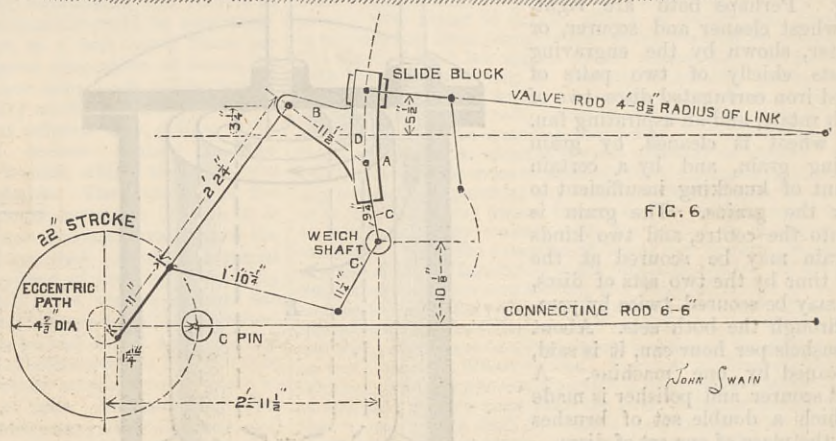
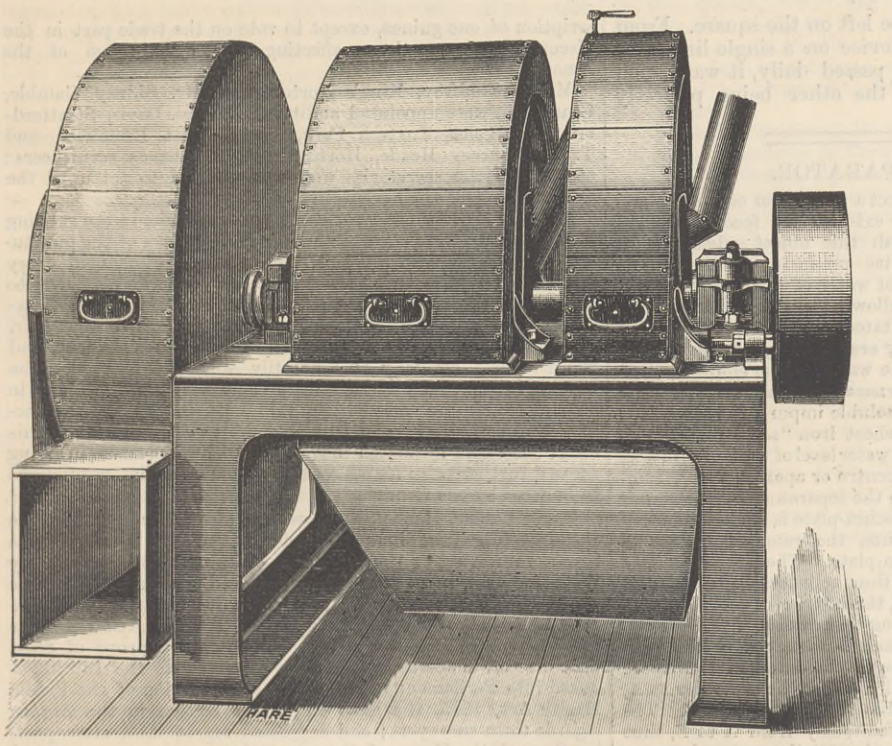
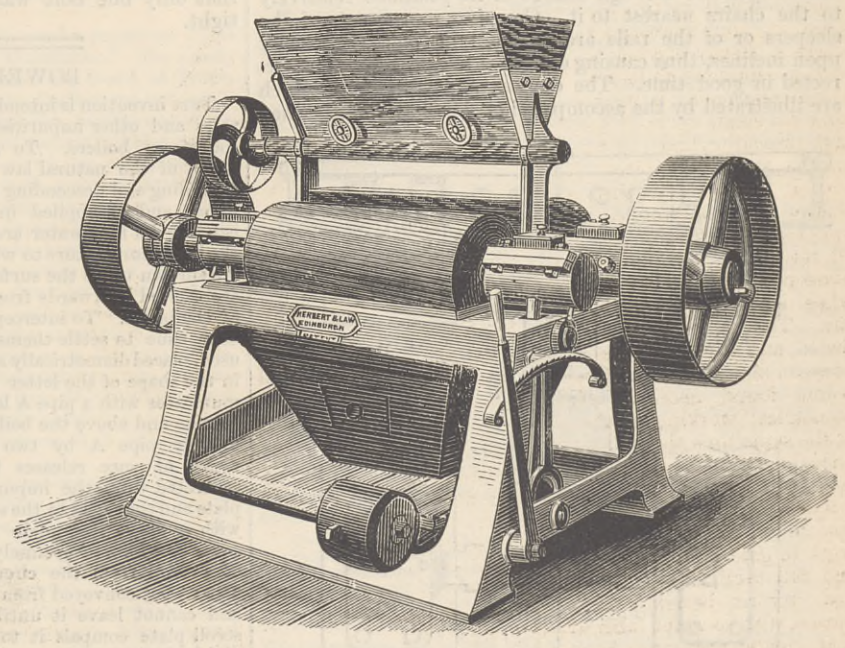


FIG. 6

position by a weigh-shaft, as in the common link motion. By moving the end of the connecting rod nearer the middle of the link an earlier cut-off may be obtained, one advantage claimed for the gear being, that the opening of the port always takes place at the same time, whatever degree of expansion may be used. Another important advantage which the gear appears to possess is that at the points of opening and cut-off the two component motions described are acting together in the one direction, consequently giving a quick opening and cut-off. On the other hand, when the port is full open the component motions are acting in opposite directions, and thus the valve is kept nearly stationary for some time. Stopping and reversing will be done as in ordinary link motion, by moving the end of the valve spindle connecting rod into the middle or opposite end of the link. Fig. 1 represents the valve gear applied to a marine engine with inverted cylinders, and valves at the end. The lever which gives lap and lead travel to the valve is freely centred on the reversing weigh-shaft, which has reversing levers, keyed on for operating the draw-bars in the usual manner. In this case, however, the excentric rod is placed so that its point of attachment with the link shall have travelled the lap and lead—same as lap-lever alluded to—when the crank is at the top and the bottom. By fixing an arm from the excentric rod end to the link and making the necessary adjustment of the excentric centre, the gear can be applied when the valves are on the side of the cylinders in place of on the end. Fig. 2 represents a horizontal engine as used in twin screw war vessels, with all the valves on the top. In Fig. 2, A is the reversing link, B the arm on the link, C the lap-lever, D the half lap + lead; S, the reversing weigh shaft, to which all the valve gears are attached, the shaft being carried on the top of the main bearing frames, so as to clear the connecting rods. The long arm of the lap-lever in this case is worked from the excentric strap. The parts are accessible while the engines are running, and there are no overhung bearings. The excentric centre is coincident with the crank, so that the principle may be used to work off the main crank or the connecting rod with modifications of the leverages. Fig. 3 is a diagram of gear applied to the same class of engines when the valves are at the side or when at the top, and with all the gear carried on the reversing weigh shaft S. Full lines show the gear for valves on the side, and dotted lines for valves on the top, and for convenience of description the crank pins for both are on the top dead centres. As shown in the full lines, the excentric is 90 deg. from the crank, the lap and lead being all got by the great angle at which the excentric rod works; in other words, when the excentric has made half a turn from the position shown, it will have advanced to the end of the link the lap + lead, where the rod is attached. The lap lever C is in the form of a bell crank, while that in the dotted lines is straight or nearly so. The dotted line excentric is exactly coincident with the crank, which must always be the case with this arrangement. Figs. 4, 5, and 6 illustrate the application of the gear to a compound locomotive having four cylinders abreast; the gear for outside cylinders being worked from an overhung crank with the same centre and travel as the two excentrics for inside cylinders. In this case as before, the lap-lever is arranged to travel the lap and lead when the piston is at the end; but in order to obtain this, extra travel is required at each end owing to the angular position of excentric rod to the side as shown, and because the centre of attachment of the lap lever link is nearer one end of the link than the other. The angular setting of the parts, &c., in this modification makes it more difficult to arrive at the exact proportion, and for this reason dimensions are given with Fig. 6 which will enable the motion to be tested by cardboard strips or other convenient means. In another arrangement for locomotives, the fulcrum rod F is made shorter to suit inside cylinders. The excentric rod itself will perform the functions of the lap-lever. The



HERBERT AND LAW'S DISC WHEAT CLEANER (See p. 56).

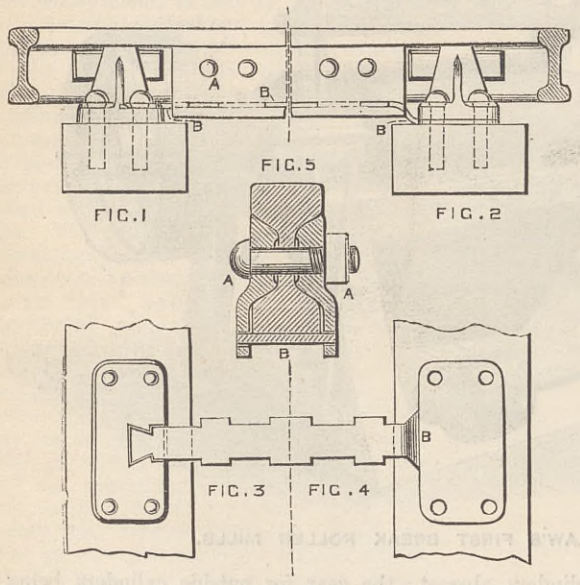


HERBERT AND LAW'S FIRST BREAK ROLLER MILLS.

link A oscillates in the fixed guide as will be understood. The excentric is coincident with the crank, and D equals ½ lap and lead.

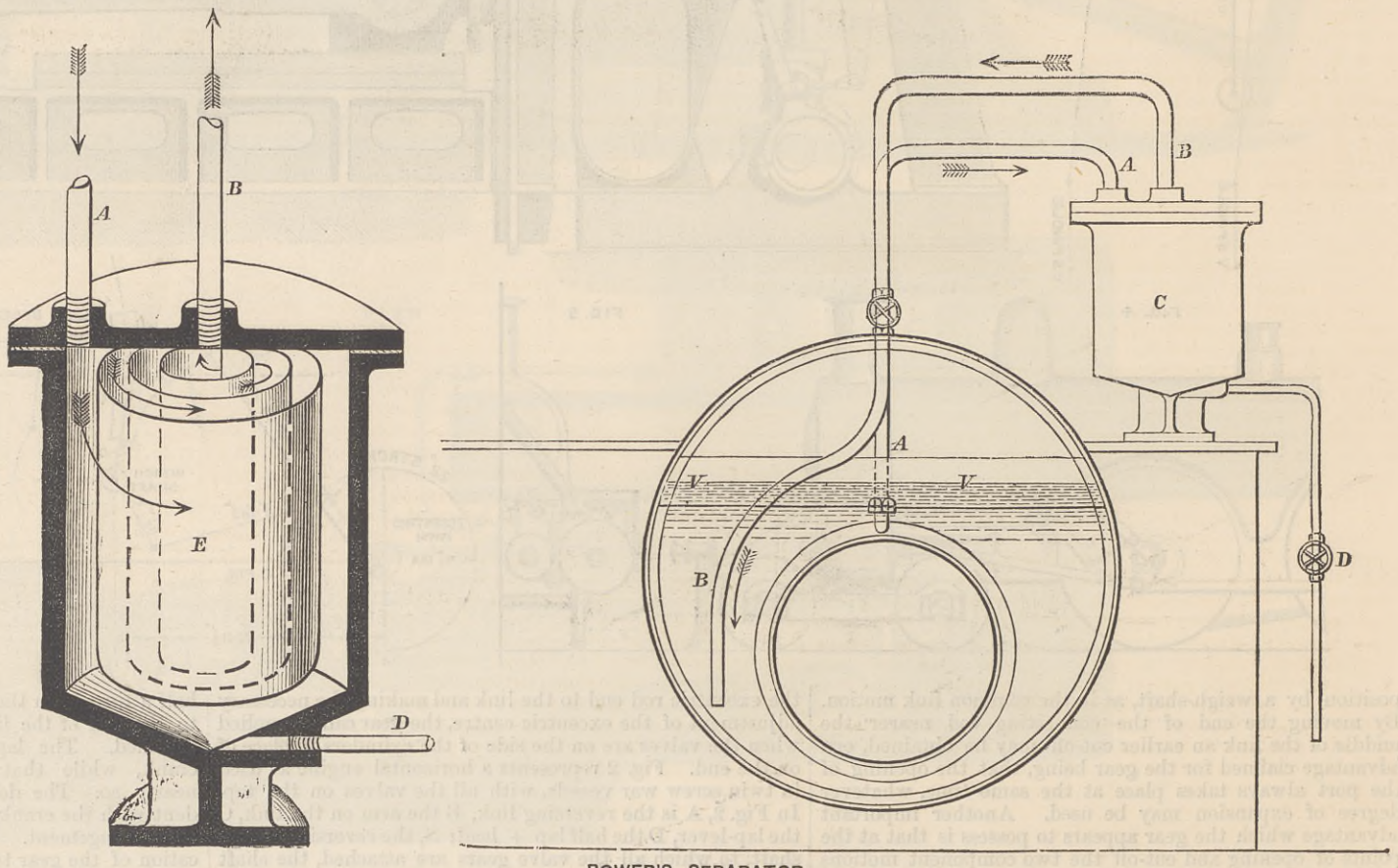
Messrs. Herbert and Law, of Edinburgh, exhibit milling machinery. Two of their machines—the "Waverley" wheat cleaner and a 30in. by 12in. break roller mill—are illustrated by the engravings, page 55. These mills, we are informed, were patented by Mr. Herbert about six years ago, and were the first grooved roller mills of chilled iron ever constructed in this country, though there had been previously several attempts made to grind wheat with steel rollers—notably at Messrs. Muir's mill in Glasgow—the mills having been manufactured, we believe, partially in this country. The mills exhibited by Messrs. Herbert and Law are the 1st, 2nd, 3rd, and 4th breaks, the spiral flutes or grooves in the rollers being finer on the second break than on the first, and so on through the series. The mills are liked because of their simplicity and easy adjustment. The makers are now extending the principle to the grinding of malt, oats, Indian corn, and rice, with, we are informed, considerable success. A mill for grinding malt and oats is exhibited by them, fitted with a vibrating feed. Messrs. Herbert and Law are paper machinery manufacturers, but they do not exhibit in this class. Their connection in it is chiefly abroad; so they do not exhibit at home. This appears to be an evidence of one of the inscrutables which actuate manufacturers in their line of action with regard to exhibitions. There seems to be still existing very various opinions as to the probable effect of exhibiting more or less fully at exhibitions. Some firms are afraid to exhibit, while others court very full examination of everything. Perhaps both are right. The wheat cleaner and scourer, or smutter, shown by the engraving consists chiefly of two pairs of chilled iron corrugated discs, two of which rotate, and an aspirating fan. The wheat is cleaned by grain rubbing grain, and by a certain amount of knocking insufficient to break the grains. The grain is fed into the centre, and two kinds of grain may be scoured at the same time by the two sets of discs, or it may be scoured twice by passing through the both sets. About 200 bushels per hour can, it is said, be cleaned by one machine. A wheat scourer and polisher is made in which a double set of brushes takes the place of one set of discs.

Within the boundary rail of the North British Railway Company's locomotive—which, with others in the Exhibition, we hope to illustrate in future numbers—Messrs. G. and J. Bell, with the company named, exhibit drawings and sample pieces of a permanent way patented by them. Whilst nothing has as yet been contrived that is as good as the well-known "fish-plate" joint connecting the ends of rails, there are situations in which this joint is liable to disarrangement through change in its positions relatively to the chairs nearest to it. Creeping movements of the sleepers or of the rails are apt to take place, especially upon inclines, thus causing danger if not prevented or corrected in good time. The devices of Messrs. Bell, which are illustrated by the accompanying sketches, are designed



with the view of preventing such disarrangement. Fig. 1 and 2 show an elevation of the rail and sleepers with alternative fish-plates, chairs, and keys. Figs. 3 and 4 show a plan of sleepers with chair soles and bottom strap, hereafter described, in place. Fig. 5 is a sectional view of rail, with fish-plates, bolts, and bottom strap shown. The fish-plates, it will be seen, are of the ordinary kind except that they are made deeper, and so as to extend a little below the rails, the lower parts being made with slots to receive lateral projections formed on the sides of bottom plate B, as shown on elevation and cross-section. This bottom plate extends from one chair to the other, and may either be made so as to dovetail into corresponding socket on top of chair sole, as shown in plan on Fig. 3, or it may have broad ends, shaped like the chairs, placed under them, and formed with holes so as to be secured by the spikes which fix down the chairs. For these fastenings several practical advantages are claimed. They relieve the strains brought on the fish-bolts by heavy loads, and allow the rails to expand and contract easily without impairing the strength of the joint. They also keep the sleepers equidistant from the joint, thereby preventing the fish-plates from being forced against the chairs, or *vice versâ*. A trial has been made, we believe, with these fastenings on part of a line having a gradient of 1 in 60, and a curve of 13 chains radius, and they have been in use for four months now without showing any movement.

At the same stand in the Exhibition Mr. Thomas P. Carswell, also with the North British Railway Company, places on view diagrams of an improved locking device for railway fish-plate bolts, which appears to answer very well the purpose for which it has been invented. The device takes the form of a locking band or strap applied outside the fish-plate, bent over the ends of same, and lying close into web of rail, being held in position by the keys on either side of rail joint. Its ends are tapered away so that the keys may be easily driven into the chairs. In applying it, all that is necessary after the bolts have been tightened up is to drive out the keys on either side of the joint, and place it over the nuts on the face of fish-plate. No alteration is required on the fish-plates and bolts generally used, and the nuts when screwed up do not require to be left on the square. From a nine months' trial with this device on a single line, over which seventy mineral trains passed daily, it was found that only one bolt was loose, the other being perfectly tight.



BOWER'S SEPARATOR.

BOWERS' SEPARATOR.

