THE MANCHESTER SHIP CANAL.

THE Provisional Committee for this undertaking, nothing deterred by the rejection of their Bill last session by the House of Lords, have deposited new and revised plans of their scheme, and appear to be fully determined to carry it to a successful issue next session. It will be remembered that the initial objection to this scheme last year was that the promoters had not deposited plans showing what works were intended to be carried out in the estuary of the river Mersey between Runcorn, were the river proper may be said to end, and Garston, the highest point in the estuary where a permanently deep channel is at present maintained. The promoters, acting on the advice of eminent counsel, assume that if they could show that the construction of the canal from Manchester to Runcorn was practicable and within their estimate, that the existing law enabled them without the sanction of Parliament to carry out such works in the estuary as would be necessary if they first obtained the consent of the Board of Trade and of the conservators of the river. The Examiner on Standing Orders taking an opposite view of the matter, rejected the Bill, but the House of Commons, regarding the undertaking as one of such importance to the trade of Manchester and the surrounding towns, passed a resolution to suspend the Standing Orders. The Bill consequently came before the committee, who, after a searching and almost unprecedentedly long enquiry, declared the preamble of the Bill to be proved, so far as the canal proper was concerned; but certain conditions were attached to the committee's decision restraining the promoters from proceeding with any of the works authorised by the Bill until the necessary powers had been obtained to construct the estuary works.

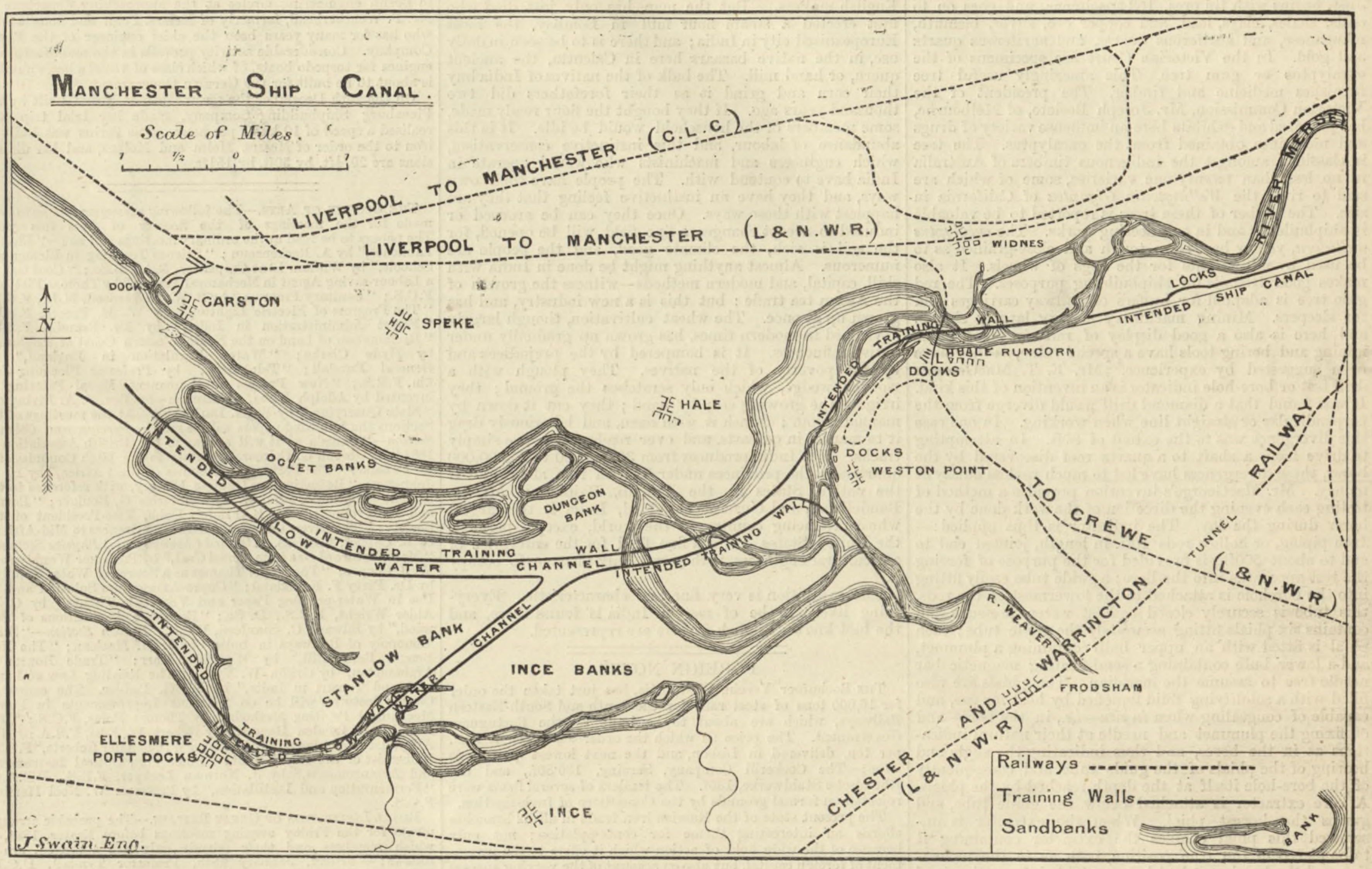
It was late in last session before the Bill reached the Committee of the House of Lords, and consequently the enquiry was less complete and exhaustive in the upper House than the enquiry in the Commons, and the end of the matter was that the Bill was thrown out. As the proceedings of the committees are strictly private after the room has been cleared, it is not certainly known how the Bill came to be rejected; but there are two facts which may account for it—first that the committee was reduced in number by the illness of one of its members, and secondly that it is a well understood rule in the Lords' Committees that when the members are equally divided in voting upon a measure of this kind the chairman gives his vote in favour of the opposition. The rejection of a measure is not always a discouragement or a disadvantage to promoters. It enables them to reconsider and revise the details of their undertaking; and it would appear that the experiences of the contest of last session have enabled the promoters of the Manchester Ship Canal to strengthen a great number of the more assailable points of attack, besides reducing materially the cost of the whole undertaking. In its general features the scheme is the same as was submitted to Parliament last year. No alteration has been made in the arrangement of the docks in Salford, but the company has submitted plans of the river from the docks upward for a distance of 2 miles and 3 furlongs, the intention being to dredge and regulate the channel to enable large traffic to be carried into the heart of the city—up, in fact, to the Cathedral and Victoria station. This extension upwards is intended to meet the requirements of the Manchester Corporation, who have hitherto regarded the position selected for the docks in Salford as being not sufficiently close to the city. After all, the site of the docks is within a mile and a-half of the centre of Manchester; and is immediately accessible by branch lines of railway from the London and North-Western and Cheshire lines railways. The line of the canal has been laid out with somewhat less of curvature than the original design, there being in the new scheme 10½ miles, or half the total length, almost perfectly straight.

The depth of cutting has been reduced, and although an additional lock has consequently become necessary, there will be a considerable saving in the total cost of the scheme. A further practical benefit will be gained in bringing the surface of the canal nearer than it was first designed to the level of the surrounding country. In last year's scheme was included a swinging aqueduct for carrying a branch of the Bridgewater Canal over the Ship Canal at Barton near Manchester, and now an additional provision is made by which coal barges can be lowered from the Barton Canal down to the level of the ship canal, and if necessary raised again into the Barton Canal; so that if anything should occur to interrupt the communication through the revolving aqueduct, the coal barges could be passed over the gap without difficulty. A similar lift, though not applied exactly in the same manner, has been designed by Mr. Leader Williams and is in use on the River Weaver Navigation.