This invention is intended to effect a separation of the mineral salts and other impurities which exist in the feed-water used for steam boilers. To accomplish this object advantage is taken of the natural law of gravity producing motion in an ascending and descending column of water of different temperatures, and is applied in the following manner. Impurities existing in feed-water are precipitated on entering a boiler by the high temperature to which they are suddenly exposed; these are thrown up to the surface of the water by the ebullition, and are carried backwards from the furnace towards the cooler parts of the boiler. To intercept these soluble impurities before they have time to settle themselves, a sheet iron "scum-plate" V is used, placed diametrically across the water level of the boiler, inside, in the shape of the letter V, the centre or apex of which communicates with a pipe A leading to the separator C which stands outside and above the boiler; the scum-plate is simply attached to the pipe A by two back nuts, the removal of one of which at once releases the scum-plate. The surface water saturated with the impurities is thus collected by the scum-plate and conveyed to the separator, the interior of which is fitted with a sheet iron plate E, hanging downwards from the top cover to which it is closely fitted, and is arranged in the form of a scroll from the circumference to the centre of the vessel. The water conveyed from the boiler enters the separator at A, and cannot leave it until it reaches the centre pipe B. The scroll plate compels it to flow circuitously from A to B, thus giving the impurities ample time to deposit themselves between the folds of the scroll to the bottom of the separator. The water, on reaching the centre of the separator, returns to the boiler by the pipe B, freed from its impurities, to a level lower and cooler than the point from which it was taken, thus causing a natural circulation from the boiler to the separator and back again, the impurities being left in the separator, from which they are blown out from time to time by the blow-off cock attached to the bottom of the separator. Messrs. C. W. Allen and Co., 63, York-chambers, and 27, Brazenose-street, Manchester, are introducing this separator, which is at work at the Camden Steam Laundry, York-road, and at the brewery of Messrs. Burge and Co., Windsor.

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS.

The annual meeting of the Association of Municipal and Sanitary Engineers was held at Hanley, Staffordshire, on Thursday, Friday, and Saturday last. The retiring president, Mr. R. Vawser, of Manchester, took the chair at the opening of the proceedings on Thursday. The report of the Council stated that twenty-five new members had joined the Association last year, making the total number 250; and that there was a balance to its credit of £206 4s. 3d. Mr. J. Lobley, Hanley, had been elected President, and Messrs. A. Dunscombe, Liverpool, J. Gordon, Leicester, and H. U. McKie, Carlisle, vice-presidents for the ensuing year; and it was recommended that the annual meeting of 1887 should be held at Leicester. After giving particulars of the recent examinations of candidates for certificates of competency, the report stated that the question of applying for a charter of incorporation had been further considered, and that the Council suggested two prizes of £10 and £5 should be offered for papers on some subject of general interest, to be restricted to candidates examined for certificates. The report was adopted on the motion of the President, seconded by Mr. Cregreen, Bromley.

Rule 3 was so altered as to allow surveyors employed under the Metropolis Local Amendment Act to become members of the Association. A hope was expressed that surveyors to London vestry boards will now join the Association, and thus increase its influence and usefulness. The only other alteration of importance in the rules related to candidates who obtain certificates of competency at the examinations held by the Association. It was decided that, until qualified for membership by obtaining some permanent public appointment, such certificated persons shall constitute a class of graduates with all the privileges of membership, on payment of an annual subscription of one guinea, except to vote on the trade part in the discussion of questions affecting the constitution of the Association.

Mr. R. Godfrey, King's Norton, and Mr. Sidney Gamble, Grantham, were appointed auditors; Messrs. Davis, Stratford-on-Avon, Price, Toxteth Park, Ayres, West Bromwich, and T. De Courcey Meade, Hornsey, were chosen as scrutineers; and the district secretaries were re-appointed to act until the next meeting of their respective districts.

Mr. C. Jones, Ealing, proposed a vote of thanks to the retiring President, Mr. Vawser, of Manchester. He spoke of the punctuality and energy with which Mr. Vawser had discharged every duty, and observed that he had done everything in his power to advance the interests of the Association. Mr. Laws, Newcastle, seconded the proposition, and remarked that Mr. Vawser, although emphatically an Association President, had worked most cordially and heartily with the Council. The motion having been carried by acclamation, the President, in acknowledging the compliment, said he had also the satisfaction of knowing that he had at least endeavoured to do his duty. He then intimated that he should have pleasure in giving £5 as a further prize for essays by graduates, under regulations to be fixed by the Council.

Mr. J. Lobley, Hanley, the President elect, having taken the chair, delivered an inaugural address, in the course of his remarks referring to the voluntary examinations instituted by the Association in all branches of knowledge requisite for those who desired to become surveyors to sanitary authorities. He said the results of the first examination held showed that this had been a wise step, and would in the future prove of great benefit to all concerned. He then adverted to the Bill introduced into Parliament to amend the 150th section of the Public Health Act, 1875, the most important section in the Act as regards town surveyors; and expressed regret that, after passing through the House of Commons, the measure was wrecked by a side wind in the House of Lords. In approving of that Bill, the Council of the Association regarded solely the interests of the public, both ratepayers and owners of property, as the work of borough engineers and local board surveyors would be materially increased. The Council had succeeded in getting important additions to and modifications of the Bill, so that, although it was not all they desired, it will on the whole have been very advantageous. Respecting the clause tacked on, in the supposed interests of canal and railway companies for exempting them from contributing to the cost of private streets on the ground that they did not use them, and they were constructed for the convenience of other adjoining owners, the President said that it was astounding that those most likely to benefit by the proposed changes in the law should have wrecked the Bill by insisting on a clause which had not a reasonable chance of passing into law or of even getting through the House of Commons, except in a special Bill of exemptions. Mr. Lobley then, at considerable length, described the principal engineering works carried out at Hanley during the last fifteen years, and the various new buildings and works in progress. One remarkable feature he mentioned was the extraordinary extent to which

Hanley is being honeycombed by iron and coal workings. Ordnance beach marks are of no use at all until checked, and that must be done each time they are used. For instance, streets between the railway station and the Town Hall have from three to six feet lower level than when taken by the Ordnance surveyors. This subsidence caused gas, water, and sewer pipes and their branches to give way, and the roadways had consequently to be constantly broken up for repairs. This peculiarity had twice rendered it necessary, in 1883 and 1885, to raise the bridge over the canal in Bucknall-road, and it was expected it would have to be raised again next year. The gradient by which it was approached was so steep that the depth between the soffit of the bridge and the road surface had to be kept down to eighteen inches; and the bridge was so constructed that it can be divided in the middle, and one-half raised with the pavements complete, whilst the traffic is passing over the other half. The most costly part was not the raising of the bridge, but adjusting the road levels on each side, and each raising made the gradient worse. The retaining walls on each side of the road are built thick enough to allow for several such subsidences and upward extensions which will in the course of time be necessary.

A vote of thanks was accorded to the President for his address, on the proposition of Mr. White, Oxford, seconded by Mr. Coulthurst, Derby.

Mr. M. Ogle Tarbottom, M. Inst. C.E., F.G.S., consulting engineer to the Corporation of Nottingham, read a paper on "Recent Sewage Operations at Nottingham." One special feature was the valley of the Leen intercepting sewer—nearly six miles long—from Bulwell to the Castle Rock, from whence the river Beck to the Trent was an outfall sewer. This intercepting sewer crosses under the river Leen seven times, and under the railway four times, and cost £50,000. Provision was made along its course for the overflow of storm water into the Leen, as it occasionally amounted to two inches in depth in an hour. He incidentally remarked that any deposit of sewage induced by chemical action is practically worthless, and that the effluent water depends almost entirely upon the oxidising influence of the river or stream into which it is discharged for the conversion of its organic and polluting substances into inorganic compounds. Irrigation, however, it had been abundantly shown, will, under proper management, cleanse the sewage, fertilise the ground, and produce healthy results. All depended upon surrounding conditions whether a sewage farm could be made to yield a substantial profit or entail an inevitable annual loss. He then described the sewage farm at Nottingham, consisting of 640 acres, in the valley of the Trent, leased for sixty years by the Sewerage Board. Although not worth more than 40s. per acre for ordinary farming purposes, the price under the lease was £5. The outfall sewer, which begins at Colwick, is four and a-half miles in length, and for two miles is tunnelled under the Colwick Hills, and several double syphons had to be introduced to cross railways, streams, and roads. The larger portion of the sewage has to be pumped from the valley of the Leen to the gravitation outfall at Colwick, equivalent to a height of 21ft. This will be done by two 40-horse power beam engines with double-acting pumps, on the bucket principle, with large areas and small lifts. The sewage will be received into land and wells, and pass through straining pits, and then be raised into a vertical iron cylinder, forming a cushion valve, or open air vessel, where the natural head will be created in order to secure a due but variable discharge through the main into the outfall conduit. Having described the farm and the carriers for distributing the sewage, he said, accommodation is provided for about 100 cows in daily milk, for about forty horses —employed on the land—and for pigs and other animals, which will altogether consume a large proportion of the vegetable products of the farm. He incidentally spoke of manufacturing refuse and waste water, and urged that the former should be wholly removed and the latter decently cleansed by manufactures, otherwise heavy public expenditure was entailed, which was very unfairly distributed. A brewer, maltster, dyer, or bleacher, might at once multiply manyfold the volume of liquid to be dealt with at the outfall—a serious question for ratepayers, whether rich or poor. He also advocated the removal of storm water from the sewers whenever possible, and defined storm water as rainfall exceeding one quarter of an inch in twenty-four hours.

The paper gave rise to some discussion, which was opened by Mr. Gordon, Leicester, who urged that it was next to impossible to carry out rigidly the separate system of drainage, and that it was not possible to extract so large an amount as was commonly supposed. Mr. Tarbottom had not said anything about the pail system which was in use at Nottingham, but he thought it would be injudicious to have both in operation. He should also like to know whether 640 acres would be sufficient land for so large a town as Nottingham.

Mr. Vawser, Manchester, said, so far as he knew, there was nothing to prevent a manufacturer from turning manufacturing refuse into sewers, provided it did not create a nuisance, injure the sewers, or prevent the sewage being purified to advantage. Personally he did not think this could ever become a serious matter, because he thought riparian owners would step in and prevent the streams being practically dried up.

Mr. Ellice Clarke, Hove, and Mr. Fowler, Manchester, also made inquiries; and Mr. Tarbottom, in replying, said that the southern part of Nottingham was subject to floods, when the water rose in the Trent sometimes as much as 12ft. in two days, causing enormous damage to property. A water-level of the highest flood was fixed upon, below which no building in that district was allowed to be erected, and the result had been eminently satisfactory. The claims for compensation for easements had averaged from 15s. to 20s. per year where they had had to pass through private property. He was not an advocate of the Rochdale pan system of dealing with sewage, but had consistently denounced it. In Nottingham £100,000 had been spent on the system. He did not say that it was a failure; but if there was a severe frost or a strike of the workpeople, there would be an enormous public nuisance. The cost of the outfall sewer and the farm had been about £160,000; and about another £10,000 or £20,000 would cover remaining contingencies. As to the ventilation of summits of sewers by shafts, no difficulty had been experienced in getting the consent of owners of property to which they were fixed, and he did not think there would be such difficulty when persons were properly approached and the necessary explanations given. As to the effluent water, Dr. Franklin and Dr. Wanklyn had analysed it, and pronounced it better than the average Thames water supplied to London. He did not say it was so at all times of the day, or that it would always continue as pure, but the results had been extremely satisfactory.

Mr. E. B. Ellice-Clarke, County Surveyor of West Sussex, read a paper on "The Present Aspect of the Rural Road Question." He advocated the abolition of the distinction between disturnpiked roads, roads connecting large towns, and county or parish roads, and these all being repaired by a single authority—adopting the county, or division of a county, as a unit of area, and fixing the distinction between rural and urban districts at all towns above 10,000 inhabitants. As to the construction of roads, he condemned "hog backs," and said the proper fall of roads was one in twenty-four from the centre for flints, and one in thirty-six where granite was used. He urged that stones of different sizes should be used for repairing roads, and the harder the material the smaller should it be broken. The proportion of different sizes which should be used in making a road remained to be determined; but when different sizes were used no binding was required.

Mr. Hodgson, Loughborough, stated that recent changes, equalising the cost of work done, had led to the breaking-up of highway boards where established.

Mr. Vawser, Manchester, thought it would be preferable to enlarge the powers of existing authorities rather than to create new ones to deal with rural roads.

Mr. Fowler, Manchester, said that he found a fall of 1 in 30 from the centre of the road rather too great. When made as nearly level as possible, the traffic was evenly distributed over the surface.

Mr. Spinks, Dunkenfield, stated that the county authorities there would not contribute anything to the repair of footpaths by the side of disturnpiked roads.

The President made a few remarks, and Mr. Clarke briefly replied, and said the discussion had convinced him more than ever that the present authorities for repairing roads should be abolished, and that they should be consolidated.

Mr. R. P. Spice read a paper on the "Economic Production of Coal Gas." He described the ordinary method of making and purifying gas, and said it had been found profitable to break the coal and raise it to the retort by an endless chain elevator made of steel buckets, and then charge the retorts by West's charging and drawing apparatus. The chief point, however, was the purification of the gas. He condemned the modern lime and oxide of iron process because unreliable and a nuisance, and advocated what is known as Cooper's patent coal-liming process, which had now been in uninterrupted use for two years and a-half at Tunbridge Wells. There the process had never failed; and the character of the coal being ascertained, the results as to the reduction of the sulphur compounds could be accurately foretold. It had been ascertained as a fact that if three per cent. of lime, slacked with the same proportion of water, be mixed with the coal used, the sulphur compounds will be less by two grains in 100ft. of gas, and every additional half per cent. of lime will reduce the quantity of sulphur two grains. The impurities which once caused serious anxiety in the purifying house no longer gave trouble, whilst the coke was rendered more combustible and saleable. The nuisance of the old system of purifying was no longer excusable because it is now avoidable, and to continue it was absolutely wasteful to the extent of a penny per 1000ft. of gas sold. Another material aid to economy was Mr. Valon's system of heating retorts, by which one half of the coke formerly used was saved, and the most trying part of the stoker's work dispensed with altogether. In connection with Valon's furnace he had found that a pound of tar will do the same amount of effective work as between four and five pounds of coke; or in other words, a pennyworth of tar was equal to four pennyworth of coke. He mentioned that the system had been found very satisfactory at Folkestone, and had just been adopted at Boston, and he declared that not a single fact that he had stated in connection with this coal-liming system had ever been disputed.

Mr. Gordon, Leicester, said the subject was an important one, as corporations are becoming the owners of gas works in many towns.

Mr. Vawser, Manchester, expressed surprise that a system which had so many decided advantages was not generally adopted.

Mr. Tarbottom, Nottingham, said that the non-adoption of the system, with the advantages of which he was familiar, was distinctly the result of prejudice. Mr. Spice, in reply to a vote of thanks, said his misfortune had been that he had never been contradicted, or he could, metaphorically, have pulverised his antagonist and demonstrated the superiority of the system.

Mr. Jas. N. Shoolbred, M. Inst. C.E., read a paper on "The Supply of Electricity in Towns as an Illuminant." He briefly reviewed the law on the subject, and said the Board of Trade, in the Bill which they introduced into Parliament and withdrew, had practically acknowledged that the twenty-one years' exemption from compulsory purchase of electric lighting undertakings by local authorities was too short, by extending the period then to forty-two years. No such provision existed in France, Germany, Austria, or any other country, and it was that absurd provision that prevented capital being invested in electric lighting in England as freely as in America.

Mr. Bates, agent for the consulting agents of the Thomson-Houston system of electric lighting, described that method, spoke of the success attained with it both in America and at several places in England, and expressed a conviction that next session the Board of Trade would introduce a Bill into Parliament for exempting electric-lighting undertakings from compulsory purchase by local authorities for a term of forty-two years. When that was done he believed electric lighting for towns would make as rapid satisfactory progress as it had done in America.

The President said the Thomson-Houston system had been tried experimentally in Hanley for three weeks, and though the dynamo was driven by the engine of the steam roller, the light was remarkably steady and never flickered.

The remaining papers were one by Mr. Wm. Dent, describing the refuse destructor in use at Nelson, near Marston, Lancashire; and one on "Road Watering," Mr. W. Santo Crimp, Assoc. M. Inst. C.E., F.G.S., who described the various systems adopted, and gave statistics of the quantity of water used per square yard and the cost of street watering in various towns.

During the meeting of the Association, Messrs. Minton's china works were visited, by invitation of the Mayor of Hanley, and also the earthenware manufactory of Messrs. Taylor and Tunnicliffe. The public buildings were also inspected, the bridge referred to in the President's paper and the sewage works; and on Thursday night the annual dinner took place at the North Staffordshire Hotel, Stoke, when Mr. Lobley presided, and Mr. Woodall, M.P. for Hanley, was present, and responded for the House of Commons.

LABOUR LEGISLATION IN THE UNITED STATES.