The revised plans show a considerable improvement in respect of the several railway diversions that the undertaking will involve. Last session the opposing railway engineers laboured to show that the gradient of 1 in 114, the ruling gradient adopted by Mr. Leader Williams for the diversions, was excessive, and would involve the expense of bank engines in order to carry on the heavy goods traffic. To meet this difficulty the gradients have been much improved; all those previously shown as 1 in 114, which is the same as the existing gradient to the Runcorn Bridge, have been changed to 1 in 132, or a foot in two chains. The last Bill showed the Stockport and Warrington Branch Railway passing under the canal with descending and ascending gradients of 1 in 60, which was obviously open to objection. In the revised plans this railway passes over the canal with gradients of 1 in 132, so that the technical grounds of objection so strenuously urged by the railway interest last session have been to a great extent removed. A small but important addition is now made to the scheme. It consists of two little branch lines of railway which are brought to the side of the canal from the Liverpool and Stockport line. These lines will bring to either bank coal from Wigan and from the great Yorkshire coal-fields for the supply of steamers and for export.

The promoters are coming prepared with plans showing what they propose to do in the estuary. If the configuration of the esturial portion of the Mersey were at all permanent there would be no difficulty in at once fixing upon the best position for dredging the artificial channel and constructing the training walls; but the estuary is so unstable that within a year, or even a few months, it is liable to be completely changed, and the conservators' plans, on which is laid down the position of the low water channel as surveyed from year to year, form a most interesting object of study for those who are interested in the physical action of streams and currents. One year the channel clings to the north side of the estuary, and the next it will change over and wash the southern margin, or fall into an intermediate position about the centre of the estuary. The illustration which we give below shows the position of the proposed training walls, but the Parliamentary plans make ample provision for deviation from the position now fixed. It will be seen that it is intended to carry the main channel in a gently curving line from Runcorn Gap down the estuary to a point almost abreast of Garston, and about three-quarters of a mile from the shore. The distance between the training walls will increase from 300ft. at Runcorn to 1000ft. at the point where they terminate close to deep water at Garston. The river Weaver, an important tributary to the Mersey, which debouches at Weston, is to be carried round along the shore line northwards by a training wall in order to keep the docks at Weston Point open, and is then to be connected with the main channel, as shown on the engraving. At a point about five miles from the lower end of the main training walls a channel is intended to be carried from the main channel in an oblique direction, running towards the mouth of the river Gowy, which falls into the estuary from the Cheshire side.

This channel is expected to set up such a scour as will keep Ellesmere Port clear, and will also operate favourably on Stoyne Deep, which is the principal anchorage in the Mersey. These works have not, we believe, been decided upon without consultation with the conservators of the Mersey; and if the promoters are able to show that the requirements of the conservators have been kept in view and acted upon, the case for the ship canal will be strengthened sufficiently to meet every opposing interest. The main channel through the estuary will have a depth of 40ft. below the level of ordinary spring tides, and 31ft. below low water of neap tides. Abundant capital is provided for in the Promoters' Bill, the scheme being in some respects more extensive than that of last year. The interest of the Bridgewater and other canals will have to be purchased, as well as a considerable amount of property in Warrington and Manchester, in order to extend the company's operations up the bed of the Irwell to Hunt's Bank. The capital to be raised under the Act is £8,000,000, in £800,000 shares at £10 each.



THE CALCUTTA INTERNATIONAL EXHIBITION.

No. I.

INDIA has opened the first international exhibition ever held in Asia. The affair promises to be very successful, and certainly, from whatever cause failure or shortcoming may arise, it will not be that exhibitors did not support the enterprise. The motive-power in this case came from abroad, and very wide abroad indeed. The Australian Colonies have furnished the prime mover—M. Jules Joubert, a Frenchman naturalised in Australia—and thence, too, came very large numbers of exhibitors, much useful material, and plenty of organising power. There are many striking features in this exhibition, but amongst them nothing is more notable than the perfect readiness of the Australians. At the time that it was difficult to find an advance copy of the official catalogue, the Victorian representatives were distributing a beautifully printed and most elaborately descriptive catalogue of the exhibits in the Victorian Court. This catalogue is full of information concerning the country and its products. New South Wales had a similar catalogue, and in the Tasmanian

Court there is a complete index cabinet and printed catalogue of the minerals and rocks of that colony. This cabinet is octagonal in form, and on each of its eight faces are arranged the small boxes containing the minerals, over 400 in number. These are so placed that a person of ordinary height may examine the contents of each box as he stands, and the catalogue gives a description of each mineral after its number in the case. Bulky specimens of these samples are in many instances shown in another part of the court. The secret of this readiness comes out in the statement that these catalogues and cabinets have been prepared by order of the Colonial Royal Commissioners for the Australian exhibitions at Melbourne and at Sydney. It need scarcely be said that gold dust is one of the products shown here. These samples are of alluvial gold, and one represents gold which has realised the highest price in the market, viz., £4 3s. 10d. per oz. Iron is also found in great abundance on the river Tamar, but after some months working by a company it was found that chromium was present in the ore, and the iron was rendered by this mineral so hard and brittle as to be unsaleable in the market, and the works were abandoned. Tin is found in such abundance that it promises, the Tasmanians say, to astonish the world. The exports of tin in seven years reached the value of £1,050,898. In the first of these seven years the value was but £220, and in the last £299,178. The cabinet, which was arranged by Mr. T. C. Just, begins with tin ores, 163 specimens, and goes on to coals, shales, clays, lead, and copper ore, silver, bismuth, manganese, and auriferous quartz and gold. In the Victorian Court are specimens of the eucalyptus or gum tree. This amazingly useful tree furnishes medicine and timber. The president of the Victorian Commission, Mr. Joseph Bosieto, of Melbourne, has prepared and exhibits here an immense variety of drugs and medicines obtained from the eucalyptus. The tree is classified amongst the indigenous timbers of Australia in no less than twenty-one varieties, some of which are said to rival the *Wellingtonia Gigantea* of California in size. The timber of these trees is reported to be valuable in shipbuilding and in engineering works. The *eucalyptus mellidora*, yellow box, is so tough and close-grained as to be used by millwrights for the cogs of wheels. It also makes good trenails for shipbuilding purposes. The red gum tree is adapted for buffers of railway carriages and for sleepers. Mining machinery is very largely shown, and here is also a good display of railway plant. The mining and boring tools have a special value, as they have been suggested by experience. Mr. E. T. MacGeorge's drill test or bore-hole indicator is an invention of this kind. It was found that a diamond drill would diverge from the perpendicular or straight line when working. In one case this divergence was to the extent of 80ft. In attempting to drive from a shaft to a quartz reef discovered by the borer, these divergences have led to much useless outlay of money. Mr. MacGeorge's invention provides a method of testing each evening the direction of the work done by the borer during the day. The indicator is thus applied:—Iron piping, or hollow rods 10ft. in length, jointed end to end to about 500ft., is provided for the purpose of forcing the test apparatus into the bore; a guide tube easily fitting into the borehole is attached to the lowermost of the rods, this tube is securely closed against water pressure and contains six phials fitting accurately the guide tube; each phial is fitted with an upper bulb containing a plummet, and a lower bulb containing a semi-floating magnetic bar needle free to assume the meridian. The phials are also filled with a solidifying fluid liquefied by heat for use, and capable of congealing when *in situ*—*i.e.*, in the bore—and of fixing the plummet and needle at their natural indications as in the bores, and thus indicating the angle and bearing of the phials of the guide tube, and consequently of the bore-hole itself at the depth reached by the phials. A core extractor is attached below the guide tube, and grasps the lowest phial. When the extractor is unscrewed this phial enables the extractor containing it to be placed in the true position, both as to the inclination and the bearing it had below. This information is of great value to those on whose behalf a bore is being made, since it forms a guide as to the proper site for the next bore shaft or level to be made. The phials being brought to the surface, a recording instrument, a sort of modified theodolite or altazimuth instrument, supplies the means of replacing the phials one by one in the exact position, both as to inclination and bearing, which they had in the borehole and of reading the angles of inclination and magnetic bearing from the vertical and horizontal arcs or graduated circles; the mean reading of six phials being taken as the true indication. This instrument is in general use in Victoria.

India offers a wide field for the introduction of agricultural machinery, but the great question is how to occupy this field. The people are very poor, very contented, and obstinately wedded to their own ways. They seem also to have the faculty of making other people like themselves. When the late Mr. John Head, of the firm of Ransomes and Head, endeavoured to induce the Government of India to introduce steam thrashing machines in India, the final argument against the scheme came from the reports of British resident officers, who pleaded the badness of the roads and the consequent difficulty of moving thrashing machines from place to place, and also that the employment of thrashing machines would, while saving labour, have the effect of starving the poor who do agricultural work for three rupees—about 5s.—a month. This is the difficulty which engineers and machinists have to encounter in India. Labour is so cheap and abundant that the arguments for saving labour lose their force. The people need few clothes, but little or no bedding, and their food is of the plainest and most simple kind. These conditions enable them to work for 60s. a year, and encourages them to swarm upon the face of the earth. In water-raising for irrigation purposes this is specially apparent. The water is everywhere raised by hand. In a journey of 1400 miles from Bombay to Calcutta there is not a windmill pump to be seen, but methods of raising water by hand are common. One of the most simple of these was a trough balanced on the edge of a stream on an upright post; to this trough was fixed a pole, which being raised by the man on the bank, dipped the trough into the stream or pool, and when the man pressed down the pole the trough, which is fixed in a line with the pole, rose full of water and shot it over the bank into a pool to feed the irrigation channels of a rice field. Even one of Warner's windmill pumps could not compete with this when the man's labour may be had for 2d. a day. This primitive instrument is defended, especially on the ground that the man in charge of it could execute such simple repairs as it might need. The argument is somewhat better in this than in the case of thrashing machines. The Indian cultivators are continually being urged to send their corn to market in a cleaner and better condition. The price is kept down very much by the dirt which is the result of treading out the corn by oxen on open thrashing floors and winnowing with the fan. But while the poverty of the small cultivators and the bad roads keep out the thrashing machine, of course pumping engines have even a worse chance, for so long as the water is raised no one need find fault; whereas the ill-condition of the corn sent to market has a depressing effect on all, on the farmer and on the labourer alike.

The same remark applies to corn-grinding machinery. Here is to be found a set of Ganz's milling machinery, and also grinding mills by Robey, by Turner, and by other English makers. But the man has only just died who first erected a steam flour mill in Bombay, the most Europeanised city in India; and there is to be seen in daily use, in the native bazaars here in Calcutta, the ancient quern, or hand mill. The bulk of the natives of India buy their corn and grind it as their forefathers did two thousand years ago. If they bought the flour ready made, some members of the household would be idle. It is this abundance of labour, and this instinctive conservatism, which engineers and machinists who would operate in India have to contend with. The people have their own ways, and they have an instinctive feeling that they are happiest with those ways. Once they can be aroused or induced to accept changes, a fine field will be opened, for the soil is rich, the climate good, and the people are numerous. Almost anything might be done in India with skill, capital, and modern methods—witness the growth of the Assam tea trade; but this is a new industry, and has grown up at once. The wheat cultivation, though largely developed in modern times, has grown up gradually under native influences. It is hampered by the prejudices and by the poverty of the natives. They plough with a wooden wedge, which only scratches the ground; they irrigate the growing crop by hand; they cut it down by manual labour; thrash it with oxen, and laboriously drag it to market in ox-carts, and over roads which are simply tracks. Yet India produces from 30,000,000 to 35,000,000 quarters in the provinces under British rule alone, and if the native States in the Punjab, Rajputana, Malwa, Bandelkand, and Guzerat be added, India is the largest wheat-producing country in the world, except, perhaps, the United States. It is a fine field for the enterprise of agricultural engineers, if they can only manage to occupy it.

The exhibition is very fine and characteristic. Everything likely to be of use in India is found there, and the best known English makers are represented.

FOREIGN NOTES.

THE Bochumer Verein, Westphalia, has just taken the order for 16,000 tons of steel rails for the South and South-Eastern Railways, which are about to be built by the Portuguese Government. The price at which the order was taken is 124f. per ton, delivered in Lisbon, and the next lowest quotations were:—The Cockerill Company, Seraing, 130·80f., and the Rheinische Stahlwerke, 135f. The tenders of several firms were rejected on formal grounds by the Committee of Investigation.

The present state of the Russian iron trade in all its branches affords an interesting theme for contemplation; not only because of the wide field of action which it offers to the investment of foreign capital, but also on account of the varying success which has attended the establishment of industrial concerns in different provinces of the empire. Whilst, for instance, the iron trade is more or less depressed in the central provinces, considerable activity prevails in Poland, where no less than six new steel and ironworks have lately been opened. These establishments, which are for the most part situated in the neighbourhood of Sosnovice, on the Warsaw-Vienna Railway, owe their existence mainly to the high tariff on iron, which has induced foreign manufacturers to open branches upon Russian territory. These Polish works appear to be gradually but surely absorbing a trade which has hitherto been monopolised by a few large St. Petersburg, Moscow, Charkow, and Nishni-Novgorod firms. A large number of the first established Russian ironworks companies committed the mistake of depending almost entirely upon Government for employment, and are not in a condition to work for private customers on an extensive scale, or to compete successfully with the new companies. The Aboukoff Steelworks at St. Petersburg, for instance, are only partially employed, and notwithstanding the enormous resources at their disposal, the managers were unable to supply armour plates until Messrs. Connal and Co., of Sheffield, undertook to superintend the manufacture of compound plates on the Wilson system. The Aboukoff was purchased by the Russian Government after its collapse as a private concern. The same was the case with the Baltic Engine Works, which were, however, subsequently leased to a French shipbuilding company, and the engines for a number of large ships of war are now being manufactured there. Several large concerns which were started a few years back with French capital are now in the market, and others are working at a loss. This state of affairs is chiefly due to the fact that these companies have erected their works at the instigation of the Russian Government without, having previously assured themselves that assistance would really be forthcoming from that quarter. For instance, a German firm was induced to erect very extensive powder mills under the impression that the Government would prove their principal customer. But they soon perceived to their cost that such was not the case, and that they were compelled to compete with foreign firms for Russian orders in the usual manner.

The shipbuilding yards on the coast of the Black Sea are well provided with Government work, as three powerful breastwork ironclads are now in course of construction at Sebastopol, Nicolajew, and at the yard of the Black Sea Steamship Company. The steel for building these vessels—about 6000 tons—is being supplied by the Briansk Steelworks, which, though nominally owned by a private company, are really in the hands of the Government, and were founded by General Timaschew some ten years ago. The ironclads Dmitri Donshoi and Wladimir Monomach, to which reference has already been made, were built entirely of English and Scotch steel; but on a petition being addressed to Government by the Putilow Ironworks and other Russian firms, complaining of the preference shown to foreign material, the Admiralty decided to employ only steel of native manufacture for the future. The dependence of these works upon the assistance of the Government contrasts unfavourably with the independence shown by the Polish firms, who have succeeded in establishing themselves at the head of the trade without any prospect of such aid. At the present moment these firms have as many orders on hand as they can well manage, and it is anticipated that the new Ivangorod-Dombrowa Railway will still further extend their field of business.

As the German War Navy has now reached the numerical strength provided for in the programme of 1871-73, but little heavy marine engine work is likely to be required in the course of the next few years. Three or four sets of large engines for vessels at present in course of construction are still in hand at private works, but it is probable that future demands for this class of work will be supplied by the Government establishments at Wilhelmshaven and Danzig. Several well-known marine engineers, who were called to Germany for the purpose of designing and building the engines for the new navy, have already completed the term of their engagements, and much regret is felt in Berlin engineering circles at the approaching departure of Mr. P. Weatherhead, formerly of Messrs. Penn and Sons' works, who has for many years been the chief engineer of the Egells Company. Considerable activity prevails in the manufacture of engines for torpedo boats, of which class of vessel a large number is about to be built for the German Government.