THE National Labour Bureau has to its late report an appendix giving a synopsis of labour legislation in the United States. It appears that few States are exempt from some sort of legislation bearing upon labour in its relation to the peculiar industries with which each State is identified. The laws affecting labour in the Eastern States are those chiefly applicable to employment in manufacturing industries, while those in the Middle and Western States are germane to the mining interests. Eight hours as a legal day's labour are recognised in the laws of several of the States, viz., California, Connecticut, Illinois, Indiana, New York, and Wisconsin. In California it is so, in the absence of a special contract. The same is stated to be true in constituting a lawful day's work in Connecticut, as given in the general statutes of 1875, though enacted as far back as 1867. In Illinois eight hours are limited to mechanical employments, and exception is made for work on farms and for service by the day, week or month. The law in Indiana is applicable only to children under twelve years of age, and it is made obligatory. All employment is prohibited to children under this age in the business of manufacturing iron, steel, metals, machinery or tobacco. By the revised statutes of 1870, the State of New York provides eight hours for a day's work for mechanics and working men, excepting those engaged in farm and domestic labour. This law applies to those employed by the State and municipalities. The Wisconsin statutes limit the employment of children under eighteen years of age, and women to eight hours a day, if engaged in mechanical or manufacturing business. There are nine States which have enacted laws requiring the provision of seats for females employed in manufacturing, mechanical or mercantile establishments, when not actively attending to their duties. This is among the Acts of 1882, of the State of Massachusetts. The purpose is the preservation of the health of the individual. The other States having laws of this kind are Colorado, Maryland, Michigan, Missouri, Nebraska, New Jersey, New York, and Ohio. They have all been enacted within a very few years, that of Ohio being among the Acts of 1885. It may not be generally known that there are several States with laws making it a punishable offence for any person to use force, threats, and intimidation for the purpose of preventing or inducing another from working. Such is among the recent laws of Dakota, which further makes a person guilty of a misdemeanour to intimidate an employer from hiring any person, or to force him to alter his way of doing business, or to compel him to increase or decrease his labouring force. Very similar are the laws of Oregon, Indiana, Massachusetts, and Rhode Island. The laws of New Hampshire have much of the same effect, as found in the Acts of 1885 to aid and protect the labouring and manufacturing interests of the State. The reading is as follows: "No person shall address to any person passing along any street to, from, or about his lawful business or occupation, any offensive, derisive, or annoying word or words, or call such person by any derisive or offensive name; nor shall any person make any noise or exclamation in the presence or hearing of such person so passing with intent to deride, offend, or annoy such person, or to prevent him from pursuing his lawful business or occupation." The Rhode Island law applies to any person, alone, or in concert with others, attempting to prevent, or actually preventing by threats, &c., the free action of another person from pursuing an employment. The penalty attached to this is a fine up to 100 dols., or imprisonment not exceeding ninety days. We should have added Texas to this list, in which it is made unlawful for persons "to the number of three or more to assemble for the purpose of preventing any person from pursuing any labour, occupation, or employment, or to intimidate any person from following his daily avocation, or to interfere in any manner with the labour or employment of another." With the exception of Texas and Georgia no mention is made of labour legislation in the Southern States. In the latter State there is a provision making the hours of labour to be from sunrise to sunset for persons under twenty-one years of age in all manufacturing establishments and machine shops. The ten hour law fixing the length of a day's labour appears on the statute books, in some form, of fifteen States. The Acts of Massachusetts are familiar, forbidding the employment of minors under eighteen years of age, and women more than ten hours a day, or so apportioned that a week's work shall not exceed sixty hours. This applies to mechanical and manufacturing establishments. The general laws of New Hampshire are referred to as providing that no person shall be compelled to work more than ten hours a day, in the absence of a contract to the contrary. Three States—Connecticut, Massachusetts, and New Jersey—have laws relating to notices by employés of intention to leave employment. They provide that when employers require such a notice from their employés, under a penalty of forfeiture of wages, they shall be liable to a like penalty if an employé be discharged without a similar notice, except for incapacity or misconduct, or in case of a general suspension of labour by the employer. Laws affecting the labourer are pretty well distributed throughout the country, except in the Southern States.—*Boston Journal of Commerce.*

THE NEW BRIDGE AT BATTERSEA.

IN our last impression we published a two-page engraving of a general view and some of the details of the new bridge about to be constructed over the Thames at Battersea, from the designs of Sir Joseph Bazalgette, M.I.C.E. With this impression we publish two more pages of engravings, illustrative of details—that on page 50 of the ironwork of the superstructure, and that on page 46 of the masonry work of the piers and abutments. In another impression we shall publish further engravings and a full description of the structure.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—G. J. Week, staff engineer, to the Edinburgh; W. H. T. Bills, chief engineer, to the Australia; J. Richardson and F. Hore, assistant engineers, to the Asia, as supernumeraries.

THE DEEPEST BORING.—The deepest bore hole in the world is at Schladebach, near Kotschau Station, on the railway between Corbetha and Leipzig, and has been undertaken by the Prussian Government in search for coal. The apparatus used is a diamond drill, down the hollow shaft of which water is forced, rising again to the surface outside the shaft of the drill and inside the tube in which the drill works. By this method cores of about 50ft. in length have been obtained. The average length bored in twenty-four hours is from 20ft. to 33ft., but under favourable circumstances as much as 180ft. has been bored in that time. Other deep holes are as follows:—

Domnitz, near Wettin	3287ft.
Probat-Jesar, Mecklenburg	3957ft.
Sperenberg, near Zossen	4173ft.
Unseberg, near Stassfurt	4242ft.
Lieth-Elmshorn, Holstein	4390ft.
Schladebach	4515ft.

The dimensions of the bore hole at Schladebach are as follows:—

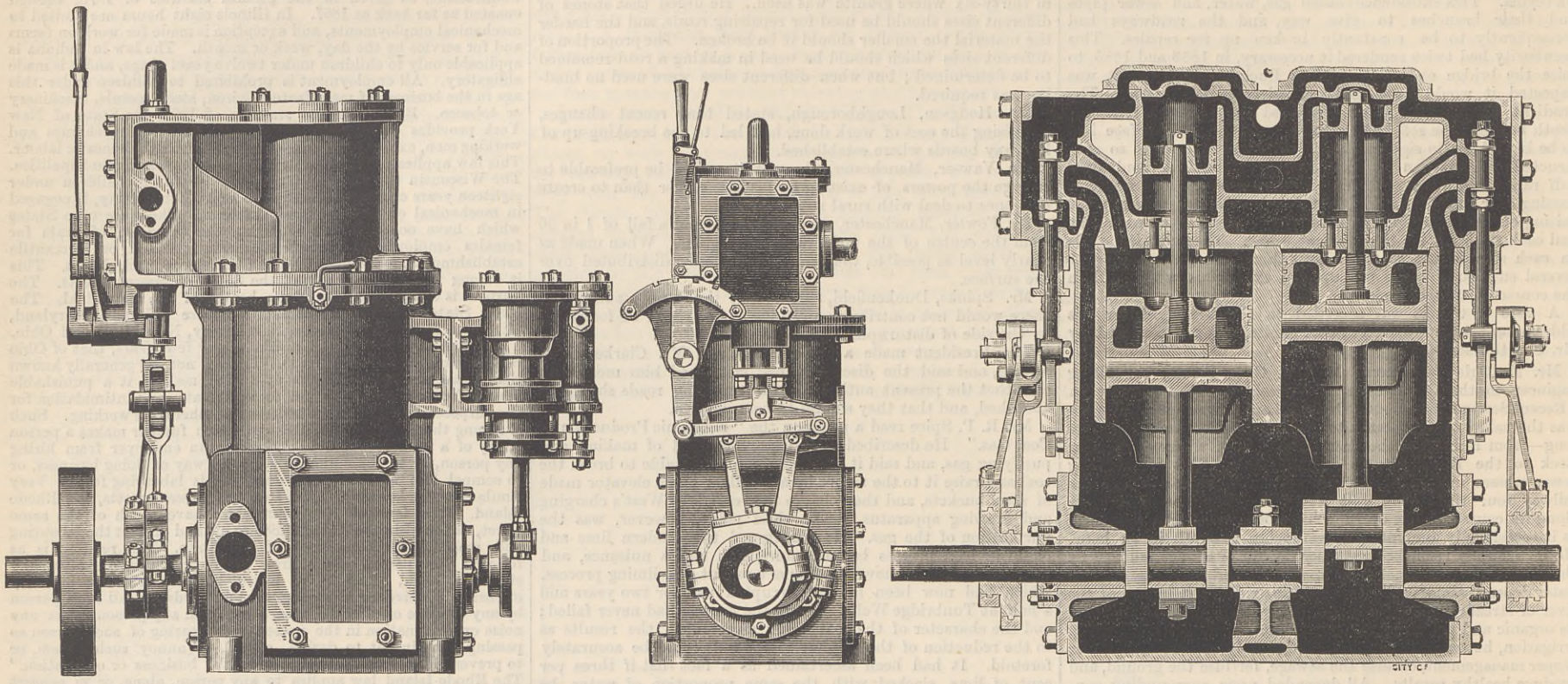
Depths from surface.	Each size bore, feet.	Diameter, inches.
189·6	189·6	11·0
605·7	416·1	9·0
661·8	56·1	7·3
1906·5	1244·7	4·7
2259·8	353·3	3·6
3543·4	1283·6	2·8
4069·9	526·5	1·97
4514·6	444·7	1·88

The various strata passed through are as follows:—

Soil and sand, about	16ft.
Clay	66ft.
Sandstone (Bunter)	459ft.
Anhydrite	59ft.
Brine spring	—
Magnesian limestone (Zechstein)	144ft.
Gypsum	36ft.
Anhydrite	295ft.
Marl-slate (Kupfersheifer)	3ft.
Sandstone (Rothliegendes)	3435ft.

The bore hole, which in January, 1885, had reached a depth of 4560ft., was commenced in June, 1880, but left after a year's work, recommenced at the end of 1882, and is still progressing. The cost up to January, 1885, was about 25,000 dols.

BUTLER'S COMPOUND LAUNCH ENGINES.

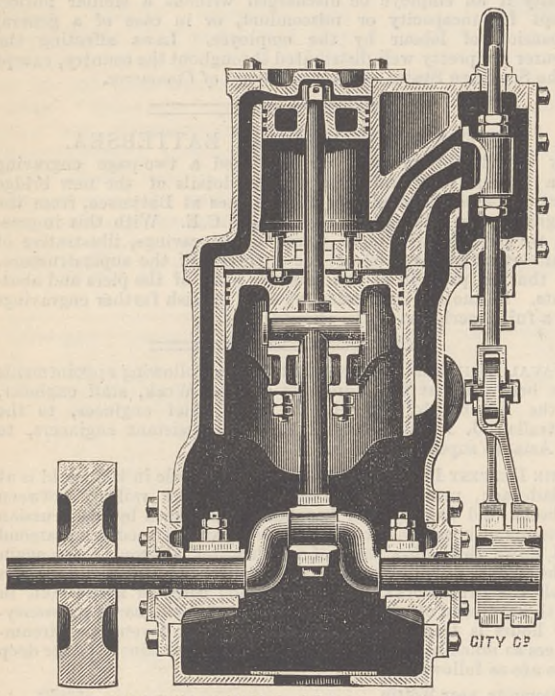


BUTLER'S PATENT COMPOUND LAUNCH ENGINES.

The principal feature of the engine which we illustrate above, and which is made by the Butler's Patents Engineering Company, Cardiff, is that compounding is effected without any addition to the number of its parts above those of an ordinary high-pressure engine, and no extra height or space is occupied for the same power. The design is a form of tandem compound engine, having two cylinders, the high-pressure cylinder being above the low-pressure. Each cylinder is single-acting, and the first admission of steam to the under side of the high-pressure piston lifts the crank to its top centre. The valve then opens communication direct with the top side of the low-pressure piston, and thus the crank is forced to its lower centre.

In this way the high-pressure steam is continually acting on the up strokes, while the low-pressure is acting on the down strokes, and the steam exhausting out of the high-pressure direct into the low-pressure, no receiver is required.

The valve is of the ordinary D shape, and its surface and friction are not more than those of the valve of an ordinary engine of the same power. It has a long lap on the lower side to cover up the final exhaust during its upward motion. The valve is so proportioned that the usual lead, cut off, early



BUTLER'S SINGLE CRANK ENGINE.

exhaust, and cushioning are provided for in both cylinders as in an ordinary engine. It will be seen that during the time the high-pressure cylinder is open to steam the low-pressure cylinder is open to final exhaust. The top side of the high-pressure piston is continually open to exhaust.

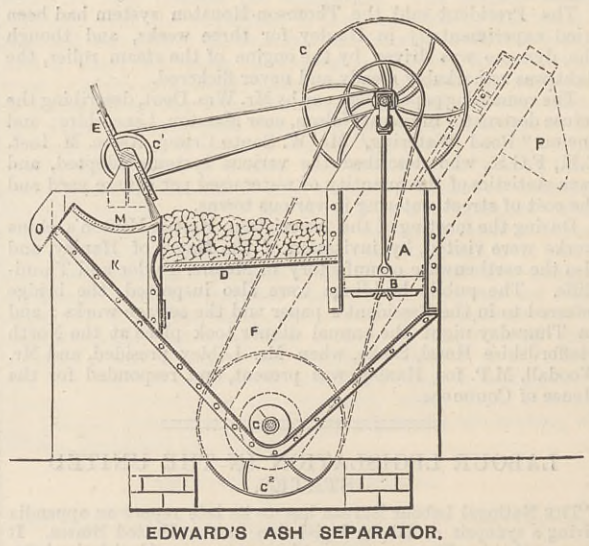
The working parts are covered in; the crank works in a bath of oil and water; the engine is perfectly clean in working, and the oil does not find its way into the bilge. Extra bearing surface is provided, so as to avoid the necessity of taking up brasses frequently. The covering in of the working parts does not interfere with their adjustment or inspection, as the covers can be removed in a few moments. Butler's patent metallic packing is used at the stuffing box between the two cylinders. There are two over-lapping brass blocks, kept tight against the piston-rod by springs, so as to take up the wear without attention.

The engines are made of various sizes, from 14½ indicated horse-power, with cylinders 5in. and 10in. by 5½in., to 72 indicated horse-power, with cylinders 10in. and 20in. by 12in.; the number of revolutions in the former case being 260 per minute, and in the latter 150 per minute.

This form of engine is made double as well as single, and it is claimed that there is a new feature introduced in the double engine by which it can be worked either as a single-acting or as a double-acting engine at will, by simply turning a cock governing passages leading to the tops of the high-pressure cylinders, these being put into communication either with the exhaust or the full pressure of steam. It being required to start the engine, the cock is placed to double-acting, at which position the tops of both high-pressure pistons are open to exhaust continually, the pressure of steam being exerted on the underside only of the high-pressure pistons; but after the engine is started the cock can be turned to single-acting, at which position the passages leading to the exhaust are closed and other passages leading to the steam chest are opened, so that the full boiler pressure acts continually down on the tops of the high-pressure pistons on both up and down strokes. In this way the high-pressure pistons are in equilibrium on the up stroke, the same pressure of steam being exerted on both sides, so that they do not work against any back pressure; while on the down stroke, the steam being exhausted from the under side of the piston into the low-pressure cylinder, the power is developed in both high and low-pressure cylinders. The object of this arrangement of working single-acting is to secure a noiseless engine after being started, the thrust being always in a downward direction.

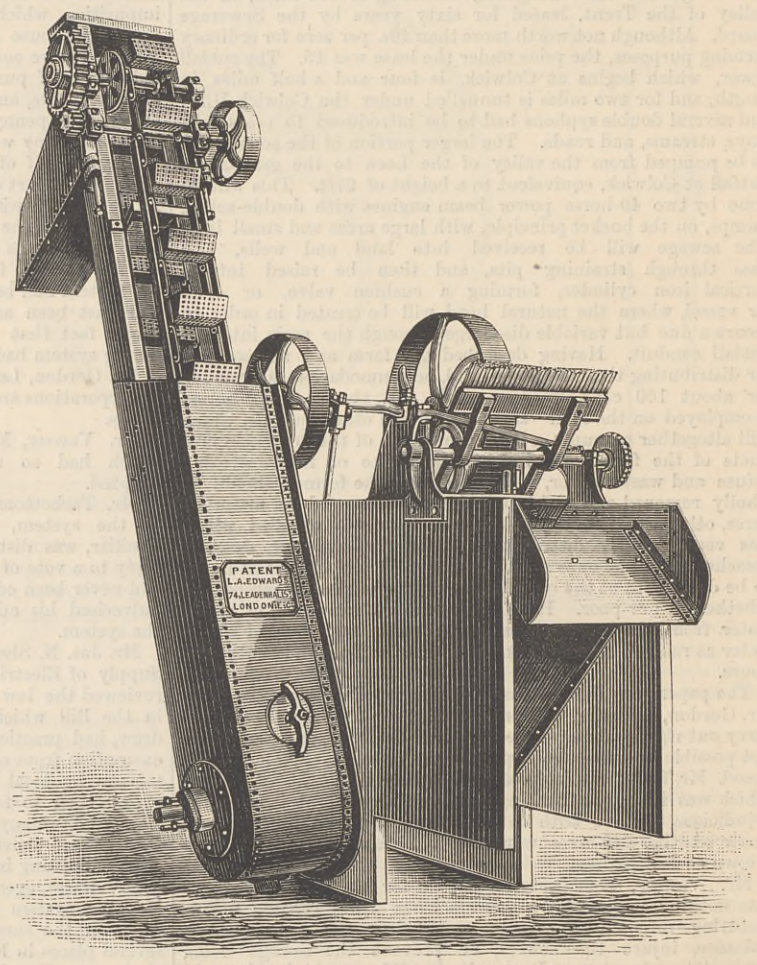
ASHES AND BREEZE WASHING MACHINES.

The accompanying engravings illustrate a machine made by Messrs. L. A. Edwards and Co., of 74, Leadenhall-street, for washing ashes and breeze. The machine, as here shown, consists of a tank or compartment kept full of water, the ashes or breeze to be cleansed resting on a grating D, which is covered by a fine perforated copper plate, allowing a free passage for water, at the same time preventing the fuel or breeze from falling through. The separation is effected by the agitator B—in the chamber A—worked by a crank shaft, giving it a suitable stroke. At each downward plunge of the agitator the water is forced upwards through the perforated copper bottom, causing the material to rise, when, owing to the greater specific gravity of the rubbish on the return stroke, it precipitates to the bottom, at the same time the breeze or unburnt fuel being lighter works



EDWARD'S ASH SEPARATOR.

to the surface; and at each stroke of the crank a body of water and quantity of clean breeze is carried on to the plate M, which also is perforated, allowing the water to fall into the division K, and thence through the valve I, to be used over again, the clean breeze being swept by the revolving brush E over the shute O. The rubbish or ash accumulates on the perforated copper plate, and from time to time is allowed to escape by the valve H into



EDWARD'S ASH AND BREEZE SEPARATOR

the chamber F, from whence it is raised by an elevator, and discharged at P. We have seen a statement of the cost of cleaning the ashes at a large sugar works, showing that where 90 tons of coal are used per day, giving about 40 tons of ashes to be treated per week, the gain is about £245 per year due to the machine.

LAUNCHES AND TRIAL TRIPS.

On Saturday last, the Banjermassin, built and engined by Messrs. Wigham, Richardson, and Co., of Neptune Works, made a successful trial run at sea. On the run from Tynemouth to Newbiggin and back, we are informed, she maintained a steady speed of about eleven knots. Afterwards she started for her Eastern voyage, and passed Dover on Sunday afternoon, averaging a speed of over eleven knots from the Tyne.