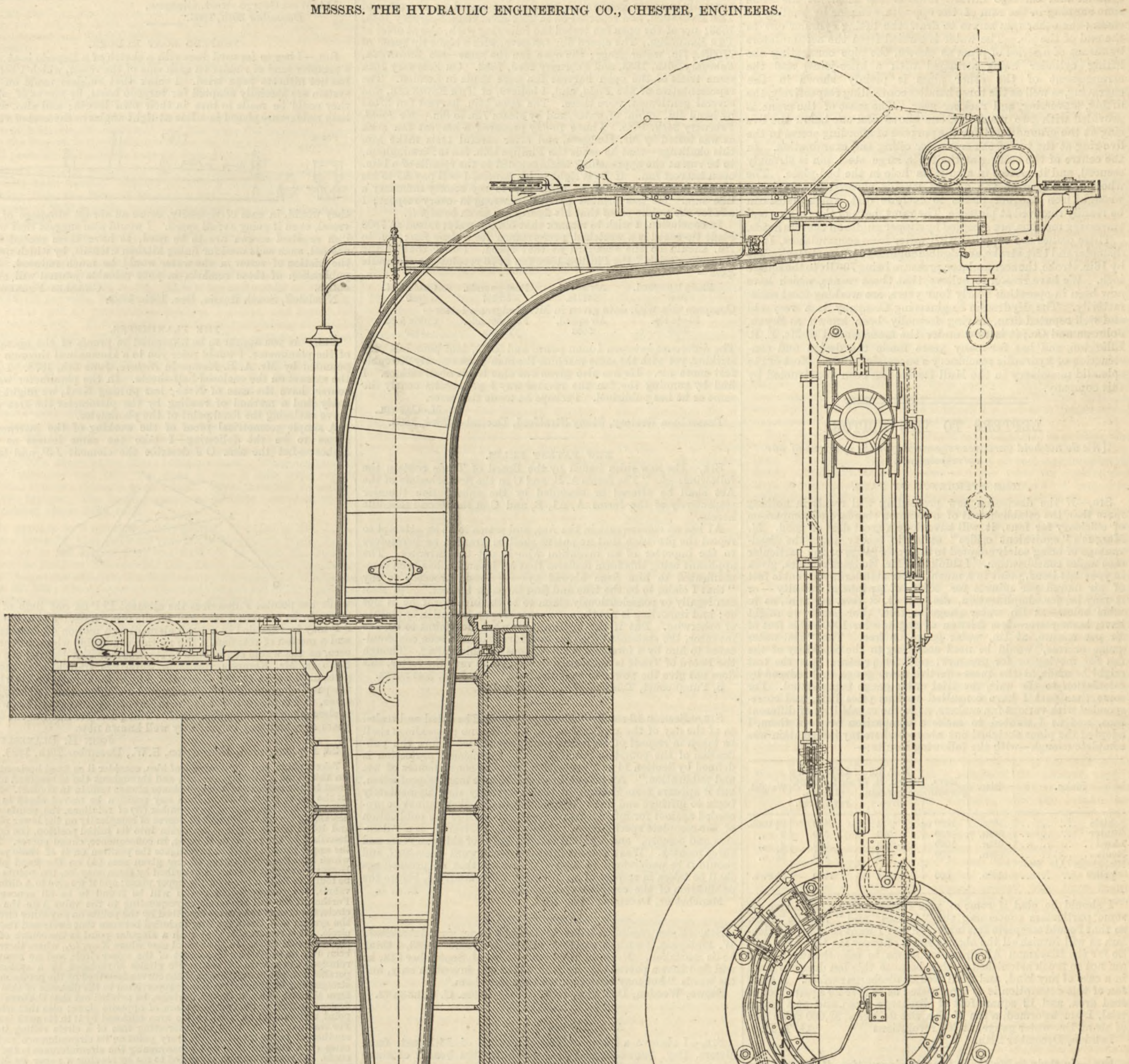
On the 25th December the screw steamer Sirius, built by the Flensburg Shipbuilding Company, made her trial trip and realised a speed of 10 knots per hour. The Sirius was built of iron to the order of Messrs. Holm and Molzen, and her dimensions are 207½ft. by 30ft. by 15¼ft.

THE SOCIETY OF ARTS.—The following arrangements have been made for the meetings of the Society of Arts this year. The papers to be read at the ordinary meetings will be:—"Electric Launches," by A. Reckenzaun; "Science Teaching in Elementary Schools," by William Lant Carpenter, B.A., B.Sc.; "Coal Gas as a Labour-saving Agent in Mechanical Trades," by Thomas Fletcher, F.C.S.; "Sanitary Progress," by B. W. Richardson, M.D., F.R.S.; "The Progress of Electric Lighting," by W. H. Preece, F.R.S.; "Forest Administration in India," by Dr. Brandis, F.R.S.; "Reclamation of Land on the North-Western Coast of England," by Hyde Clarke; "Water Regulation in England," by General Rundall; "Telpherage," by Professor Fleeming Jenkin, F.R.S.; "New Process of Permanent Mural Painting"—invented by Adolph Keim, of Munich—by Rev. J. A. Rivington; "Slate Quarrying," by W. A. Darbishire. At the meetings of the Sections the following papers will be read:—*Foreign and Colonial Section*—"Canada as it will appear to the British Association in 1884," by Joseph G. Colmer, Secretary to the High Commissioner for Canada; "The Portuguese Colonies of West Africa," by H. H. Johnston; "Reflections on Chinese History, with reference to the present situation of affairs," by Demetrius G. Boulger; "Borneo and its Products," by B. Francis Cobb, Vice-President of the Society; "The Rivers Congo and Niger as entrances to Mid-Africa," by R. Capper, F.R.G.S. *Applied Chemistry and Physics Section*—"Manufacture of Gas from Limed Coal," by Professor Wanklyn and W. J. Cooper; "The Upper Thames as a Source of Water Supply," by Dr. Percy F. Frankland; "Cupro-Ammonium Solution and its Use in Water-proofing Paper and Vegetable Tissues," by C. R. Alder Wright, F.R.S., D. Sc.; "Economic Applications of Seaweed," by Edward C. Stanford, F.C.S. *Indian Section*—"State Monopoly of Railways in India," by J. M. Maclean; "The New Bengal Rent Bill," by W. Seton-Karr; "Trade Routes in Afghanistan," by Griffin W. Vyse; "The Existing Law of Landlord and Tenant in India," by W. G. Pedder. The course of Cantor lectures will be on "Recent Improvements in Photo-Mechanical Printing Methods," by Thomas Bolas, F.C.S.; "The Building of London Houses," by Robert W. Edis, F.S.A.; "The Alloys used for Coinage," by Professor W. Chandler Roberts," F.R.S., "Chemist of the Royal Mint; "Some New Optical Instruments and Arrangements," by J. Norman Lockyer, F.R.S., F.R.A.S.; "Fermentation and Distillation," by Professor W. Noel Hartley, F.C.S.

ROYAL INSTITUTION OF GREAT BRITAIN.—The probable arrangements for the Friday evening meetings before Easter, 1884, to which members and their friends only are admitted, are as follows:—Friday, January 18th, Professor Tyndall, D.C.L., F.R.S., M.R.I., "Rainbows." Friday, January 25th, the Rev. Professor T. G. Bonney, M.A., F.R.S., "The Building of the Alps." Friday, February 1st, Professor F. Max Müller, "Râjah Râmmohun Roy, the Religious Reformer of India, (died at Bristol, 1833)." Friday, February 8th, Mr. George J. Romanes, M.A., LL.D., F.R.S., "The Darwinian Theory of Instinct." Friday, February 15th, Professor T. E. Thorpe, F.R.S., "The Chemical Work of Wöhler." Friday, February 22nd, Sir Frederick Bramwell, F.R.S., M.R.I., "London—below Bridge—North and South Communication." Friday, February 29th, Professor D. E. Hughes, F.R.S., M.R.I., "Theory of Magnetism, illustrated by Experiments." Friday, March 7th, Mr. C. Vernon Boys, A.R.S.M. Friday, March 14th, Mr. J. N. Langley, F.R.S., "The Physiological Aspect of Mesmerism." Friday, March 21st, Mr. W. Besant, "The Art of Fiction." Friday, March 28th, Prof. Osborne Reynolds, M.A., F.R.S., "The Two Manners of Motion of Water shown by Experiment." The lecture arrangements are as follows:—Subscribers of two guineas are admitted to all the courses; a single course, one guinea, or half-a-guinea (lecture hour, three o'clock). Christmas lectures: Professor Dewar, M.A., F.R.S., M.R.I., six experimental lectures (adapted to a juvenile auditory) on "Alchemy" (in relation to modern science), on December 27th (Thursday), December 29th, 1883; January 1st, 3rd, 5th, 8th, 1884. Before Easter, 1884: Mr. Reginald Stuart Poole, LL.D., Keeper of Coins, British Museum, two lectures on "The Interest and Usefulness of the Study of Coins and Medals," on Tuesdays, January 15th, 22nd; Mr. Archibald Geikie, LL.D., F.R.S., Director-General of the Geological Survey of the United Kingdom, five lectures on "The Origin of the Scenery of the British Isles, on Tuesdays, January 29th, and February 5th, 12th, 19th, 26th; Professor John G. McKendrick, M.D., F.R.S.E., Prof. Inst. of Med. Univ. of Glasgow, Fullerian Professor of Physiology, R.I., five lectures on "Animal Heat: its Origin, Distribution, and Regulation," on Tuesdays, March 4th, 11th, 18th, 25th, and April 1st; Mr. Ernst Pauer, Principal Professor of the Pianoforte at the Royal College of Music, six lectures on "The History and Development of the Music for the Pianoforte, and its Predecessors the Clavecin, Harpsichord, &c. (with musical illustrations on these instruments), On Thursdays, January 17th, 24th, 31st, and February 7th, 14th, 21st; Professor Tyndall, D.C.L., F.R.S., M.R.I., six lectures on "The Older Electricity: its Phenomena and Investigators," on Thursdays, February 28th, March 6th, 13th, 20th, 27th, and April 3rd; Professor Henry Morley, six lectures on "Life and Literature under Charles I.," on Saturdays, January 19th, 26th, and February 2nd, 9th, 16th, 23rd; Captain Abney, R.E., F.R.S., M.R.I., six lectures on "Photographic Action, Considered as the Work of Radiation," on Saturdays, March 1st, 8th, 15th, 22nd, 29th, and April 5th.

FORTY-TON HYDRAULIC CRANE, PORTSMOUTH DOCKYARD.

MESSRS. THE HYDRAULIC ENGINEERING CO., CHESTER, ENGINEERS.



ABOVE we illustrate one of a pair of hydraulic cranes calculated to lift forty tons. They are forge cranes, and were built by the Hydraulic Engineering Company of Chester for her Majesty's Dockyard at Portsmouth. In the year 1877 the Admiralty invited designs and tenders for the construction of a pair of cranes of this kind, and this company's design and tender were accepted subject to certain modifications in detail ordered by the Admiralty. The height of the rails on the jib from the ground is 20ft., and the range from the centre of the mast to the centre of the lifting cylinder, when the cylinder is at the end of the jib, is 27ft. The traverse of the cylinder on the jib is 15ft., the mast and jib are simply a bent box girder. The mast from the toe or step to the end of the traverse rail is a single box, and from thence to the end of the jib it is split into two smaller boxes, between which the lifting cylinder traverses. The toe rests in a casting with a broad flange strengthened by ribs, and faced up in a lathe, and this casting rests on a live ring as shown, the live ring itself resting on a turned facing which is part of a cast iron bed-plate, through which the holding down bolts pass, and are secured underneath with cotters.

At the ground level, a circular cast iron bearing ring of a box section is recessed in the masonry; the holding down bolts passing through and secured by nuts; the clear distance between the bed-plate and the ring is 25ft. 6in. and the two are connected by four lengths of cast iron tubing, 8ft. outside diameter, bolted together through internal flanges. The top ring has dovetailed recesses in it as will be seen on the plan; these are filled with wood blocks, and inside them an iron ring or tire is placed. Round the mast at this level is a cast iron ring made up in four segments, bolted and rivetted to the mast; the outer circle of this ring combines the ordinary live ring bearing of the crane, and a chain wheel above it. Between the castings on the crane and the tire, a live ring, having rollers 8in. in diameter, is set, and the wood blocks serve to receive and deaden any shock that might arise in the working of the crane to the outer ring. Two hydraulic cylinders, with their rams and pulleys, as shown, are bolted one at either side of the mast, and a pitch chain passes half round the chain wheel and over the ram pulleys; these are used for racking or slewing the cranes round through a quarter of a circle, swinging the forging from the furnace to a steam hammer. The lifting cylinder is 16in. diameter, and 8ft. stroke, it has a heavy flange cast round it strengthened with ribs as shown, and the carriage consists of a ring with bearings for the traverse wheel axles. The flange and ring are so fitted as to admit of a slight ball-and-socket action; the wheels of this carriage move on a pair of rails on the jib arms. At the outer end of the jib to the left of the centre a snatch wheel is carried in a bracket, and at the inner end of the rails a similar wheel is set to the right. At either side of this jib, outside, is fixed a hydraulic cylinder and ram, and these are connected with the lifting cylinder carriage by chains passing over the snatch pulleys; one of these rams draws the lifting cylinder and carriage inward towards the mast, at the same time running in the ram of the opposite cylinder by hauling its chain; the other ram serves to draw the lifting cylinder out to the end of the jib. The water is carried from the accumulators by means of a series of pipes as shown, the pipe connecting the lifting cylinder being arranged with a knee-joint, and the arrangement of the other pipes is plainly shown in the engraving, as well as the three handles controlling respectively, the lifting, traversing, and racking gear. The mast of the crane is provided with two manholes, one above and one below the live ring at the ground level, for the purpose of affording access to the live ring at the toe of the crane, for oiling and examination. In the centre of the casting at the toe a large steel pin is strongly secured, and it rotates in a suitable hole in the bed-plate. The whole of the gear at the ground level is covered closely in by wrought iron chequer plates to exclude dirt, which plates can be readily removed at pleasure. The rams, both of the racking and traversing motions, are steadied by slipper guides on the ram heads.

These cranes are supplied with water from accumulators, 12in. diameter and 12ft. stroke, and double engines $10\frac{1}{2}$ diameter cylinders by 16in. stroke, the accumulator pressure being 700 lb. to the square inch. We have reason to believe that these cranes, which have now been in operation nearly four years, are working most satisfactorily. The Hydraulic Engineering Company is a very old and well reputed firm, having formally been known as Bryan, Johnson and Co.; it is now under the management of Mr. E. B. Ellington, and has for many years made the design and construction of hydraulic machinery a successful study. Most of the splendid machinery in the Hull Docks has been constructed by this company.

LETTERS TO THE EDITOR.

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

THE EFFICIENCY OF FANS.

SIR,—If the discussion now proceeding will result in nothing more than the establishment of a common standard of comparison of efficiency for fans, it will have done a great deal of good. M. Murgue's "equivalent orifice" seems to labour under the disadvantage of being solely adapted to the water gauge of the particular case under consideration. I think that Mr. Hodgson's tables, given in your last issue, point to a much better standard, viz., cubic feet of air moved per minute for 100ft. of peripheral velocity — or it may be, for simplification, dia. cu. ft. × revs. per min., as in table below—at 1in. water gauge or free. For power we might have, horse-power—less friction of engine—for 1000 cubic feet of air per minute, at 1in. water gauge or free. The "1in. water gauge or free," would be used according to the capability of the fan for moving or for pressure; and for pressure fans the test might be made at the most effective water gauge, and reduced by calculation to the unit, the trial water gauge being stated. For some time past I have consulted various price lists, and corresponded with various fan makers, as to the capabilities of different fans, and as I wanted to make a comparison between them, I adopted the plans sketched out above—where my information was complete enough—with the following results:—

Make.	Size.	Revs. per min.	H.P. for 1000 c. ft. of air per min., free.	Cub. ft. of air for 100ft. of diam. revs., free.	Weight.
Schiele	60in.	1000	·414	580	$2\frac{1}{2}$ tons.
Günter	50in.	700	·533	520	2 ,,
Lloyd	48in.	1000	·888	225	2 ,,
Roots	60in.	300	·972	720	$2\frac{3}{4}$,,
Blackman Air Propeller	48in.	600	·084	1230	$2\frac{1}{2}$ cwt.