We recently noticed the launch—which took place on June 16th—from the Low Walker yard of Messrs. Sir W. G. Armstrong, Mitchell, and Co., of the steamer Gluckauf, which has been built for the carriage of petroleum in bulk from America to Europe, and to which a peculiar interest attaches, she being the first steamer that has ever been expressly constructed for this trade. The Gluckauf is a vessel of 3000 tons d.w. capacity, including fuel. She is 300ft. in length, and externally has the appearance of an ordinary three-masted cargo steamer; but internally she is entirely different, being subdivided into a number of cells or compartments for carrying the petroleum, special arrangements being made to allow for the expansion and contraction of the liquid cargo, and for controlling the gases which escape therefrom, the details of which arrangements have been carried out on a system patented by the builders. It is further claimed for this system that vessels so constructed should be insured at a very low rate, both as regards the vessels themselves and their cargoes, as not only is the risk of fire reduced to a minimum, but, owing to the extensive water-tight subdivisions, such a vessel is rendered practically unsinkable, and in the event of even a considerable number of the compartments being holed by collision or stranding, the

vessel could still be navigated to her destination. This being the first vessel of the kind, it was necessary to subject her to special tests, to prove that the structural details were in all respects perfect, and also that the stability of the ship is in proper control under all circumstances. The first condition was proved, while the vessel was on the stocks, by testing every compartment to double the pressure that it will ever have to bear in actual practice—the same as is done in the case of boilers—and with this in view, the scantlings and distribution of material, rivetting, and workmanship generally, have been carried out as boiler work, and not as ordinary shipbuilding. As an additional test, the vessel was launched with some of the compartments full to the upper deck, with the result that neither the bulkheads nor any other parts showed the slightest leakage or deflection. Since the completion of the vessel she has been tried under various circumstances, and on one occasion several of the compartments were pumped up while the vessel was at sea. The Gluckauf is fitted with a very elaborate system of pumping appliances, the whole of the pumps having been manufactured by the Worthington Pumping Engine Company, and during the trial they worked with the greatest regularity, and without noise. Four of these pumps are fitted on board for different purposes, the largest one being of sufficient capacity to discharge the whole cargo in twelve hours. The machinery of the vessel has been manufactured by the Wallsend Slipway and Engineering Company, and is on the triple expansion system, and during the official trial trip, which took place on Saturday, gave the greatest satisfaction, propelling the vessel, which the *Newcastle Daily Journal* says, had over three-fourths of her dead weight on board, at a speed of 10¼ knots. The vessel throughout is supplied with the electric light, which has been fitted by Messrs. Clark, Chapman, Parsons and Co., of Gateshead. The Gluckauf left the Tyne on the 13th, for New York, where she will take in her first cargo of petroleum for a German port; and her further movements will be watched with interest, seeing that, if she be successful, the whole subject of the carriage of petroleum will assume a new character.

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

(*From our own Correspondent.*)

ORDERS upon ironmasters' books do not this week show any large increase as the result of last week's quarterly meetings, but current inquiries promise early additions. The best feature is the improved condition of the galvanised sheet trade—an industry of so great importance to this district that prosperity amongst galvanisers means prosperity among black sheet makers and not a few others.

That the galvanisers should have seen fit to declare an advance in prices of 5s. per ton is evidence of the revival. Before the advance was declared there were several important concerns who were refusing orders at the old price. The Australian, the South American, and the Cape buyers are those who are sending home the revived inquiries resulting from the increased values of Colonial and South American produce. The loan of £5,500,000 sterling which is now being negotiated by the New South Wales Government, for expenditure mainly upon railways and other public works is another factor of Colonial improvement which is just being favourably remarked upon by ironmasters here. Black steel makers may now fairly show, as this week they are showing, a little more firmness in their prices. Orders are likely to grow on their account, and their mills should, if the revival continues and strengthens, soon be more active than they have been for several months past. The advance in corrugated sheets brings up the price of firms who previously were accepting £9 15s. for 24 w.g., f.o.b. Liverpool, to £10, and the price of makers who would take nothing less than £10 to £10 5s. per ton. Competition by firms upon the seaboard is still complained of. Black sheets for galvanising are £5 10s. to £5 15s. for 20 w.g., and £6 for 24 g., with £7 easy for 26 g.

Certain of the marked bar makers who do a Colonial business are now speaking more cheerfully. If the revival in prices of produce holds, they too, no less than the steel makers, must be advantaged. Messrs. N. Hingley and Sons, who occupy a prominent position in the Australian marked bar trade, especially express this view this week. Prices of best iron are steady.

The list of Messrs. W. Millington and Co., Summerhill Ironworks, stands at:—Bars, £7; small rounds and squares, £7 10s.; $\frac{5}{16}$in. bars, £8; ¼in., £8 10s.; No. 5, £9; $\frac{3}{16}$in., £9 10s.; No. 7, £10 10s.; No. 8, £11 10s.; and No. 9, £13. Best bars they quote £8; double best, £9; and treble best, £11. Plating bars and cable iron, £7 10s.; and best ditto, £8 10s.; with double best, £9 10s. Rivet iron, £7 10s.; best, £8 5s.; and double best, £9 15s. Angles, £8 to £8 10s., and on to £9 10s., according to quality. Boiler plates and sheets, £8 10s.; best, £9; double best, £10; and treble best boiler-plates, £12.

Boiler and other plates are quoted by the New British Iron Company as follows:—£8 for best Corngreaves, £9 for Lion, £10 for best Lion, £11 for double best scrap Lion, £12 for treble best Lion, and £13 for extra treble best. Sheets of 20 gauge are quoted £8, £9, £10 10s., and £11 10s, according to quality, and best charcoal sheets £13. Ship and fender plates are £7 10s. to £8 10s. Slit-rods the New British Iron Company quote—£6 5s. for Corngreaves, £7 C.G.C. brand, £7 10s. Lion, £9 best Lion, and £11 10s. best charcoal. Steel rods are £8, and iron horseshoe rods £6 10s., £7 10s., and £9, according to quality. Hoops the company quote £7, £8, and £9 10s. Steel hoops are £8 10s., and best charcoal £12.

Makers of medium and common bars, hoops, strips, and other merchant sections, were on 'Change in Wolverhampton yesterday, and in Birmingham to-day—Thursday—expressing confidence in the early receipt of good orders. It is wholly gratifying that buyers are putting on less pressure in the matter of prices. They seem to have now, many of them, come to the opinion that prices have touched rock bottom. Makers report this week that they are not now being constantly pressed to execute every succeeding order at a less price than its predecessor, as was some time ago the case.

Best second-class bars are £5 15s. to £6; ordinary, £5 5s. to £5 10s.; and common, £4 12s. 6d. to £5. Hoops and strips are unaltered.

United States orders are upon the market for stamping and working up thin sheets, hoops, tin-plates, steel, hematite pigs and best iron ores. The revival of the American iron trade is undoubtedly benefitting our iron and steel producers. East Worcestershire thin sheet makers are getting a good proportion of the American sheet orders. They are also fairly engaged on account of the Canadian and of the Continental and European markets. Prices in this branch keep up better than in several others. Messrs. Jno. Knight and Co., Cookley Ironworks, quote this week: Working-up sheets, £10 10s.; soft steel, £11 10s.; charcoal, £19; Crown bars, £7; plough bars, £9; and charcoal bars, £15. Tin-plates they quote: charcoals, 23s. per box; cokes, 19s.; ternes, 17s.; tin sheets, 24s. 6d. for cokes, singles; and 29s. 6d. for charcoals.

The transfer of Messrs. Knight's business from Cookley to Brierley Hill is being accomplished very slowly. At present they have only begun tin-plate manufacture at Brierley Hill, though in a month or two's time they hope to have two large sheet mills and a large tinning pot down. The Cookley works they expect to keep running for six months yet.

There is a good deal of competition among the steel makers for the custom of buyers in this district. The steel of special quality rolled by the Barrow Company is quoted, delivered into this district, at £5 per ton for Siemens-Martin blooms, and £4 15s. per ton for Bessemer blooms. Siemens-Martin billets of 2in. and upwards are quoted £4 17s. 6d., and Bessemer billets £4 12s. 6d.; small sizes are quoted 7s. 6d. per ton extra. Tin bars of 7in. size are quoted £5 2s. 6d. for Siemens, and £4 17s. 6d. for Bessemer qualities, all less 2½ per cent. The Barrow Company's representatives here announce that the concern is doing a large business in steel tin-plate bars for the Welsh market, which is taking about 1500 tons a week, and that some of the orders placed run to miles of bars in a line. The superior quality of the company's steel gives it a market in such an important steel producing centre as Wales.

There will now be more activity at the Shropshire mills and forges. The strike which for twenty-two weeks has been going on at the works of the Shropshire Iron and Wire Company terminated on Wednesday by the men, after new hands had been set on, accepting their masters' terms, subject only to the condition that, as to the puddlers, the question of "extras" should be arbitrated by the chairman of the Staffordshire iron trade. This decision, it is assumed, determines also the action of the men at the Haybridge Works, who also lately have been upon strike.

Pig iron agents are in receipt of considerable offers from purchasers. But they are mostly at such prices that agents cannot consider. The actual business doing is not therefore of large account in cases other than those where makers must have money and are selling for cash against delivery, or other early terms of payment. Selling rates are at present very varied. Clay Cross and some other Derbyshire firms refuse less than 35s. delivered into this district, while firms of less repute will accept 33s. and 34s. Lincolnshire pigs are still quoted 38s. delivered.

Native pigs are quiet and production is slow. Two or three new furnaces are, however, being built. Apedale—North Staffordshire—pigs are quoted 40s. delivered, South Staffordshire partmines 35s. to 40s., and common forge 27s. 6d. to 30s. Bradley's Capponfield best forge pigs were quoted to-day in Birmingham 40s., second qualities 35s., and third qualities 30s. Foundry qualities were: No. 1, 45s.; No. 2, 40s.; and No. 3, 35s. per ton, all at makers' furnaces.

Minerals are quiet. Northampton ironstone varies from 5s. 6d. to 6s. per ton, according to locality of delivery. North Staffordshire cokes are quoted 12s. to 12s. 6d. per ton delivered, Welsh 12s. to 13s. per ton for ordinary hard sorts for furnace purposes, Derbyshires 13s. to 13s. 6d. per ton for ordinary qualities, delivered to railway stations, and Durham sorts 15s. to 8s.

Makers of machinery suited to the wants of the tea planters are much gratified with the news from Ceylon. Merchants from the market who have taken advantage of the Colonial Exhibition to visit this country are now, some of them, in the Birmingham district, and are placing large orders for plantation tools and other manufactures. They confirm the intelligence of the increasing prosperity of the Ceylon tea trade, which has now become the staple industry of the island. It is understood that Lincoln and Belfast machinery engineers are getting most of the orders for the patent tea rolling and drying machines now required in increasing numbers.

The chain cable and anchor makers do not give a bright account of the demand. They have, however, reasonable grounds for anticipating a revived demand as soon as the shipping business looks up.

The exhibition at Bingley Hall to be held in connection with the visit to Birmingham of the members of the British Association promises to be a complete success. Already, for want of space, many intending exhibitors have had to be disappointed. Some of the most prominent engineering and toolmaking firms in the neighbourhood will be represented, and not the least interesting feature of their exhibits will be machinery in motion, illustrating the various processes to which the machinery is applicable. The building will be lighted with electricity by the Gulcher Company, with arc incandescent lamps.

Since my last report, the three days' meeting of the Association of Municipal Engineers and Surveyors has been held at the Town Hall yesterday; Mr. J. Lobley—Hanley—was elected president for the ensuing year.

At the meeting of the Birmingham Trades Council on Saturday, the chairman—Councillor Granger—read a detailed statement to be presented to the Royal Commission on Trade. This pointed out that the average earnings of the majority of local workmen had been reduced from 15 to 20 per cent. since 1876, the cause being scarcity of employment. The introduction of improved machinery, the operation of hostile tariffs, the prejudicial effects of merchants and middle-men in lowering the value of material and workmanship, were mentioned as contributing to the present state of affairs.

At the meeting of the Wolverhampton Trades Council on Tuesday, one of the delegates read a paper on the "Importation of Foreign Labour." He condemned the introduction of alien operatives as disastrous to the community generally, and remarked that manufacturers employing such persons would have no right to complain were the State to interfere to prevent the furtherance of their own interests to the prejudice of the national welfare.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—A generally depressed tone continues the prevailing feature of the iron trade throughout this district, and the prospect of any improvement is apparently quite as remote as ever. The year is now so far advanced without any change for the better showing itself that a settled despondent tone with regard to the future appears to have taken possession of the market, and no one seems to look forward to more than a continuance of the present unsatisfactory trade. Users of pig iron, where they are not already more than amply covered for all their current requirements—and this would seem to a very large extent to represent the position of consumers—purchase only from hand to mouth in the smallest possible quantities, and very rarely for deliveries extending over more than from month to month. This extreme caution in buying has been only the natural result of the long continued downward tendency in prices, and even at the excessively low basis to which they have now got, buyers, whenever they have to renew a contract, seem to expect some concessions upon the price they have previously paid, no matter how low this may have been. It would scarcely be safe to assume that prices have even yet touched their lowest point, although some makers have apparently, so to speak, put their backs against the wall and absolutely decline to give way any further. As regards manufactured iron, there is no sign of any break in the depression which has so long prevailed in this branch of industry, and the growing competition of steel for numberless purposes where wrought iron was previously used cannot but make itself seriously felt. Only the other day I was passing through an engineering works, when I was told that in the construction of their machine tools steel had now practically supplanted entirely the use of wrought iron, and with this process multiplied in a variety of ways in all classes of work, the falling-off in the demand for finished iron can be readily understood.

The Manchester iron market on Tuesday presented no new feature as compared with the dull depressed markets which have been held for some time past. The weight of business offering was again extremely small, and the prices at which transactions of any kind were practicable were excessively low. For Lancashire pig iron the quoted prices nominally remain at about 37s. to 37s. 6d., less 2½ per cent., for delivery equal to Manchester. Offers in anything like quantity would no doubt be entertained at a little under these figures, but local makers decline to meet buyers on anything like the basis at which some of the low priced district brands offering in this market are to be got. For Lincolnshire brands some of the makers are holding to 36s. 6d. and 37s., less 2½ per cent., as their minimum quoted rates for forge and foundry qualities delivered equal to Manchester, but in the face of other Lincolnshire brands to be got as low as 34s. and 34s. 6d., less 2½ per cent., they are practically out of the market, and for good reputed brands the actual selling prices do not average more than 35s. 6d. to 36s., less 2½ per cent., delivered into this district. For outside brands quoted prices are about steady at late rates, and for best named foundry Middlesbrough delivered equal to Manchester over the remainder of the year, 38s. 4d. net cash has been got, but there are cheaper sellers in the market, and in Scotch iron there is some very low underselling.

There is still only a very poor demand for hematite pig iron, and prices remain extremely low. Local brands are to be got at 48s. to 49s., and Cumberland at 50s. 6d. to 51s., less 2½, for No. 3 foundry qualities delivered equal to Manchester.

In the manufactured iron trade there is still only a very slow business doing, with £4 17s. 6d. for bars, £5 7s. 6d. for hoops, and about £6 10s. for sheets remaining the minimum basis of quoted rates for delivery equal to Manchester, but for good specifications it is probable sellers would be found prepared to take even a little under these figures.

Last week I quoted from the returns of the Steam Engine Makers' Society as to the state of employment in the engineering trades. This week the monthly report of the Amalgamated Society of Engineers has been issued, and this also again shows a slight decrease generally in the number of unemployed. In this immediate district the number of members on the books in receipt of out-of-work support is now about 8½ per cent., but the decrease which has taken place in the number of unemployed is, however, to no large extent, and is scarcely what might be expected at this time of the year. It certainly does not represent any influx of trade which is giving employment to the men, but rather the re-starting of men who were stopped during the recent holidays and the stocktakings. In general engineering work no real improvement can be reported in this district, and although some of the leading tool makers keep well employed, others are not so busy as they were, and are discharging men, and locomotive builders are generally slack. Cotton machinists are about steadily employed. The number of pattern-makers on the books of the society is less than it was a few months back, and at one of the large works in the Salford district, which for some time has been only very indifferently employed, the pattern shop has this week been put in full work, but I do not hear of new work of any moment being got generally.

The refusal of the men at the Lancashire and Yorkshire Company's railway works to work overtime unless they were put back again on the rate of wages ruling prior to the late reduction has resulted, as I recently intimated, in the workmen being put on five days a week. I understand that the men, if they could have obtained the permission of the Amalgamated Society of Engineers to cease work, would have come out on strike, but trades union societies have no funds to waste on reckless and unjustifiable disputes of this description.

I hear that Messrs. Beyer and Peacock, of Gorton, have just completed for Messrs. Vickers and Co., of Sheffield, a lathe of exceptionally large dimensions. The total weight of this tool is about 80 tons, and it is 78ft. in length. One special feature is the screw for actuating the slide rests, which is 58ft. long, and made in one piece. The head-stocks weigh about 7¼ tons, and the slide rests nearly 1½ tons each.

In the coal trade a very dull demand for all descriptions of fuel is reported, and colliery proprietors are not getting orders more than sufficient to keep their pits on about half-time. Current quoted prices are no lower, but this is more because it is scarcely possible that colliery proprietors can give way any further than that there is any actual firmness of tone in the market. At the pit mouth best coals average 8s. to 8s. 6d.; ordinary seconds coal, 6s. 6d. to 7s.; steam and forge coals, 4s. 9d. to 5s. 3d.; burgy, 4s. 3d. to 4s. 9d., and slack from 3s. for ordinary to 3s. 9d. and 4s. for the best sorts.

In the shipping trade there has been a little more stirring, but business generally is still very quiet, and steam coals delivered at the high level, Liverpool, or the Garston Docks can be got, according to quality, at from 6s. 6d. to 7s. per ton.