I should be glad if some of your correspondents could give me some particulars concerning the "Guibal" and "Waddle" fans, so that I could complete this table. In fact I want as many particulars as will furnish all the above results of every fan that I can get. So far the Blackman Air Propeller seems to take the lead; but I am not so much astonished at this, because this fan does not work in a case of any kind, and is all feed or discharge surface. A 48in. fan of this description is so constructed as to give 20 square feet of feed area, and 12 square feet of discharge area; and at a recent trial, I am informed, a fan of this size delivered 38,000 cubic feet of air at 1in. water gauge, at 600 revolutions G. T. H.

London, December 24th.

SIR,—In reply to Mr. C. H. Treglown's question, "Why did not Mr. Capell object to the water gauge reading at the meeting?" I was some distance from him, and did not hear his figures, but well remember his speaking of "two ways of calculating the water gauge," by one of which the power in the air would be much higher than the power in the engine. He referred to certain wild observations made at unknown speed after the trials on the first day as one of the methods for calculating the water gauge. Against this I protested strongly, and explained why a wind gauge observation made close to the inlet obstruction was perfectly unreliable.

He then asks why I ignored the trials of November 1st. My reply is, because I knew nothing about them officially, the results not having been put into my hands; and when I went to the meeting on the 5th I was actually unaware of the figures which would be produced, except by hearsay. After some considerable time I obtained the diagrams and particulars from the secretary.

On November 1st it was agreed by all that the water gauge taken close to the inlet was most unsatisfactory and misleading. I agreed to repeat the trials on the 3rd, and to have a 6ft. length of tube, and a *vena contracta* mouth. I got all ready for the 3rd, and the secretary and another engineer, also a member of the South Staffordshire Mining Institute, attended, as I thought, on behalf of the Institute. The secretary stated at the meeting he saw the 36in. fan pass at 699 revolutions 13,770 cubic feet of air per minute through the mouth of the 6ft. length of 20in. diameter tube, and give in the open mouth of the tube $3\frac{1}{4}$in. water gauge, with indicated horse-power of 3·14. He also stated he saw the same fan, with inlet contracted to 45in., give at 920 revolutions $7\frac{1}{2}$in. water gauge in the opening. He was followed by the other member of the Institute who was present, who corroborated every particular. A gentleman who was sceptical on the first day got up and stated the inequalities of the water gauge had been corrected by the 6ft. length of tube, he having seen the fact and the fan working that morning. Now, I ask, why does Mr. C. H. Treglown ignore the evidence of the secretary of the Mining Institute, who attended to watch the experiment agreed upon by the members present on the first day? Why are these results ignored, which have been published in the *Colliery Guardian*, and have not been contradicted—nay, have been vouched for by Mr. Alexander Smith, the secretary, in your paper, and by another gentleman in the *Colliery Guardian*?

I hope I may not be thought presumptuous when I say this is not the way to search out difficulties in science or mechanics—simply to ignore them. If I saw a cart drawing a horse, I should at once say it was contrary to all my experience, but should "buckle to" and proceed to investigate the paradox. The trials which I shall hold next month will be merely a repetition in every particular of the first experiment to establish their authenticity. The new high-pressure blast fans and low-pressure disc ventilator can then be tested. Neither are quite ready just yet in the size I wish to test.

In reply to Mr. J. Hodgson, I can only say his experiments do not tally in water gauge with my 6in. fan tested at the office of THE ENGINEER, and reported on in THE ENGINEER, February 16th, 1883; nor of the open fan tested the following week, also at office of THE ENGINEER. The closed 6in. fan gave, with a blade tip speed of 7700ft., 7in. water gauge; the open fan the same—see ENGINEER, February 16th, 1883, and February 23rd, 1882. On February 19th some trials of the open harvest fan were made in London. The representative of the *Field*, and, I believe, of THE ENGINEER, and several gentlemen, were there. The open 14in. harvest fan lifted by hand 4in. to 5in. of water, and by steam 7in. to 8in.—see *Field*, February 24th, 1883. I have to-day procured a harvest fan such as was tested by Mr. Hodgson, and after careful tests make him this challenge—that he sends the Phillips 15in. fan to Birmingham, to be run at the approaching trials coupled to the spindle of a 14in. open harvest fan. If he is right in his figures, I will pay £5 to his county infirmary; if not, he shall pay to my county infirmary a like sum. He has printed particulars wrong in every respect; I ask for the public proof that his figures are given *bonâ fide*.

In conclusion, I wish to remark that 3in. of water raised at 7800 blade tip speed is a wretched performance for a close fan; 6in. to 7in. should be the standard at that speed. I find that at the "Reading trials" the Phillips 15in. fan at 76 revolutions of handle gave—

Blade tip speed.	Air speed.	Foot-pounds.	Cubic feet.
5447	2374ft.	53·757	839

Compare this with data given in Mr. Hodgson's letter—

Blade tip.	Air speed.	Foot-pounds.	Cubic feet.
4800	3593	1 man	1029

The difference between 1-man power and 53·757 foot-pounds is very striking, yet with the same machine the man passes nearly 200 cubic feet more air. He has also given one clue to his observations. I find by running the fan the reverse way I get results nearly the same as he has published. Perhaps he made this error.

G. M. CAPELL.

Passenham Rectory, Stony Stratford, December 23rd, 1883.

NEW PATENT RULES.

SIR,—The new rules issued by the Board of Trade contain the following:—5. "The forms A, B, and C in the first schedule of the Act shall be altered or amended by the substitution therefor respectively of the forms A, A1, B, and C in the second schedule hereto."

A1 has no counterpart in the Act, and seems to be an attempt to repeal the provision that no patent shall be granted as heretofore to the importer of an invention who is not the inventor. The applicant using this form declares that an invention has been communicated to him from abroad by————and proceeds to say "that I claim to be the true and first inventor thereof." No man can legally or conscientiously claim to be the inventor if he is not so; and importing is not the same as making an invention by statute or otherwise. But if the applicant is what he claims to be, the inventor, the statement that his own invention has been communicated to him by a foreigner is superfluous and misleading. Though the Board of Trade is authorised by the Act to vary the forms, this does not give the power to vary the law. J. K. SMYTHIES.

5, Pump-court, Temple, W.C., January 1st.

SIR,—Section 13 reads—"Every patent shall be dated and sealed as of the day of the application, provided that no proceedings shall be taken in respect of an infringement committed before the publication of the complete specification." Provisional protection is defined by Section 14 as "protection from the consequences of use and publication." An inventor can obtain nine months' protection, but it appears from Section 13 that everybody may immediately begin to infringe and do so for nine months, as they cannot be proceeded against for infringements committed before the publication of the complete specification. Surely such protection is a "delusion and a snare," and a patent is really only for thirteen years and three months. Was a comma intended at the word *committed*, and should it be understood to read—"Provided that no proceedings shall be taken in respect of an infringement committed, before the publication of the complete specification?" P. J. L.

Manchester, December 24th, 1883.

SIR,—Upon reading a letter in to-day's issue, signed Archibald W. Finlayson, I wish to say that with regard to Clause 33, I think he is mistaken. If he turns to your issue of September 7th, he will find that a patent may be granted for one invention only, and the words "but may contain more than one claim."

Stowe, Weedon, Dec. 21st, 1883. THOS. C. SARGEANT.

AYR HARBOUR SLIPWAY.

SIR,—I observe a letter in THE ENGINEER of 14th inst. from Messrs. Day, Summers, and Co., which, for the benefit of those who may wish to build a slip dock, requires an answer.