Barrow.—The steadier tone reported in the iron trade of this district is fully maintained, and the business doing shows a general improvement all round. American, colonial, and home users have bought largely, especially of Bessemer descriptions, and a good enquiry is experienced from all these quarters. Makers are firm in their quotations, but while no improvement is shown in them there is certainly no disposition to accept lower values, and practically all the business doing is at 42s. per ton net at makers' works for mixed Bessemer descriptions, with No. 3 forge and foundry iron at from 40s. to 41s. per ton net. The output of the district is steadily maintained; indeed it is shown to have increased during the past few weeks, although as a matter of fact some of the works in the district have entirely suspended operations. The business doing in inferior qualities of pig iron is very small. Several large parcels have been disposed of out of stocks which for some time past have accumulated at makers' works and in the storeyards throughout the district. Something like 150,000 tons of pig iron is held in stock, but in many instances makers have disposed of all the iron they held, while in others heavy stocks are held either by makers themselves or by them for others who are waiting for an improvement in trade generally. The output of the district is estimated at from 26,000 to 27,000 tons per week. The steel trade is well employed only in two of its branches—those of steel rails and tin-plate bars. Good orders for these goods are held by makers throughout the district, and a fair enquiry is experienced for prompt and forward deliveries. Other descriptions of steel are in limited request, but there is nevertheless a fair trade doing in steel wire, hoops, nails, and lightwork generally. Merchant mills are indifferently employed, except so far as regards fish-plates. Steel sleepers are in lessened demand. Shipbuilders have received but one new order lately, and that is a steamer of upwards of 1000 tons for the Corporation of London secured by the Barrow Shipbuilding Company. The Pacific steamer Orizaba, 6000 tons, building at Barrow, will be ready for sea in the course of a few weeks, and a sister ship of equal size will soon be launched from the yard of the Barrow Shipbuilding Company. Forge work is very inactive, and orders for boilers, engineering, &c., are scarce. Iron ore is in slow sale at from 8s. 6d. per ton. Coal and coke is in steady request.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

MR. CHARLES MARKHAM, the managing director of the Staveley Coal and Iron Company, is a candidate for the North-eastern division of Derbyshire on Unionist principles. In the course of a long campaign he has devoted considerable attention to the iron trade, on which he is an acknowledged authority. He says he looks forward to the coming winter with the greatest anxiety. He never knew the iron trade so bad—one firm after another went into liquidation; in fact, he did not know a single iron firm in the district that was working at a profit, and if trade could not be got there would soon be an end of work. One great factor in this bad trade was the constant change going on in the minds of our legislators. Mr. Watkin Davies, of the Renishaw Works, states that, as one behind the scenes, he could confirm Mr. Markham's views about the iron trade, and that further, if the trade did not soon mend, three-fourths of the blast furnaces in this country would be blown out.

The Barnsley magistrates had before them on Friday seventy pit lads, who, by neglecting work, caused a stoppage of a colliery belonging to the Monk Bretton Company, who sued for 2s. 6d. compensation from each lad. The prosecution, on the lads promising amendment and paying costs—between £20 and £30—withdrew the cases.

Some interesting particulars of the way in which the cutlery trade is carried on have recently been furnished. A parcel of miscellaneous specimens of pen and pocket cutlery, picked up in two districts, were forwarded to Sheffield. On being examined by an expert, he discovered that two specimens were of German make—one carded in florid style, with the English Royal Arms, and marked "Rotgen's Superior Cutlery;" the other stamped "Imperial Cutlery Company." The other samples were of Sheffield make, and for the most part of very inferior quality. Some of the goods were purchasable in Sheffield at 17s. a gross, but carded so as to sell at the Antipodes at 1s. each. The wholesale price of others, also retailed abroad at 1s. each, was 3s., 3s. 3d., and 3s. 6d. per dozen;

while others, selling in New South Wales at 1s. 6d. each, were to be had here at prices ranging from 5s. 3d. to 6s. 6d. per dozen. In one case, it is said, knives which can be bought wholesale in Sheffield at 4s. per dozen, were being sold abroad at 2s. each. A Sheffield newspaper, commenting on this point, states: "The point of interest to Sheffield workmen and manufacturers seems to us to be, that the prices named ought, surely, to enable our cutlery firms to send out a fairly good article. The lowest retail price of a Sheffield knife obtained by our correspondent was 9d.—a German knife was selling at 4½d.—for which 3s. per dozen would be paid in Sheffield. Now we are open to conviction if wrong, but we imagine many a Sheffield maker would be prepared to supply a serviceable article, creditable to himself and to the town, to be retailed at 9d., 1s. 1d., 1s. 6d., or 2s., at prices that would yield a very fair and even handsome profit to the exporter."

The Board of Trade returns for the quarter ending 30th of June last enable us to see the volume of foreign trade for the half-year. It is pleasant to note that the returns for June are unusually gratifying. In hardware and cutlery the value exported was £252,133, against £235,794 for June, 1885; iron and steel, £2,129,939, against £2,026,470. The chief increase in hardware and cutlery is to the United States, the value exported there last month being £35,368, against £21,587 for the corresponding month of 1885. British Possessions in South Africa, India, Australia, and the markets summed up under "other countries," show a falling off, against which increases are reported from Russia, Germany, Holland, France, Spain, the West Indies, Brazil, the Argentine Republic, and Canada. In unwrought steel there is a gratifying improvement—the value exported last month being £116,210, against £89,933 for June of last year. France has risen from £6985 to £8069, while the United States have nearly doubled their business—£18,223 in June of 1885 having advanced to £35,581 last month; while "other countries" have taken a value of £72,560 as compared with £64,715 for June of last year. The quantity shipped last month was 10,608 tons, against 5114 tons a year ago, and 4457 tons in June of 1884. It is again evident that the increased foreign business is not in the higher grade of the old crucible steel, for the average price last month was only about £11 a ton. Though the very expensive "standard" steels are still called for by American manufacturers for tools and other purposes, the special makes which have developed so much of late years have found a rapidly increasing market, particularly in the United States.

For the half-year ended June last the value of hardware and cutlery exported was £1,402,285, against £1,382,801 for the first six months of 1885. The increasing markets are Russia, France, Spain and Canaries, the United States, from £129,370 to £156,735; Foreign West Indies, from £15,658 to £26,137; Brazil, British North America, from £56,018 to £63,893; British East Indies, from £127,060 to £137,413; and Australasia, from £296,278 to £307,854. The decreasing markets on the six months are Germany, Holland, Argentine Republic, British Possessions in South Africa, and "other countries"—which show a decrease from £366,193 to £324,578.

In steel rails, the value exported was £1,080,948, against £1,425,499 for the corresponding half year of 1885. The increasing markets are Italy, the United States, from £26,202 to £72,184; Mexico, Brazil, Argentine Republic, from £178,218 to £194,840; British East Indies, from £682,648 to £820,992; and Australasia, from £263,161 to £326,043. There are, on the other hand, some extraordinary decreases, notably Sweden and Norway, from £61,231 to £44,717; Holland, from £1105 to *nil*; Egypt, from £157,927 to £17,636; Chili, from £24,251 to £6005; British North America, from £234,911 to £161,705; British Possessions in South Africa, from £69,921 to £12,392.

The quantity of coals taken to Hull from the Yorkshire collieries during June was 122,096 tons, against 102,592 tons for the corresponding month of 1885. For the six months the quantity has been 612,488 tons, against 532,256 tons for June, 1885. On the month the largest tonnage is sent by Denaby Main — 13,000 tons, against *nil* in June of 1885, owing to the strike. The export trade from Hull shows an increase on the six months—236,195 tons, against 229,202 tons; and a decrease on the month—58,870 tons, against 236,195 tons. Germany, Sweden and Norway, and North Russia have been the principal customers.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

No change of importance has taken place in the Cleveland pig iron trade during the past week. Business of every kind continues dull and lifeless; and with the present dismal and uncertain prospect consumers naturally refrain from purchasing more than is absolutely necessary to meet their immediate wants. There was but a poor attendance at the market held at Middlesbrough on Tuesday last. Although the sales made were few and unimportant, and buyers did their best to obtain concessions, they did not succeed in forcing down prices below what they were last week. Merchants asked 29s. 4½d. per ton for No. 3 g.m.b., for prompt delivery, and only in one or two exceptional cases were small lots disposed of at a lower figure. Makers still demand 6d. to 7½d. per ton more than merchants. Some of the latter are offering No. 3 at 30s. per ton for delivery to the end of the year, but they do not often find buyers willing to commit themselves so far ahead.

There are no buyers of warrants, even though they are freely offered at 29s. 6d. per ton.

The stocks of pig iron at Messrs. Connal and Co.'s stores are still steadily on the increase. At Middlesbrough, on Monday last, the quantity held was 262,354 tons, being an increase of 3502 tons for the week. A year ago the stock was only about 56,000 tons. At Glasgow, the quantity in store on Monday last was 785,692 tons, being an increase of 3310 tons for the week.

Pig iron shipments proceed only at an unsatisfactory rate. They have not been so small during the month of July since the year 1879. Only 22,530 tons had been sent away up to Monday last, as compared with 31,391 tons last month, and that quantity was far below the average.

Messrs. Bolckow, Vaughan, and Co., of Middlesbrough, are said to have booked an order from a foreign customer for 5000 tons of steel rails, at £3 18s. 6d. per ton. The North-Eastern Steel Company has also received a large order for rails.

The pig iron trade accountant's certificate for the quarter ending June 30th last, shows that the net average selling price of No. 3 g.m.b. was 30s. 11·85d. per ton, as against 31s. 9·65d., the price for the preceding quarter. This involves a reduction of 1 per cent. in miners' day wages, and one-tenth of a penny in their tonnage rate, the latter being reduced from 9·22d. to 9·12d. per ton.

A German named Gottliebe Schiele, who until lately was pay-clerk to the firm of R. Dixon and Co., shipbuilders, Middlesbrough, has been arrested on the charge of misappropriating sums of money belonging to his employers to the extent of £2190. From the evidence produced before the stipendiary magistrate, it seems that he had applied to the cashier from time to time for more money than was really due to the workmen in payment of their piece-work contracts, and he had not accounted for the difference. It was because the total cost for labour on certain ships seemed to be excessive that suspicion arose, and an investigation took place. On the 31st of January last the prisoner obtained leave for a day's absence, and did not return. Subsequently he was arrested at Sheffield. Cases of misappropriation by pay clerks have repeatedly occurred in the Cleveland district during the last few years. They arise most commonly when long and apparently faithful service on the part of the delinquent have disarmed suspicion, and won universal confidence. The pay-clerk is the one official in whom is centred a detail knowledge of all the men and the pecuniary obligations of the firm to them at any particular time. Partners and other officials, who have usually plenty to do, get into the habit of trusting him, and as long as all goes smoothly, no one really takes the trouble to check him. Consequently, if, as has often happened, the temptation to misappropriate becomes too strong for him, he generally has a long run before he is finally caught.

A crane accident, not unlike that by which Mr. Wyllie, of Hartlepool, was recently injured, and a foreman of labourers lost his life, has just occurred at Middlesbrough. The crane in question belonged to Mr. John Jackson, contractor for the Middlesbrough dock extension works, and was an ordinary steam jib crane mounted upon a bogie. The man in charge, Joseph Clarke, was in the cabin attached to the crane, and was manipulating it at that time. The chain was attached to some loaded bogies, when, from some unexplained cause, the crane was pulled off the line, and fell over and down to the bottom of a cutting 30ft. in depth. It was completely smashed to pieces, and the man was found among the *débris*, terribly wounded and scalded. He is not expected to recover.

Mr. Mansergh has not an altogether happy time with his employers, the Stockton and Middlesbrough Water Board, as regards the Hury reservoir difficulty. He has just written a letter, setting forth the result of his interview with the contractors, Messrs. Walter Scott and Co., to whom he communicated the recent decision of the Board. He says the contractors positively refuse to proceed, unless the claim they have made, and which he considers fair and equitable, be conceded forthwith. He reminds the Board that one of the conditions of the contract is that the engineer is sole arbitrator, in all disputes arising between the Board and their contractors, and he intimates pretty clearly that he will be bound to award as a referee what he now recommends as a technical adviser. A member of the Board having, though amid loud expressions of dissent from the others, imputed unworthy motives to himself, Mr. Mansergh is quite willing to leave it to the Board to say what, if any, commission shall be paid to him on the value of the extra work about to be done. Mr. Mansergh thinks the cost of the dam will come out about 66 per cent. beyond the original estimate.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

There is a limited business in the pig iron trade. Towards the close of last week the quotations of warrants stiffened a little, owing to a slight speculative movement, and the terms this week were for several days firmly maintained. For business the week has been a short one, in consequence of the opening of the Glasgow Fair holidays on Thursday. The annual trade holidays extend over the greater part of a fortnight, so that next week at the least there will be very little doing in business circles. Shipments of Scotch pig iron were again unsatisfactory in the past week, amounting to only 5311 tons, as compared with 6424 in the preceding week, and 7044 in the corresponding week of 1885. The addition to stocks in Messrs. Connal and Co.'s stores in the course of the week has been rather larger than for some weeks past, amounting to 3368 tons. Since last report one furnace has been put out at Quarter, and there are now 85 in blast, compared with 91 twelve months ago.

Business was done in the Glasgow warrant market on Friday at 38s. 9d. to 38s. 9½d. cash. On Monday transactions occurred in the forenoon at 38s. 8d. to 38s. 9½d. cash, the afternoon's business being at 38s. 10d. and 38s. 10½d. cash. On Wednesday the market was quiet, and business was done from 38s. 9½d. to 38s. 10½d. cash. To-day—Thursday—the market was firmer in tone and opened at yesterday's closing rate, advancing ½d. per ton on cash price.

The current values of makers' pigs are as follow:—G.m.b., f.o.b. at Glasgow, per ton, No. 1, 39s. 3d.; No. 3, 36s.; Coltness, 46s. 6d. and 43s.; Langloan, 43s. and 41s.; Gartsherrie, 42s. 6d. and 41s.; Calder, 46s. and 41s.; Summerlee, 45s. 6d. and 41s.; Carnbroe, 41s. 6d. and 39s.; Clyde, 42s. and 39s.; Shotts, at Leith, 44s. and 43s. 6d.; M. and C., 39s. and 37s.; Glengarnock, at Ardrossan, 42s. and 39s. 6d.; Eglinton, 39s. and 36s.; Dalmellington, 40s. 6d. and 37s. 6d.; Kinneil, at Bo'ness, 43s. and 42s.; Carron, at Grangemouth, 46s. and 45s.

Bessemer hematite warrants, Nos. 1, 2, and 3, are quoted on Glasgow Exchange at 41s. cash.

The malleable iron and steel trades are quiet, particularly the former.

In the past week there was shipped from the Clyde locomotive engines and tenders to the value of £37,750, of which £27,750 went to Kurrachee, and £10,000 to the River Plate; machinery, £4120; sewing machines, £4868; steel goods, £6738; and general iron manufactures, £22,600.

There has been a good business in the course of the past week in the shipping department of the coal trade. The quantity despatched from Glasgow was 20,803 tons, against 26,853 in the same week of last year; Greenock, 3846, against 327 tons; Ayr, 9834, against 8341; Irvine, 2370, against 2435; Troon, 9496, against 4893; Leith, 2759, against 2808; Bo'ness, 5797, against 5689; Burntisland, 29,100, against 18,559; and Grangemouth, 14,176, against 13,003 tons. The inland trade is quiet, and there will be very little doing in the next week or ten days.

Since the wages of the Lanarkshire miners were reduced a week ago, frequent meetings have been kept along with the idle days for the ostensible purpose of organising means of opposition. The leaders of the men and the more intelligent among themselves are, however, quite aware that in the present circumstances of the trade there is no hope of effectual resistance. The meetings have proclaimed short time and a restricted darg, but it is not expected that such a policy will be generally carried out. The men are already too poor to be able to forego any part of their wages, and therefore it is not at all likely that restricted output will be adopted in any important degree. The likelihood is that after the fair holidays full time will be the rule at most of the collieries.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Tredegar Steel Works are now turning out a rail 144ft. in length, and this is cut into six lengths of 24ft. each. There are no works in Wales, I believe, which can compete in this matter. It is worth citing in these economic days, as showing the minimum of labour cost in rail making. The steel and iron works are better employed, and Newport has been a little more benefited of late by the consignments sent down from the Monmouthshire works, Blaenavon, Ebbw Vale, Tredegar and Rhymney. Amongst the business of late may be noted bar iron for Spezia and Constantinople, 500 tons rails for Smyrna, 1600 tons rails for Geraldton, and 1000 tons rails for Bombay.

Prices of best steel rails vary according to specification, but an average may be given at £3 15s., though in questions of large contracts it is known that £3 10s. has been the figure. Sleepers are at £4 10s. This trade lags, though there is a confident opinion that works will be busy soon in this direction. Railways are going in, I hear, for heavy rails, probably nine-pounders, as "bull-heads" are called. Looking at the slight improvement in business, the tempting prices of rails and sleepers, the necessity for home railways renewals, and the greater vitality in the iron ore trade, the prospects of the Welsh works may be regarded as encouraging. To some extent the better tone is due to the activity in the tin-plate trade. Swansea enjoys the cream of this trade at present, though some of the Monmouthshire works are busy. Last week close upon 39,000 boxes were shipped from Swansea. New York alone took 2450 tons, and judging from the steamers in to load this week, a good round total will be the result, and a diminished number of boxes in stock. Scarcely half the stock is now held compared with former storage. Prices are firm. A good deal of business has been refused in ordinary cokes for 13s. 6d., makers holding out for 13s. 9d. and 14s. Bessemers command 14s., and as much as 14s. 3d. has been obtained for Siemens, though it must be admitted that Bessemer steels are most in request. Charcoals go up to 17s. Altogether the trade keeps the port active, and a thousand tons of steel boxes weekly coming in with quantities of pig iron and ore add to it.

It must be admitted that some of the tin-plate districts do not enjoy the activity of Swansea, Kidwelly and Llantrissant to wit. There is no restart either at Ypsitty Works. As might have been expected, the improvement in prices has moved the men, and meetings are announced for Swansea and Morriston. It is to be hoped that prudence will direct. The men should only be too grateful for full work.

In coal, I am sorry to note that Swansea is still backward, but in patent fuel there is an improvement. Over 5000 tons left last week, so that there is still room for increase, considering that double the quantity used to be a common total.

The coal trade generally is about the same; Cardiff and Newport showed better totals last week, but there is not much cause for congratulation. Appearances are bad. Notices are out at Messrs. Nixon and Co.'s Collieries, which are generally carried on well, and these notices are significant of a great reduction in the number of men employed at least. There is a great deal of labour now employed in collieries which may be regarded as unskilled. A colliery manager told me this week that he would readily engage a hundred skilled colliers at once if they could be found. I instance this as showing how the surplus labour at ironworks and other industries drift down into the pits, hampering business, and not showing much of a result in output.

Dowlais collieries are tolerably well occupied, and in one or two instances I note that partial stoppages there have been due more to idleness on the part of the colliers than want of contracts.

In these days of depression it is consoling to see that some good shipments are being made. I may instance this week 2000 tons to Sourabava, 2000 to Malta, 2350 to Taranto, 3950 to Perim, 3600 tons to Rio de Janeiro. Cardiff totals, though still weak, showed 20,000 tons more last week than the previous week.

Taff Vale Railway shares are being offered for £220. I scarcely think they will come lower, and when Roath branch is opened an upward movement may follow.

The Maritime Company has obtained an injunction against the Barry Dock Railway. This railway is making substantial progress.

An interesting fact has just been brought under my notice with regard to the lesser cost in ironmaking now compared with the past. At the works small coal washed and made into good coke forms the fuel of the furnaces. Formerly it was the best large coal. In 1872 Tredegar alone used 125,000 tons of large coal for the furnaces.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

There is nothing favourable to remark this week on the iron trade. Prices have remained nearly stationary, but when buyers have had orders to give out, especially in larger quantities, sellers have made concessions, although even the quoted prices were unremunerative. Ores are in smaller request, both here and in Bilbao. The coal and coke prices remain unaltered as last noted, but shortly a change will take place, and prices become weaker, for it appears the Coal Convention, after a lengthened trial, is to be broken up, because it was found too difficult and complicated a matter to control so large a number of mines, extending over the whole Rhenish-Westphalian coal-field.

Present quotations are as follows, though, under the circumstances stated above, but nominal:—Siegerland steel stone, raw, M. 7·50 to 8·00; roasted, M. 9·90 to 10·40; brown iron ore, M. 8·20 to 8·80; iron glance M. 8·90 to 9·20 p.m.t. at station on trucks. Spiegeleisen, of which little is now exported, is for that containing 10 to 12 per cent. Mn., M. 46 to 47; special qualities, with more Mn., M. 0·5 pfg. to M. 2.0 higher. The best brands of forge pig fetch M. 40; inferior sorts, M. 38 to 38·50. In Silesia forge pig costs, M. 42 to 43; foundry pig, M. 50 to 52; Luxemburg forge pig has been sold for as little as M. 28·80, though it is quoted at M. 30·40; Westphalia forge pig, M. 39 to 40; foundry, No. 1, M. 52 to 54; No. 2, M. 50 to 51; No. 3, M. 45 to 48. German (Siegen) Bessemer, M. 43 to 44; Westphalia, M. 42 to 43; white steel iron (Siegen) M. 39 to 40; Westphalia, M. 41 to 50. Basic pig, M. 38 to 38·50, all p.m.t. on trucks at nearest station to works. In rolled bars prices are weak, and want of orders is complained of. Boiler and tank plates have also hardly kept up to the quotations, and sheets have fallen a shade in price as a projected convention amongst the works in this branch has not yet been definitively organised. Wire rods are as dull as ever, and prices all round depressed. In railroad material the same complaint is made generally, but some few articles have held their place through tenders having recently been called for. Merchant bars cost M. 93 to 98, the average tending most towards the first figures. Angle iron, M. 100 to 105; building girders, M. 94 to 98; hoops, M. 102 to 105. Bessemer rods vary much in price at different works, and there are before us quotations from M. 105 to 115. Silesian common bars are M. 95 to 97 50. Best quality boiler plates cost in Westphalia M. 140 to 143, but M. 145 has been realised exceptionally; Silesian boiler plates, M. 150 to 155, and occasionally M. 145 has been taken; Westphalia common small, M. 130 to 133; steel boiler plates, M. 145; sheets, M. 142 to 145. Some works higher for thin Bessemers. Siegen thin sheets, M. 125 to 127; iron wire rods, M. 103 to 107; steel, M. 106 to 110; rivet iron, M. 115 to 130; wire nails, M. 132 to 140; rivets, M. 155 to 162; drawn wire in iron and steel, M. 118 and a little higher; steel rails, M. 125 to 130; longitudinal and transverse steel sleepers, M. 122 to 130; complete wheels and axles, M. 315 to 320; steel tires, 220 to 225; steel mine rails, M. 90 to 95 p.m.t. at works. The railway wagon and machine works are all much in want of orders, and none can work full time. The brass foundries during last month had full work, but at low prices, the fluctuating prices of raw materials, influencing them unfavourably. The average prices may be quoted:—Yellow brass castings, M. 1·60; phosphor bronze, M. 1·70; red brass, M 1·70 per kilo. Zinc at Breslau, in cake, M. 275 to 277 p.m.t. A good deal of spelter has changed hands this last month, whilst the sale in sheets and oxide has somewhat diminished.

The State Railway Administration at Breslau has just accepted two tenders—one from the Königs and Laura Hütte for 2600 tons of steel rails at M. 135, and the other from the Upper Silesian Company for railway material for 1300 tons at M. 135·30 p.t.

To show the continued efforts which are here made to meet competition, the Administration of the State Railways has granted from the 1st of June additional facilities of transport for coals from the Westphalian basin to the North Sea and Baltic ports stations.

For a long time past the construction of locomotives has been a losing business, and now the executors of the late Mr. Borsig have determined to close for ever the celebrated locomotive engine works at Berlin, there being no chance of the business ever reviving to become what it once was in this country or even abroad. Some of your readers may not be aware that this was perhaps the most considerable locomotive factory on the Continent.

The lowest tender for ten goods engines for the Italian Mediterranean Railway Company has just been accorded to the Austrian-Hungarian State Railway Company at the price of 96½ cs. per kilo. To show how prices have declined of late, it may be stated that two years ago a Vienna firm received for some locomotives delivered to France 1f. 69c. per kilo., at which price a loss resulted, although, as will be the case now, a drawback of duty was allowed on all foreign materials consumed in their construction.

The Berlin Handels-Gesellschaft has signed a treaty with the Servian Government for the purchase of the coal mines of Senja. A Servian Mining Company will be formed with a capital of 3½ to 4 millions of denares, to which, however, the consent of the Chambers is still required.

On the 21st of June last a convention at Nancy was agreed to between the ironmasters of the Lorrain district to restrict production and settle a minimum price of sales of pig iron.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, July 3rd.

TO-DAY'S telegrams from Western industrial centres show a sharp improvement in demand for iron, steel, lumber, and agricultural machinery. Jobbing interests in textile products in this city have filed telegraphic orders this week for supplies for Chicago and St. Louis distribution. The spring trade was broken into by the strikes, and stocks have run down in most Western markets, and current demand is therefore of a supplemental character. To-day's commercial summary shows, as compared to the first half of 1885, a decline in the number of failures from 6004 to 5166, and in amount from 74,722,000 dols. to 50,434,000 dols. Other statements will not be much different. A decline of 33 per cent. in the volume of liabilities is a significant indication, which carries its own force. The entire commercial and industrial situation is good, and the weekly volume of business is increasing even at a time when it is not ordinarily expected. Our banks are disbursing about 100 million dollars, much of which will seek investment. Railroad managers in the North-west telegraph to-day there is an abundance of business in sight for both railway and manufacturing interests, and this seems to be the general accepted conclusion in high commercial and financial circles here. The Trunk line pool held a meeting yesterday, at which it was agreed to maintain rates. The Western pool conditions are being lived up to, and earnings show a gradual improvement. The European demand for gold is strong, but shipments are moderate. Money is abundant in Eastern financial centres, but scarcity prevails in the West, where rates on small loans range from 6 to 12 per cent. Next week railroad building begins in earnest. Large stocks have been piled up at Eastern rail mills for July and August delivery, and to-day brokers representing two Pennsylvania mills received inquiries for 25,000 tons for October delivery. Contracts have been taken for January and February delivery. The only labour difficulty in the iron trade is a strike of 1500 mill hands at Philadelphia for a slight advance. The amalgamated iron and steel workers will support the strike, which will continue several weeks. Edison, the electrician, is pushing the transfer of his manufacturing capacity from this city to Schenectady, on the Hudson. Three or four other large manufacturing concerns are contemplating a similar course. Organised labour is exceedingly dictatorial, and is disposed to rigidly hold every advantage secured. Rumours are current relative to large transactions in stock, large orders for material, and railway combinations intended to prevent the occurrence of Trunk line wars. The "bull" movement has been gaining strength for several days. There is an undercurrent of improving business in locomotive and car building. Much railway material is wanted in the Southern States, and machine shops of large dimensions are projected at seven or eight centres in Virginia, Georgia, Alabama, and Tennessee. These are comparatively new States, and are rich in minerals, timber, and agricultural resources. New York capitalists have made large investments there within sixty days in view of the probable rapid development due to railroad construction. Six blast furnaces are to be erected near ironstone and coal beds. Four rolling mills are projected. Iron and steel-making will develope more rapidly in these States hereafter than in Pennsylvania, although some fine and rich ore beds are under development in that State. Virginia is coming to the front as an iron-making State. The product of its blast furnaces is sold at Philadelphia, New York, and Boston, and helps to control prices of Northern iron. Two railroads are to be built from that State—one of them from Pittsburgh—into the richest ore-making centres. The demand for wrought iron pipe for gas purposes keeps in advance of the supply, and the natural gas supply keeps on increasing beyond the greatest expectations. The industries in the States have never been on a safer foundation, and the manufacturing interests rejoice that the revenue reformers have made one more failure in attempting to reduce tariff duties. The tariff issue is to be made the great political issue, but the protection feeling is gaining ground throughout the South.

NEW COMPANIES.

THE following companies have just been registered:—

Avery Gas Company, Limited.

This company proposes to acquire the patent rights of the Hon. Richard Benjamin Avery for improvements in the means of generating fixed gases for illuminating, heating, and metallurgical purposes, and in particular the Letters Patent, No. 6938, dated 8th June, 1885. It was registered on the 7th inst. with a capital of £100,000, in £1 shares, of which 50,000 are fully-paid shares, deliverable to the vendor in pursuance of an agreement of the 31st October, 1885. The subscribers are:—

	Shares.
*G. D. Laycock, St. Stephen's Club, director of an insurance company	100
*Charles Marvin, Grosvenor House, Plumstead, author	100
*J. Coley, Bromfield, Northumberland-avenue, consulting engineer	100
E. Sabel, Tavistock House, Hampstead, merchant	10
F. Pool, Tunbridge-road, Maidstone, tobacco merchant	10
J. C. Humphreys, 32, Albert-gate, Hyde Park, contractor	10
T. Smith, 142, Glenarm-road, Clapton Park	10

The number of directors is not to be less than three nor more than seven; qualification, 100 shares; the first are the subscribers denoted by an asterisk, and T. Stephen Lindsay and Major B. F. Weeks. The remuneration of the board will be £750, to be proportionately increased if the directors are increased from five to seven. In any year in which the dividend exceeds 10 per cent. the board will be further entitled to 5 per cent. upon the amount of such dividend.

Bruzual Railway Company, Limited.

This company proposes to construct, equip, and work railways in Venezuela, and in particular a railway between Puerto Cabella and Bruzual, and for such purposes to acquire the rights and privileges conferred by a concession dated 18th April, 1886. It was registered on the 3rd inst. with a capital of £3,000,000, in 150,000 shares, of £20 each. The subscribers are:—

	Shares.
F. E. Hersee, 50, Leyland-road, Lee, secretary to a company	1
C. D. Grant, Hatfield-chambers, Salisbury-street, W.C., secretary to a company	1
A. W. Browning, 35, The Avenue, Acre-lane, Brixton, clerk	1
W. H. Barnard, Bay Tree House, Acton Vale	1
T. J. Lloyd, Stock Exchange, stock and share dealer	1
J. J. Pallard, 4, Birchin-lane, merchant	1

The number of directors is to be five; the subscribers are to appoint the first and act *ad interim*; qualification, £500 of the nominal share capital; remuneration, £2500 per annum and expenses.

Jarvis Silver Mining Company, Limited.

This company takes power to carry on the mining operations in Great Britain, the United States of America, British North America, or elsewhere. It was registered on the 5th inst. with a capital of £100,000, divided into 90,000 ordinary shares and 10,000 preference shares of £1 each. The subscribers are:—

	Shares.
G. Wilson, Midlothian, ironmaster	1
A. R. Gray, 15, Maitland-street, Edinburgh, engineer	1
F. O. T. Delmar, 17, St. Petersburgh-place, Bayswater	1
J. M. Read, 5, Austinfriars, stockbroker	1
G. A. Thomson, 13, Austinfriars, stockbroker	1
W. A. Stone, 90, Cannon-street, chartered accountant	1
W. Cash, 90, Cannon-street, chartered accountant	1

The number of directors is not to be less than three nor more than seven; qualification for first directors 100 shares, and for subsequent directors 100 shares. The subscribers are to appoint the first directors; the company in general meeting will determine remuneration.

Moldacot Pocket Sewing Machine Company, Limited.

This company was registered on the 2nd inst. with a capital of £75,000, in £1 shares, to carry on business as sewing machine manufacturers and mechanical engineers. The subscribers are:—

	Shares.
E. J. Sheriff, 22, York-place, Portman-square, merchant	1000
W. Irving, 4, Queen-street, E.C., secretary to a company	500
E. Moreton, 16, Tokenhouse-yard, share broker	1000
W. Lichfield, 61, Leyspring-road, Leytonstone, surgeon	300
A. C. Tulk, 46, Pollard's-row, Hackney-road, reporter	200
J. Grunell, 9, Gloucester-terrace, Edmonton, accountant	500
D. U. Nicol, 8, Featherstone-buildings, Holborn, provision merchant	250

The number of directors is not to be less than two nor more than seven; qualification, 200 shares; the subscribers are to appoint the first and act *ad interim*; remuneration, £200 per annum to each director, with an additional £100 for the chairman; but the payment of this remuneration is conditional upon the declaration of 20 per cent. dividend.

North Queensland Gold Mining Company, Limited.

Upon terms of an agreement of the 26th ult., this company proposes to purchase from Charles Frederick Barker certain gold mines situate at Charter's Towers, Queensland. It was registered on the 3rd inst. with a capital of £40,000, in £1 shares. The purchase consideration is £3500 cash, and £12,500 in fully-paid shares. The subscribers are:—

	Shares.
*C. F. Barker, Lytham House, St. Alban's-road, Kensington, mine proprietor	1
*John Scarlett Campbell, 1, Queen's-gate-place	1
*Lieut.-General E. Wray, 11, Harrington-gardens, S.W.	1
A. W. Browning, 35, The Avenue, Acre-lane, Brixton, clerk	1
C. D. Grant, Hatfield-chambers, Salisbury-street, secretary to a company	1
T. W. Smith, 3, Hyde Vale Villas, Greenwich, solicitor	1
S. James, 9, St. Stephen's-road, Lewisham, clerk	1

The number of directors is not to be less than three nor more than five; the first are the subscribers denoted by an asterisk, and Mr. Archibald W. Stirling; qualification, 100 shares. Remuneration, £100 per annum to each director, with an additional £50 to the chairman, if any. The directors will also be entitled to 5 per cent. on the net profit remaining after payment of 10 per cent. per annum in dividend or bonus.

London River Steamers, Limited.

On the 7th inst. this company was registered with a capital of £250,000, in £5 shares, to carry on the business of steamboat owners and carriers upon the River Thames and elsewhere. The subscribers are:—

	Shares.
J. N. McAlister, 21, West India Dock-road, shipbuilder	1
Demetrius Cowan, 49, Lime-street, iron merchant	1
Blair Black, 49A, Lime-street, naval architect	1
F. H. Sharp, 13, Albert-street, Kennington Park-road, accountant	1
Edgar Shand, 30, St. Mary's-road, Peckham, steamboat manager	1
Edwin Downs, 70, New Corn Exchange, steamboat manager	1
Jesse Jacob, 485, New-cross-road, lighterman	1

The number of directors is not to be less than five nor more than seven; qualification, fifty shares; the subscribers are to appoint the first; remuneration, £1750 per annum, and such further sum as the company may vote in any year in which the dividend is at least 10 per cent.

Farmers' Direct Sale Association, Limited.

This company proposes to breed and deal in live stock, and to trade in meat and farm and dairy produce of every description, both animal and vegetable. It was registered on the 1st inst. with a capital of £200,000, in £100 shares. The subscribers are:—

	Shares.
P. Saltmarshe, Saltmarshe, Howden, York	1
*Lord Wantage, 2, Carlton-gardens	1
*Chapman de Laune Faunce de Laune, J.P., Sharsted-court, Sittingbourne	1
E. R. Fisher Rowe, J.P., Guildford	1
*Westley Richards, J.P., Ashwell, Oakham, Rutland	1
Lord Yarborough, Ulceby	1
Lord Combermere, Whitchurch	1

The number of directors is not to be less than three nor more than seven; qualification, £100 of share capital; the first are F. W. W. Cornwallis, Maidstone; Albert Pell, Hazlebeach, Northampton; and the subscribers denoted by an asterisk. The company in general meeting will determine the remuneration of ordinary directors.

Thompson and Shackell, Limited.

This company proposes to take over the business of Thompson and Shackell, trading as musical instrument makers and agents, at Swansea, Cardiff, Newport, Merthyr Tydvil, Gloucester, and elsewhere, and to carry on the additional business of manufacturers of pipe organs. It was registered on the 7th inst. with a capital of £50,000, in £5 shares. The subscribers are:—

	Shares.
*D. E. Jones, Cardiff, surgeon	50
*H. L. Carr, Cardiff, newspaper proprietor	50
*E. W. Shackell, Cardiff, music seller	1000
*P. W. Carey, Cardiff, wine merchant	60
C. Clarke, Cardiff, auctioneer	1
*J. Guthrie, Penarth, shipbroker	50
*S. F. Thompson, Swansea, music seller	1000

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

BIRMINGHAM AND CABLE TRAMWAYS.