When the Ayr Harbour Trustees instructed me to prepare plans for the 1200-ton slip now completed, I took the trouble to make myself acquainted with the various methods adopted for hauling up vessels on inclines or slipways. Messrs. Day, Summers, and Co. brought their "patent" system under my notice, and put themselves to a great deal of trouble to supply me with information regarding their slipway and the system of wire rope haulage, for which they have taken out a patent. I visited their slip, and was much pleased with the flexibility of the wire rope manufactured by the Messrs. Bullivant, of London, and its apparent suitability for its work, but I was not pleased with the machinery, which appeared to have been designed too weak, and afterwards supplemented by an auxiliary engine; nor did I like the use of the worm gearing, which seemed to be the distinctive feature of the system.

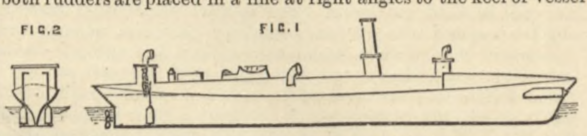
On my recommendation, the trustees resolved to adopt the wire rope system of haulage, but with the simplest possible arrangements, and I prepared the requisite drawings and specification for machinery, such as may be seen at any colliery or railway incline where wire rope is used. The result has been entirely successful. Messrs. Day, Summers, and Co. tendered for the erection of the Ayr machinery according to their own design, but the offer was not accepted. Messrs. Day, Summers, and Co., however, made a claim of £300 for royalty, which was resisted by the Harbour Trustees, who informed the claimants, through me, that they were quite prepared to contest with them their perfect right to adopt wire rope haulage without infringement of any valid patent, but expressed their willingness, in consideration of the courtesy shown by Messrs. Day, Summers, and Co. to the trustees' representatives on two occasions when visiting Southampton, and the trouble they took in starting their machinery, and otherwise in connection with this matter, to grant an honorarium of one hundred guineas, provided all claims were waived. Messrs. Day, Summers, and Co. accepted the sum offered instead of the £300 claimed, but preferred to take the money as for their "patent right," instead of as an honorarium, and the trustees, to end the matter, ultimately agreed to do so, so long as it cost them nothing more.

Now, I do not wish to take away any credit that is due to Messrs. Day, Summers, and Co., for had we not heard of the successful working of their slip by means of wire rope, the idea of adopting that system would probably not have occurred to us; but if Messrs. Day, Summers, and Co. wish to get royalties for their "patent system," the less they rush into print by way of cheap advertisement, and to disparage the work of others, the better, especially of those who know that boats have been hauled up inclines or slipways by wire ropes ever since wire ropes were generally known—notably on the Monkland and Shropshire Union Canals, where the haulage is not only non-fleeting, but non-patent, and precisely similar to that adopted by Messrs. Day, Summers, and Co. and the Ayr Harbour Trustees. It would be interesting to know that a spoon that had been used for eating porridge could be patented for eating peas. JNO. STRAIN.

154, West George-street, Glasgow, December 20th, 1883.

TORPEDO BOAT RUDDER.

SIR,—I beg to forward herewith a sketch of a torpedo boat with a peculiar kind of rudder on each side of the vessel, which I believe has not hitherto been tried. I think that rudders made on this system are specially adapted for torpedo boats, by means of which they could be made to turn in their own length; and also, when both rudders are placed in a line at right angles to the keel of vessel



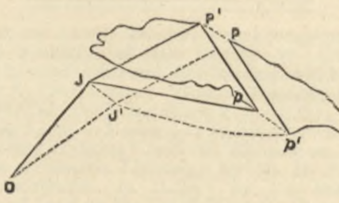
they would, in case of necessity, cause an abrupt stoppage of the vessel, even if going at full speed. I would also suggest that when iron or steel screws are to be used, to have them coated with enamel, such as is used for lining kitchen utensils, by which means the friction of screw in the water would be much reduced. The publication of these remarks in your valuable journal will much oblige. CHARLES FOLKERT.

Nicolaieff, South Russia, Dec. 18th, 1883.

THE PLANIMETER.

SIR,—As you appear to be interested in proofs of the operation of the planimeter, I would refer you to a kinematical theorem propounded by Mr. A. B. Kempe in *Nature*, June 6th, 1878. I give the extract on the enclosed half-sheets. In the planimeter we, of course, have the case of $N=o$; but putting $N=1$, we might probably find a method of reading by the planimeter the area of a curve enclosing the fixed point of the planimeter.

A simple geometrical proof of the working of the instrument seems to be the following—I take the same letters as Mr. Fisher:—Let the arm O J describe the element $J J^1$ and back,



while the pointer P describes the element $P^1 P$ on one limb of the curve to be measured, and $p p^1$ on the other limb. The motion of J P may be regarded in a small element as a motion of translation and a motion of rotation. The motion of rotation when summed is zero, as the whole comes back to its original point—giving the case $N=o$ in Mr. Kempe's theorem—while the translational motion gives as the area of the element $P P^1 p p^1$ the difference clearly of the parallelograms $P P^1 J J^1$ and $p p^1 J J^1$. Either side $J J^1$ being the same, this is proportional to the difference of their breadths, which is clearly registered by the wheel. This proof occurred to me some years ago, and may be perfectly well known now.

JOHN H. BLAKESLEY.

23, Fopstone-road, Kensington, S.W., December 29th, 1883.

Take a plane, and, for clearness of idea, consider it as fixed horizontally On this fixed plane lay another, and throughout the subsequent movement let the surfaces of the two planes always remain in contact. Now, let the upper plane starting from any position be moved about in any manner whatever, making any number (N) of rotations, the points of it describing curves of any desired degree of complexity on the lower plane; and let it finally settle down again into its initial position, the curves described by the points on it being, in consequence, closed curves. Take the upper plane, and let us investigate the position on it of those points which have described curves of any given area (A) on the fixed plane. However complex the curves described by them may be, the points will be found to lie in a circle on the upper plane; and if we give to A different values, the corresponding circles will be found to be all concentric. Further, if we call the circle corresponding to the value $A=o$ the zero circle, the area of the curves described by the points on any other circle of the system $=$ N times the ring included between that circle and the zero circle. It is remarkable that such a singular point as the centre of the circles should exist. In the special case where $N=o$, *i.e.*, where there has been only an oscillatory movement of the upper circle, and no complete rotation, the system of concentric circles is replaced by a system of parallel straight lines, the area of the curves described by the points on any straight line of the system being proportional to the distance of that line from the zero line. It should, perhaps, be pointed out that the area of a figure 8 is zero, as the two halves are of opposite signs; also that when a point reciprocates on a curve the area enclosed by it in its path is zero. For example: if we take the interesting case of a circle rolling inside another of twice its diameter, every point on its circumference reciprocates on a straight line, and consequently the circumference is the zero circle. This theorem was suggested to me by reading a paper by Mr. C. Leudesdorf in the *Messenger of Mathematics*, where I have already enunciated it. It seems, however, to be one which, from its startling simplicity, may interest a larger class of readers than a purely mathematical one. The proof is simple. Let $P P^1$ be two points on the moving plane, and let $A A^1$ be the areas described by them. Let $P P^1=r$, and let the total movement of P^1 perpendicular to $P P^1=n$. Then $A-A^1=nr+N\pi r^2$. If we take P^1 as origin and the position of $P^1 P$ in which n is a maximum and equal to n^1 as initial line, $n=n^1 \cos. \theta$. Thus $A-A^1=n^1 \cos. \theta r+N\pi r^2$, the equation to a family of concentric circles. Transforming to the centre, we have $A=N\pi(r^2-a^2)$, where a is the radius of the zero circle.

BOILER ASSURANCE.

SIR,—Last week I drew your attention to Mr. Gray's report, and this week you criticise it and disagree with his remarks about "boiler assurance," and you "further say that boiler assurance cannot do everything," "but it can do a great deal and ought to be encouraged." I beg leave to say, Sir, that "boiler assurance," far from "doing everything," never did any good at all. Three weeks ago, Sir, I gave you an instance that came under my own experience where a boiler had been insured in a dangerous condition, said boiler being about thirty years old and without an original plate, I believe, exposed to the fire, but full of patches and frequent repairs, the last repair having been done in an unskilful and grossly careless manner, leaving the boiler worse than before; yet spite of this I was informed by the principal himself—neither hearsay nor theresay—that he had paid and renewed the premium for "assurance" of same.