MR. E. PRITCHARD, one of the engineers of the Birmingham Central Tramways Company, has just returned from America, where he has been making inquiries into the working of the various systems of cable tramways which have been adopted in the States, with a view to the adoption of cable locomotion on the Handsworth and Bristol Road routes, convinced not only that cable trams are perfectly feasible, but that they are the most economical and desirable form of street locomotion yet put into practice. Mr. Pritchard is, in conjunction with Mr. Joseph Kincaid, engineer to the Birmingham Central Tramways Company, who are at present the owners of many miles of steam tram lines in Birmingham and the district. Some time since the Central Company obtained, by arrangement with the Birmingham Tramway and Omnibus Company, the latter's right in respect of their lines outside the borough at Bournbrook and Handsworth. They also obtained from the Corporation a lease of the lines then worked by the same company between the borough boundary in Bristol-road and Hockley Brook, parliamentary powers being obtained by the Corporation for the alteration—in the borough—of the existing gauge of 4ft. 8½in. to 3ft. 6in., the latter being the universal gauge of the tramways in the borough. In consequence of the severity of some of the gradients on the Handsworth and Bristol road routes—especially in Hockley-hill and Snow-hill—and the fact that certain objections were raised to the use of steam power by the residents, the attention of the company was turned to cable trams, favourable reports of which were received from America. At the Patent-office, Washington, where he was most courteously received, Mr. Pritchard learned that over 220 patents have been taken out in connection with cable trams or "cable street railroads," as they are called there. That cable haulage as a means of street locomotion is by no means such a novelty, even in this country, as some might be inclined to think, is evident from the fact that the first patent in connection with it dates from 1840. In San Francisco cable haulage for street traffic was first adopted in Clay-street in 1873, and since then five additional companies, making six in all, have been formed, and are being worked successfully. One, the Market-street Company, possesses sixteen miles of single track. The City of Chicago, which is exceedingly level, there being practically no gradients, possesses some 20¾ miles of "cable railroads"—measuring the lines as a single track—owned by the South-street Railroad Company, who also control many miles of horse tramways and a few miles of steam. For the cable lines the whole motive power to work the lines is supplied from one station, the route being so situated as to render a central station economical and suitable. The cables operated from this station represent 110,209ft. in length. At St. Louis, where is an excellently-equipped line, there are a great many curves on the route—over twenty in a very short distance. Some of these curves have a radius of only 31½ft., whereas the severest curve on the Birmingham route has a radius not less than 45ft. In Chicago the cost of the construction of works has been extraordinarily high—in fact, more than double than in some other cities. A great deal of this high expenditure has been rendered necessary by the excessive severity of the weather in the winter season. Even with this great initial cost, however, the present value of the 100 dols. stock is now 325 dols., there being buyers at that price in May last. The service of cars varies from two minutes on the Cottage Grove line to one and a-half minutes on the State-street line, and the total number of passengers carried per annum is 40,000,000, or over 100,000 per day. The total receipts for 1885 represented an average of 21·75 cents per car per mile, whilst the total expenses for the same period were 10·75 cents per mile. Both the expenses and receipts appear somewhat small, but this will be explained by the great number of cars employed, and the consequent frequence of the services. The companies prefer to receive 10s. each from four cars rather than 15s. from two.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

6th July, 1886.

8790. BENCH VICES, J. Evans, Sheffield.
8791. SAFETY PINS, J. Jenkins, London.
8792. STENCIL PRINTING, J. Brodrick and G. Robinson, London.
8793. WINDOW FASTENINGS, G. Schuritz, London.
8794. UTILISING the EXPANSIVE FORCE of VAPOUR for THROWING PROJECTILES, &c., J. Murrie, Glasgow.
8795. KEYS for PIANOFORTES, &c., J. H. Hele and W. Spencer, Longport.
8796. ATTACHING LAMPS to CARRIAGES, R. Grindle, Birmingham.
8797. GLASS ENAMELLING, T. Thorp, Whitefield.
8798. VESSELS, C. Blagburn, London.
8799. FISH-HOOK, G. F. Priestley, Halifax.
8800. ILLUMINATING the FACE of INSTRUMENTS that INDICATE TIME, A. W. Foster and L. Oxford, Nantwich.
8801. SECURE PICTURE NAIL, E. J. Berry, Salford.
8802. ILLUMINATING the CARD in MARINER'S COMPASS, A. W. Foster and L. Oxford, Nantwich.
8803. FIRE-DAMP INDICATORS, Sir W. T. Lewis, Mardy, and A. H. Maurice, Maesteg.
8804. DECORATIVE SCREEN for FLOWER POTS, H. P. Dunnill, F. R. Smith, and J. Jones, near Iron Bridge.
8805. PIN VICES, A. C. Wells, London.
8806. CUSHIONING PISTONS in WATER-METER, &c., CYLINDERS, A. Goodwin, London.
8807. AIR-TIGHT MOULDING, R. Morgan, London.
8808. CARTRIDGES for FIRE-ARMS, A. J. Boult.—(*G. W. Morse, United States.*)
8809. BREECH-LOADING FIRE-ARMS, S. K. Hindley and E. S. Field, Liverpool.
8810. SHIFTING SPANNERS, E. Baastad, Liverpool.
8811. GASBURNERS, G. Galland and E. Groux, London.
8812. SELF-REGISTERING SOUNDING MACHINE for RIVER BED, &c., SURVEYING, C. A. Lidstone, London.
8813. HONEY EXTRACTORS, W. P. Meadows, London.
8814. TELEPHONES, A. J. Boult.—(*A. M. Phelps, United States.*)
8815. TWO-WHEELED VEHICLES, W. Botwood, Ipswich.
8816. CONNECTING JACQUARD CARDS, &c., A. Anderson and R. A. F. Pollock, Glasgow.
8817. HOLDING and AFFIXING ADHESIVE STAMPS to LETTERS, &c., G. Davis, Clifton.
8818. MORTICING MACHINES, M. Rothschild, London.
8819. DISTILLING and PURIFYING AMMONIACAL LIQUIDS, L. A. Chevalet, London.
8820. COOLING and QUENCHING the THIRST of ANIMALS, L. A. Couteau, London.
8821. DARK SLIDES for PHOTOGRAPHIC CAMERAS, G. Lowdon, Dundee.
8822. HEATING and VENTILATING APPARATUS, M. H. Dement.—(*G. W. Le Vin, United States.*)
8823. CAPS or HEAD COVERINGS, S. J. Henochsberg and M. Myers, London.
8824. WOVEN WIRE MATTRESS FRAMES, &c., W. G. P. Sharp and C. Bradley, London.
8825. GAS WASHERS, H. and F. C. Cockey, London.
8826. CASH REGISTERS and INDICATORS, H. J. Haddan.—(*The National Cash Register Company, United States.*)
8827. OIL CUPS for AXLES, C. Crandall, London.
8828. FREEZING MACHINES, J. W. Froud, London.
8829. DRYING GRAIN, A. W. Gillman and S. Spencer, London.
8830. SCALES, J. E. Pitrat, London.
8831. CUSHION and GUARD for PENHOLDERS, P. A. Newton.—(*S. S. Harman, United States.*)
8832. SALINE PREPARATION for use in GALVANIC BATTERIES, A. Schanschieff, Gipsy Hill.
8833. GOLD COVERED ALLOY, C. B. Headley, London.
8834. LABEL, J. de L. and G. Watson, London.
8835. SAFETY POCKET for MEN'S or WOMEN'S GARMENTS, C. Doucet, London.
8836. ASPHALTE PAVEMENT, E. H. Bassett, London.
8837. WHITE LEAD, F. M. Lyte, London.
8838. CHECK REIN HOLDER, A. M. Clark.—(*R. E. King, United States.*)
8839. ROCK-DRILLING MACHINES, N. C. Pond, Marshall, O., W. and E. Simons, London.
8840. LAMP SHADES, H. H. Lake.—(*The Ansonia Brass and Copper Company, Incorporated, and W. A. Hull, United States.*)
8841. DRESSING METAL SLIT RODS, &c., J. Webster, London.
8842. PLATES without SUPPORT entirely made of ACTIVE MATERIAL, E. Andreoli, London.
8843. HAIR PIN for CURLING and FRIZZING HAIR, W. L. B. Hinde, London.
8844. DETECTING CARBURETTED HYDROGEN in MINES, E. Morand, London.
8845. AUTOMATICALLY COMPENSATING the EXPANSION of SIGNAL WIRES, J. W. Somerton, London.
8846. HANDLES for SAUCEPANS, E. Fisher and H. W. Ludlow, London.
8847. PROPULSION of TRAMCARS, W. Potter and F. W. Frost, London.
8848. MARKING PIGEONS, J. Thomson, London.
8849. FIRE-BOXES of STEAM BOILERS, &c., J. Westray, London.
8850. UTILISING the POWER of TIDES, H. H. Lake.—(*J. H. Hagerty, United States.*)
8851. GAS REGULATORS, W. C. Rossney, C. L. Hunt, and C. A. Shaw, London.
8852. LUBRICATORS, I. Fréchette and J. W. Currier, London.
8853. COATING PAPER with WAX, H. H. Lake.—(*J. Jordan, United States.*)
8854. LAMPS, H. H. Lake.—(*The Ansonia Brass and Copper Company, Incorporated, and W. A. Hull, United States.*)
8855. LOOMS for WEAVING, H. H. Lake.—(*C. W. Sweet, United States.*)

7th July, 1886.

8856. RACKS for SLATES, W. L. Ridge, Selby.
8857. PORTABLE TEA CHESTS, J. E. Hopkinson and H. Rumsey, London.
8858. SECURING GAS GLOBES, E. J. King, Bradford.
8859. DIVIDING and MEASURING DOUGH, M. Coleman, Dublin.
8860. CAUSTIC SODA, A. M. Clark.—(*M. Honigmann, Germany.*)
8861. FEED for MILLS, S. B. Bamford, Uttoxeter.
8862. HARDENING FELT HATS, F. S. Anderson, Manchester.
8863. DETONATING BURGLAR ALARM, E. L. Oppermann and A. Sieber, London.
8864. SEWERAGE and DRAINAGE WORKS, M. J. Adams, London.
8865. HATS, J. Hague, Manchester.
8866. MEASURING RODS, E. Crossley, Halifax.
8867. CARRIAGE STEPS, W. E. Carmont, Manchester.
8868. CUTTING SOAP to the EXACT WEIGHT, J. Wright, Saltley.
8869. HARVESTING MACHINERY, J. Hornsby and J. Innocent, Grantham.
8870. MAKING HAT and COAT HOOKS, W. D. Wilkinson and W. H. Richards, Birmingham.
8871. ATTACHING SPRING and SLIDE to PHOTOGRAPHIC HOLDERS, W. D. Wilkinson and W. H. Richards, Birmingham.
8872. HINGES and DOOR CLOSERS, W. Potter and T. and W. L. Cole, London.
8873. DRESSING STONES, &c., E. Grach, Berlin.
8874. TREATING SEWAGE and other POLLUTED WATERS, J. Bannehr, Devonshire.
8875. VALVE and VALVE GEAR for MARINE, &c., ENGINES, J. W. Hackworth, London.
8876. SELF-ACTING FASTENINGS for DOORS, &c., H. W. Hennis, London.
8877. FILTERING FLUIDS, J. Strang, London.
8878. HEATING and COOKING by GAS, W. Moffatt, Glasgow.

8879. Laying Down Asphalt, G. Hudson, London.
8880. Promoting the Combustion of Fuel, H. J. Haddan.—(*H. Welsh, United States.*)
8881. Steel and Ingot Iron, P. M. Justice.—(*H. T. Rode, Germany.*)
8882. Cases for Watches, J. Sharpe and J. Howard, London.
8883. Vessels for Serving Ice Cream, S. W. Smith, London.
8884. Coating Photographic Plates and Paper, W. J. Wilson, London.
8885. Dressing Minerals, H. Boyns, London.
8886. Fire Grates, J. Price and J. B. Wayne, Birmingham.
8887. Holder and Cover for Tumblers, T. White, London.
8888. Blasting for Mining, &c., H. Bonser and T. G. Marsh, London.
8889. Safety Fastenings for Window Sashes, W. Dryden, Glasgow.
8890. Shielded Spectacle, H. Fisher, Chelsea.
8891. Stopper for Bottles, R. W. Thomas and P. C. Smith, London.
8892. Fishing Tackle, R. M. Campbell and T. G. Henderson, Glasgow.
8893. Slide Valves, W. Westwood, London.
8894. Steam Boilers, E. Walker and J. Radcliffe, Manchester.
8895. Obtaining Gas for Illuminating, &c., H. Williams, Manchester.
8896. Self-winding Clocks, J. G. Lorrain, London.
8897. Stamping Apparatus, G. F. Redfern.—(*J. Priss, France.*)
8898. Metal Combs, G. F. Redfern.—(*A. Knippenberg, Germany.*)
8899. Automatic Boiler Cleaners, H. Sims, London.
8900. Stand for use in Water-closets, E. H. and C. D. Cooke, London.
8901. Incandescent Electric Lamps, A. Bernstein, London.
8902. Effecting the Decomposition of Hydrocarburet and Water Vapour Mixed in Closed Vessels, A. J. Boult.—(*A. Blancafort, ——.*)
8903. Printing or Colouring of Yarns, L. M. Lardière, London.
8904. Fishing Trawl, J. Thurlow, London.
8905. Separating Impurities from Solids and Liquids, S Vickers, Liverpool.
8906. Carbonates of Soda and Potash, G. A. Jarvis, near Wellington, Salop.
8907. Fixing Sheets of Zinc, &c., T. W. Helliwell, Halifax.
8908. Files for Sharpening the Cutters of Reaping Machines, E. Harris, Manchester.
8909. Bottles or Vessels for Containing Milk, &c., J. Storer, Glasgow.
8910. Feeding Mechanism for Saw Frames, J. Law, Glasgow.
8911. Coal Boxes, J. Tonry, London.
8912. Calculating Machines, E. Selling, Wurzburg.
8913. Shafts or Frames for Wire or Metal Healds, A. B. Barlow and H. Brooke, Manchester.
8914. Wet Spinning Frames, J. Erskine and F. W. Finlay, Wolfhill.
8915. Fastening Brush and Broom Handles to Brushes, &c., E. Brookes, Hanley.
8916. Overwheel or Wheel with Endless Rails, W. Fender, Barmen.
8917. Generating Motive Power, J. Phethean, London.
8918. Double Current Telegraph Instruments, J. Edwards, Liverpool.
8919. Locks, Latches, and Keys, J. M. Hart, London.
8920. Anemometers, J. Gordon, jun., and E. J. B. Lowdon, Maryfield.
8921. Saddlery, J. F. C. Farquhar, London.
8922. Check-rest, &c., for Guns and Rifles, A. Hall, Halifax.
8923. Rocking or Oscillating Horses or Chairs, E. Davies, London.
8924. Extracting or Separating Oil or Grease from Cotton Waste, J. Whittle, London.
8925. Attaching Shoes to Horses, J. G. Smeaton and C. J. Jutson, London.
8926. Washing Clothes, &c., H. Metham, London.
8927. Lamps for Burning Mineral and other Oils, D. C. Defries, London.
8928. Lawn Mowers, T. Clarke, London.
8929. Valve Cocks, A. H. Pinnock, London.
8930. Toasting Forks, A. R. Korsch, London.
8931. Dressing or Cutting Slate, R. M. Greaves, London.
8932. Roasting or Popping Grain, A. W. Gillman and S. Spencer, London.
8933. Lubricating Compounds, J. L. Mott, jun.—(*Messrs. Dreher and Co., United States.*)
8934. Centrifugal Apparatus for Moulding Cement, &c., F. C. A. Meier, London.
8935. Utilising Heat of the Exhaust Steam from Steam Engines, A. M. Clark.—(*M. Honigmann, Germany.*)
8936. Spent Hops for Paper and Millboard, E. Davies and H. F. Harris, London.
8937. Connecting Pipes for Steam, &c., for Stopping Leaks, E. C. Hiscox, London.
8938. Rendering Mineral Phosphates capable of being Assimilated by Plants, P. de Wilde, London.
8939. Continuous Fleeces and Felted Goods, W. L. Wise —(*A. Marthaus, Germany.*)
8940. Bracelets and Finger-rings, A. A. Fridlander. (*Messrs. Langlois and Tiphaine, France.*)
8941. Administering Medicinal Balls to Horses, &c., R. Yeomans, London.
8942. Treating Molten Metals before being Cast into Ingots, &c., H. White, London.
8943. Better Delivery of Reaped Corn, G. Storer, Thoroton Hall, near Birmingham.

9th July, 1886.

8944. Rails for Permanent Way of Railways, A. Howat, Manchester.
8945. Soap Economiser, R. Bradshaw, Swinton.
8946. Carding Engines, T. Duncan, Oldham.
8947. Pumping Apparatus for Mines, R. Moore, Glasgow.
8948. Treating and Purifying Paraffin Wax, R. Tervet and F. Alison, Glasgow.
8949. Coupling Railway Trucks, H. Terrett, London.
8950. Making Joints of Pipes of Copper, &c., R. B. Pope, Glasgow.
8951. Fire-boxes for Vertical Boilers, J. Partington, Bradford.
8952. Shedding Motions of Looms for Weaving, W. Thompson and F. W. Jepson, Halifax.
8953. Moulding Pipes, E. Steele, Longton.
8954. Day and Night Signalling Apparatus, J. Wall, Bootle.
8955. Double-action Ratchet Brace Box, J. A. Charnock, Glasgow.
8956. Horseshoes and Cultivators, C. Barker, Hadwell.
8957. Case Kiln, R. Skeoch and W. G. Wodson, East Heaton.
8958. Band Saws, J. Richardson, Manchester.
8959. Cigar Protector, J. M. Haselgrove, Birmingham.
8960. Stopping Draughts through Doors, &c., E. Airey, Sunderland.
8961. Lock Nuts, G. H. Wells, London.
8962. Extraction of Precious Metals, E. Martin, London.
8963. Sight-feed Lubricators, J. H. and J. W. Galloway, London.
8964. Nail Cutter, &c., L. F. Marsh, London.
8965. Sliding Spring Fish-hooks, H. Wyers, Redditch.
8966. Tin, &c., Metal Coated Plates, D. Owen, London.
8967. Covering Treads or Steps of Stairs, &c., S. J. Hodder-Row, London.
8968. Riding Saddle Girths, J. E. Butler and S. E. Willis, London.
8969. Metallic Packing for Steam, &c., Engines, E. Edwards.—(*A. P. Duval, France.*)
8970. Motive Power, C. J. Eyre, London.
8971. Concentration of Sulphuric Acid, S. B. Bowen, London
8972. Coating Photographic Plates, M. P. Ismay and E. Doads, London.
8973. Range Finders, N. L. Walford, London.
8974. Ornamental India-rubber Waterproofed Fabrics, G. C. and S. L. Mandleberg, and H. L. Rothband, London.
8975. Brick and Quarry Boxes, J. and G. P. Jones, London.
8976 Drawing Wire, A. S and T. Bolton, London.
8977. Drawing Wire, A. S. and T. Bolton, London.
8978. Driving and Change Speed Gear for Velocipedes, A. Paice, London.
8979. Pianos, J. Delerue, London.
8980. Hats, &c., M. Haslam, London.
8981. Weighing Machines, A. Warner, London.
8982. Protector for the Shoulders, &c., of Draught Animals, W. H. Sleep, London.
8983. Dominoes, R. Spear, London.
8984. Placing Ordinates, &c., and Deducing from Indicator Diagrams, J. G. Claude-Mantle, London.
8985. Filing Newspapers, &c., G. P. Jäkel, London.
8986. Bicycles, &c., A. J. Eli, London.
8987. Pencil Cases or Holders, B. S. Cohen, London.
8988. Treatment of Waste Tin Cuttings to Recover Tin, &c., T. Fenwick, London.
8989. German Silver, E. Cottam, London.
8990. Breech Mechanism of Ordnance, T. Nordenfelt, London.
8991. Gun Mountings, T. Nordenfelt, London.
8992. Green Colouring Matters, &c., C. D. Abel.—(*The Farbwerke Vormals Meister, Lucius and Bruning, Germany.*)
8993. Reaping Machines, A. Mitchell, London.
8994. Automatic Telegraphy, W. L. Wise.—(*J. Rae and J. C. Simpson, Canada.*)
8995. Telegraphic Alphabets, W. L. Wise.—(*J. Rae and J. C. Simpson, Canada.*)
8996. Shuttle Apparatus in Looms for Weaving, E. Dixon and T. Coulthard, London
8997. Refrigerating, &c., Machine Tools, P. Van den Kerchove, London.—*13th January.*
8998. Bullets, A. M. Clark.—(*C. Alger, United States.*)
8999 Bullets, A. M. Clark.—(*C Alger, United States.*)
9000. Preparing Printing Surfaces or Formes, E. Konig, London.

10th July, 1886.

9001. Automatic Railway Couplings, R. F. Kerr, Renfrewshire.
9002. Ornamentation of Woven Fabrics, J. Platt, Manchester.
9003. Strengthening Metallic Boxes, W. H. Jones, B. Jones, W. H. Jones, and B. H. Jones, Wolverhampton.
9004. Blacking and Varnish, E. O. Eaton, London.
9005. Bending Metal Bars, &c., S. Leathley, Bradford.
9006 Cigarettes, M. F. Fitzgerald and M. Goodbody, Glasgow.
9007. Operating the Marking Appliances of Machines for Sizing Yarns, L. Wilkinson and E. Morriss, Halifax.
9008. Drilling Machines, A. E. Stayner, near Sheffield.
9009. Permanent Way of Railways, G. Woodcock, Manchester.
9010. Traces, S. Ogden, Manchester.
9011. Operating the Healds of Looms for Weaving, W. Hargreaves, Halifax.
9012. Toy Rattle or Bones, H. Whitfield, Birmingham.
9013. Electric Batteries, R. Rauschke, Halifax.
9014. Tennis or other Racquets, J. F. Gilmore, London.
9015. Fusing of Enamel Ware, W. H. Jones, B. Jones, W. H. Jones, and B. H. Jones, Wolverhampton.
9016. Measuring the Efficiency of an Electric Circuit, Sir W. Thomson, Glasgow.
9017. Tanning Hides and Skins, F. J. Pohl, Bootle.
9018. Combined Drinking Flask and Sandwich Box, W. Thornhill, H. Thornhill, and G. Zimmerman, London.
9019. Chairs, F. M. Morgenstern, London.
9020. Economical Self sifting Ashpan, B. K. Noy, Colchester.
9021. Supports of Bassinette Head Rests, J. Hall, Birmingham.
9022. Combined "Tuptometer" and Advertiser, W. Oliver, London
9023. Alarm Locks and Latches, J. Walton and W. H. Edwards, London.
9024. Musical Boxes, A. Karrer, Switzerland.
9025. Burning Inflammable Oils for Heating Purposes, C. Oswald, Liverpool.
9026. Securing Rubber Tires to Wheels, A. J. Wheeler, London.
9027. Production of Resin-acid Esters, E. Schaal, London.
9028. Animal Skull Petty Wares, L. von Fialka, London.
9029. Fire Service System, J. Jackson, London.
9030. Automatic Fuel Feeding Apparatus for Stoves, H. J. Haddan.—(*F. Eisenbeis, Germany.*)
9031. Journal Bearings, J. J. Lappin, London.
9032. Alkalis, J. Marx, London.
9033. Liquid Meters, J. J. Tylor, London.
9034. Flower Baskets, J. W. Hoffman, London.
9035. Automatic Sale of Newspapers, E. Anthony, London.
9036. Washing Machines, A. Samson, London.
9037. Seats for Dog Carts, &c., A. H. and J. E. Hayes, London.
9038. Surface Condensers, A. Myall.—(*J. McIntyre, U.S.*)
9039. High Speed Steam Engines, A. Bever, London.
9040. Indicating Names of Stations to Passengers in Railway Carriages, &c., G. F. Redfern.—(*L. Buck and A. Becker, Belgium.*)
9041. Ticket Printing and Registering Mechanism, W. R. Lake.—(*J. P. Dunn, United States.*)
9042. Electric Incandescent Lamps, W. R. Lake.—(*A. Zanni, Italy.*)

12th July, 1886.

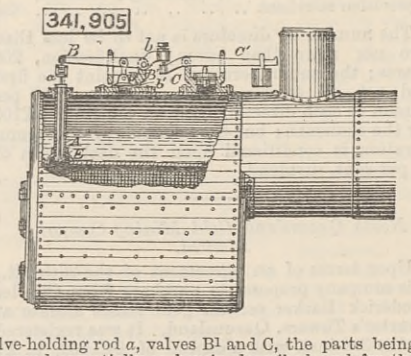
9043. Composing Stick, T. N. Palmer.—(*W. H. Golding, U.S.*)
9044. Regulating Flats in Carding Engines, T. Duncan, Oldham.
9045. Ash Pans, R. Normansell, Birmingham.
9046. Bobbin Carriers of Winding Machines, R. Broadbent, Manchester.
9047. Generating Steam, J. Blum, London.
9048. Separating Grain, &c., W. Anfield, Great Driffield.
9049. Chain Pumps, H. Duke, Liverpool.
9050. Door Check, T. Thornton, Manchester.
9051. Opening Books, W. L. Parker, Bristol.
9052. Delivery Boxes. E G. Hoffman, London.
9053. "Krotophones," E. S. Spalding, London.
9054. Clamps, A. E. A. McClure, Manchester.
9055. Lamps J. Sankey and A. Bonehill, Birmingham.
9056. Electric Machines, W. Maxwell, Fulham.
9057. Lock Fastenings, F. J. Cotterell, Moseley.
9058. Refrigerators, W. Craig, Glasgow.
9059. Combined Traction Engine and Digging Machine, F. Burrell, Thetford, & F. Proctor, London.
9060. Elastic Band, &c., for Breeches, T. Doughty, London.
9061. Gas Burners, E. C. Urry, London.
9062. Driving Belts, A. J. Boult.—(*W. H. Avis, Canada.*)
9063. Ball Castors, F. R. Wildegose, London.
9064. Securing Railway Axle Brasses to Axle-boxes, D. Foster, Sheffield.
9065. Metallic Wheels for Tramcars, T. Mallaband, Sheffield.
9066. Magazine Guns, J. Schulhof, London.
9067. Steam Jet Blowers, J. J. Meldrum, Liverpool.
9068. Stereotyping Apparatus, &c., M. H. Dement, London.
9069. Suspended Lifts, J. S. Stevens and C. G. Major, London.
9070. Magic Dyeing, &c., J. Holloway and H. S. James, London.
9071. Railway Chairs for Sleepers, J. Wroe, Manchester.
9072. Railway Chairs for Sleepers, J. Wroe, Manchester.
9073. Ventilated Handle for Bats, F. W. Seeley, Maidstone.
9074. Compressing and Preserving Fodder, J. M. Fletcher, Cheadle.
9075. Dust Bin, A H. Williams, London.
9076. Water Gauges, G F. Redfern.—(*J. R. Louppe, France.*)
9077. Drying Racks for Photographic Plates, M. P. Ismay, London.
9078. Saddles for Horses, N. J. Heckmann and G. P. Nightingale, London.
9079. Electric Arc Lamps, E. Cantelli and L. Musso, London.
9080. Preventing the Shrinking of Flannel Shirt Collars, R. W. Hayter, London.
9081. Mechanical Trapeze, L. A. Vaidis and F. Beauchamp, London.
9082. Gas Batteries, A. R. Upwards and C. Pridham, London.
9083. Draw-back Bolt Fire-arms, &c., J. P. Pieri, London.
9084. Files, L. Muller, London.
9085. Electric Accumulators, V. Sass and K. Friederich, London.
9086. Coupling, A. T. Boon, London.
9087 Stethoscopes, J. Arnold, London.
9088. Electric Cells for Gravity Batteries, R. H. Courtenay, London.
9089. Receptacle for Coin and the Automatic Delivery of Cigars, &c , W. Hillman, London.
9090. Finings for Brewing, A. W. Gillman and S. Spencer, London.
9091. Solitaires, &c., J. Y. Johnson.—(*A. C. Lemaire, France.*)
9092. Holder for Periodicals, &c., J. H. Hoyle, London.
9093. Toy Gun H. L. Hansen, London.
9094. Cruet Stand, A. H. Gladwin, London.
9095. Wheel Axles, &c., J. Pustowka, London.
9096. Suction Apparatus, H. Gardner.—(*F. von Grubinski, Russia.*)
9097. Securing Rails, J. Whitestone and W. C. Somerville, London.
9098. Amalgamators, E. Fischer and M. W. Weber, London.

SELECTED AMERICAN PATENTS.

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

341,905. Low-water Safety Attachment, *James S. Griffith, Springfield, Ill.—Filed March 6th*, 1884.

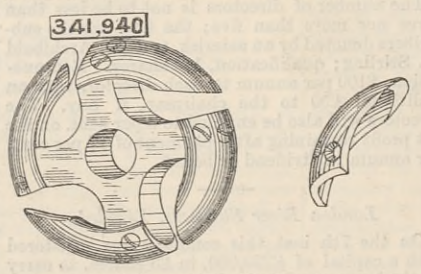
Claim.—(1) In a low-water safety apparatus for steam boilers, the combination of the following elements:—An upper flue tube or crown sheet having an upwardly-projecting hollow portion, essentially as herein described, with the fusible metal containing tube A, of a safety relieving device, substantially as and for the purpose set forth. (2) In a low-water safety apparatus for steam boilers, essentially as herein described, one of the flues or crown sheets of a boiler having an upwardly-projecting hollow portion formed by a bonnet E, and a tube A attached thereto and containing a body of fusible metal, in combination with the valve-holding rod *a* and valve B^1, essentially as herein described, and for the purpose set forth. (3) In a low-water safety apparatus for steam boilers, essentially as herein described, the combination of the containing tube A for the fusible metal,



valve-holding rod *a*, valves B^1 and C, the parts being arranged essentially as herein described, and for the purpose set forth. (4) In a low-water safety apparatus for steam boilers, essentially as herein described, the combination of valves B^1 C and their levers B C^1 with the compensating set screw *c*, essentially as herein described, and for the purpose set forth. (5) In a low-water safety apparatus for steam boilers, essentially as herein described, the valve B^1, formed with a valve portion b^1, and a disc or piston portion b^2, in combination with the valve C, connections b C^1, tube A, containing a body of fusible metal, rod *a*, and lever B, essentially as herein described, and for the purpose set forth.

341,940. Blade for Rotary Cutters, *Charles E. Phillips, Rochester, N.Y.—Filed August 29th*, 1885.

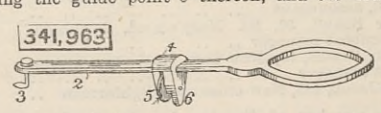
Claim.—The cutter-blade above described, made of sheet metal, shaped as shown, with its exterior surface the converse of the form to be cut, and its inner



surface substantially parallel with its exterior surface sharpened by grinding at one end, and adapted to be secured to a rotating head, all substantially as and for the purpose set forth.

341,963. Can Opener, *George H. Tansley, Springfield, Mass.—Filed March 29th*, 1886.

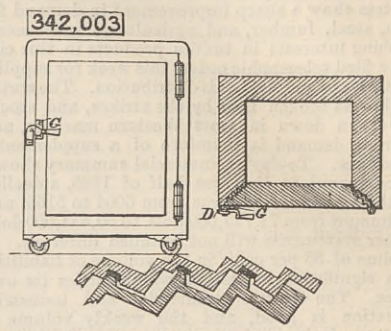
Claim.—A can opener consisting of the bar 2, provided with the pivot hook 3, the cutter carrier 4, having a free sliding movement on said bar and having the guide point 6 thereon, and the rotary



cutter 5, pivotted in said carrier to rotate in plane at an incline to a line drawn at right angles across said bar 2, combined and operating substantially as set f rth.

342,003. Safe, *Henry Gross, Chicago, Ill.—Filed September 26th*, 1885.

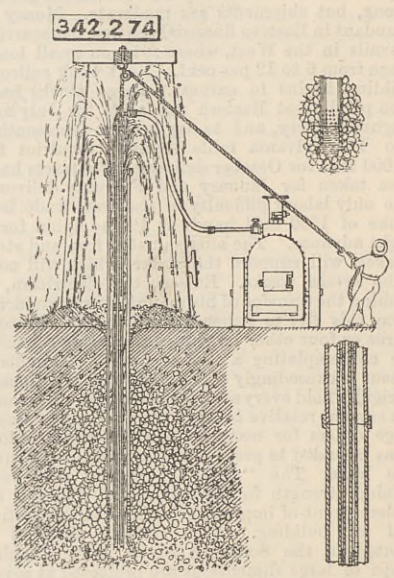
Claim.—(1) In a safe, the combination of a frame or jamb and a door connected thereto by fixed hinges, said door and frame or jamb being provided on their top, bottom, and front faces or edges with ribs and grooves adapted to mesh, and being provided on their hinged faces or edges with ribs and grooves arranged at an angle to the plane of the ribs and grooves on their front faces or edges, substantially as described. (2) In a safe, the pressure mechanism for the door, comprising a cam G, a bent pressure bar pivotted at one end and provided with a handle at the



opposite end, a recessed retaining plate D for said bar, and a journal pin for said bar, having one end held by the retaining plate and the opposite end held in the wall of the safe, substantially as described.

342,274. Steam Excavating Process of Sinking Wells, &c., *John A. Wagner, Middletown, Ohio.—Filed September 10th*, 1885.

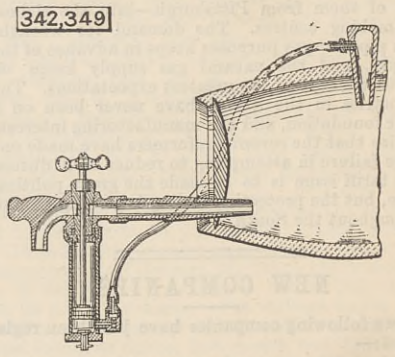
Claim.—(1) The process of excavating or sinking wells, shafts, adits, or other perforations in the earth's crust, which consists in directing a jet of steam against the earth to be removed, and gradually inserting into the excavation thus formed the pipe or tube through which the steam is conveyed, until the desired depth is reached, substantially as set forth. (2) The process



of excavating or sinking wells, shafts, adits, or other perforations in the earth's crust, which consists in directing a jet of steam against the earth to be removed, gradually inserting in the excavation thus formed the pipe or tube by which said steam is conveyed, and sinking in said excavation as its formation progresses a tube or casing which surrounds the steam pipe and forms a wall, substantially as set forth.

342,349. Faucet, *Samuel Gissinger, Pittsburg.—Filed June 18th*, 1885.

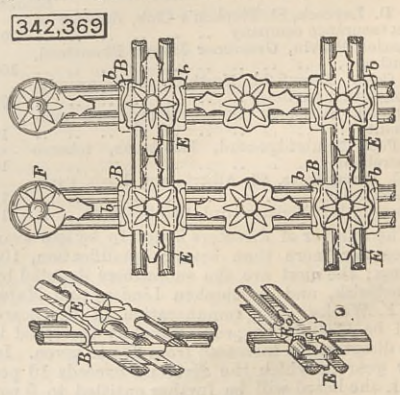
Claim.—(1) A faucet plug having a central tube for the passage of a piston-rod, an air cylinder having air inlet ports and situate below the plug, an air conduit leading from the air cylinder, arranged to be connected with and open into the barrel, and a valve arranged to open and close the air conduit. (2) The combination, in a faucet, of a plug having a central



passage for a piston-rod leading into a cylinder below the plug, a water-way in the plug around but separated from the central passage, and a water passage in the body and nose of the faucet communicating with the water way, substantially as and for the purpose specified.

342,369. Iron Fence, *Charles A. Lockwood, Haverstaw, N.Y.—Filed August 29th*, 1885.

Claim.—(1) The combination of pairs of rods forming uprights, pairs of plates fitted to said rods, pairs of rods forming rails, pair of plates fitted to the rods forming the rails, and bolts passing through all the said plates and between all the said rods, substantially as specified. (2) The combination of pairs of rods



forming uprights, pairs of plates B, fitted thereto, pairs of rods forming rails, pairs of plates E, fitted to the rods forming the rails, and bolts for securing the parts together, the plates B having projections *b*, substantially as specified.