30, Hagley-road, Birmingham, JOHN SWIFT.
December 18th, 1883.

AN IMPROVED GAS-BURNER.

SIR,—In your last issue of THE ENGINEER you published an account, with sketch, of an improved gas-burner by R. Allison, Stoke, Ipswich. Allow me to inform Mr. R. Allison that he is not the first inventor of this gas-burner. I have made and used this burner nearly three years ago, which I showed to some friends, who informed me that I should find a similar one in Knight's "Dictionary of Mechanics," and there styled Franklin's burner, the main features of which are the same, with the exception of the annular pipe up the centre. A. HEMINGWAY.

Rochampton, London, S.W., December 27th, 1883.

THE EXPLOSION AT CARTHAGENA.—The Royal Mail Company's steamer Nile brings news that in the fatal explosion on board the Severn at Carthagena last month, the combustion chamber of the port boiler gave way, and seven of the engineering staff, the cook, and baker were killed.

RAILWAY MATTERS.

THE Varna Railway was blocked last week by a heavy snowfall from Christmas Day, and the mail service was much interrupted, and even telegraphic communication became uncertain.

THE *Railway Age* reports that 6600 miles of new American railway were built in 1883, against 11,600 the previous year. This construction cost 165,000,000 dols., and makes a total mileage of 120,000.

THE Texas Pacific Railway bridge across the Atchafalaya river, Liouisiana, has been completed. It has been two years building, and cost £100,000. This bridge is of great importance to the South-Western Railway traffic.

THE second section of the Hounslow and Metropolitan Railway, of which Messrs. Wells, Owen, and Elwes are the engineers, carrying the line on to the Hounslow Barracks, is in active progress, and will probably be ready for opening during this year.

THE number of passengers—of every description—who travelled to and from various stations on the Metropolitan Railway on Boxing Day, the 26th of December last, was 227,146, being an increase of 2052 over the number conveyed on the corresponding day in 1882.

TENDERS for the third section of the Illawarra Railway from Coal Cliff, New South Wales, to the Macquarie River, a distance of 26 miles and 15 chains, have been opened. Seven were received, and the lowest was that of Messrs. Proudfoot and Logan, the amount being £318,526 2s. 8d. This is approximately at the rate of £12,432 per mile, but, the *Colonies and India* says, it is only for works such as excavations, bridges, culverts, and laying the permanent way. It does not include the permanent way materials, station buildings, water supply, &c. On this section, near Coal Cliff, there will be a tunnel 1056 yards in length.

A BRIDGE is to be built over the Susquehanna River between Havre de Grace and Port Deposit, Md., on the Baltimore and Ohio's new Philadelphia branch. It is to rest on granite piers, which will be founded on the bed rock by means of pneumatic caissons sunk after the manner of those at the East River and St. Louis bridges. There are to be five of these caissons, each about 40ft. by 80ft. in area, and they are to be sunk to depths varying from 50ft. to 85ft. below water surface. The grade line will be 90ft. above water, there being no draw. Where crossed by the Baltimore and Ohio the river is over a mile wide, and is divided into two channels by an island. Thus there will, in reality, be two bridges. The longest span is to be 520ft. and most of the remaining spans 400ft. each.

IT appears by a return recently printed by order of the Legislative Assembly that the total cost of the New South Wales Tramways up to the end of 1882 was £458,145, of which the Bridge-street to Redfern line cost £41,665; Liverpool-street to Randwick and Coogee cost £66,443; Darlinghurst to Waverley and Woollahra cost £37,332; Crown-street to Cleveland-street cost £6511; railway to Glebe Point and Forest Lodge cost £38,827; Devonshire-street Junction to Botany, £71,262; Newtown-road Junction to Marrickville, £30,160; Campbelltown to Camden, £29,515. Rolling stock, £136,430. The earnings for the year are given as follows:—Redfern to Bridge-street, £23,651; Liverpool-street to Coogee, £22,323; Darlinghurst to Waverley and Woollahra, £33,226; Crown-street to Cleveland-street, £10,498; railway to Forest Lodge and Glebe Point, £3539; Devonshire-street to Botany, £18,819; Newtown-road to Marrickville, £9146; Campbelltown to Camden, £2153. The total expenditure for working the several sections, taken in the same order, shows the following figures:—£28,443, £20,813, £23,417, £9586, £9678, £16,374, £9130, £2720, or a total of £120,181, as against the total receipts of £128,355, which gives a credit balance of £8174, or nearly 6·4 per cent.

FOR some time the failure of the Government as a railway owner has kept alive the proposal for transferring the French State Railways to the existing companies. The price is set down at from 400,000,000f. to 420,000,000f., the State guaranteeing 4·65 per cent. interest. Two grounds are given for this sale. The first is that the State railways are at present badly managed, and that the State is losing by them. The second is that the transaction would save the Government from the necessity of resorting to a loan to adjust the Budget. Both grounds seem bad. If the Government is losing on the railways, it is quite comprehensible that it should sell them, but without guaranteeing interest. The *Times* Paris correspondent says: It would be better to sell at a lower price and give no guarantee; for to guarantee a losing concern is a ruinous process. This would not necessarily be the case, as a private company could work at a profit, and this it is not as easy for the State to do as for private persons. The correspondent referred to says: "This system of selling State property to cover Budget deficits can be carried too far, and might finish by disposing of the Louvre." He will probably learn that the chief reason for the sale is that France is now convinced that railways cannot pay well that are in the hands of uninterested Government officials.

THE report of the Oude and Rohilkund Railway Company for the first half of 1883 shows the following results, as compared with the corresponding half of 1882:—In number of passengers, a decrease in 1883 of 43,954, or 3·01 per cent.; in receipts from passengers, a decrease in 1883 of £14,406, or 12·21 per cent.; in tons of goods, a decrease in 1883 of 39,717, or 7·97 per cent.; in receipts from goods, a decrease in 1883 of £1368, or 0·83 per cent.; in gross receipts, a decrease in 1883 of £6886, or 2·29 per cent.; in gross expenditure, a decrease in 1883 of £26,390, or 14·48 per cent.; in profit, an increase in 1883 of £19,504, or 16·54 per cent.; in expenditure on gross receipts, a decrease of 7·57 per cent. The falling-off in gross receipts as shown in the accounts—viz., £6886—is more apparent than real, as it was chiefly owing to a considerable reduction in the freights charged for the carriage of revenue stores. On one item alone—coal—the charge for carriage was reduced from one-sixth to one-tenth pie per maund per mile, and if the nominal debits and credits under the head of carriage of revenue stores were eliminated, the actual earnings would have represented an increase of £2771. In ordinary seasons so small an increase would have been accepted as an indication of slow but satisfactory progress; but during the half year under review, everything pointed to more prosperous results..

THE following is a list of lines of proposed railway surveys and extensions, indicating reproductive works, forwarded to the New South Wales Crown Lands Department for the purpose of having the Crown lands through which such lines pass reserved from sale, in accordance with Ministerial direction:—From Grafton to the Tweed River, *viâ* Casino, Lismore, and Byron Bay; from Grafton to Inverell, *viâ* Glen Innes; from Grafton to Tenterfield; from Grafton to Tabulam; from Uralla, or Kentucky, to Inverell; from Tenterfield to Casino; from Woodburn to Iluka; from Trial Bay to Armidale, coast survey, Morpeth to Grafton; from Narrabri to Memgindi; from Narrabri to Moree; from Coonamble to Walgett; from Blue Rock to Brewarrina; from Ghilambone to Cobar; from Nyngan to Cobar; from Cobar to Wilcannia; from Dubbo to Coonamble; from Mudgee to Coonamble, to accommodate, if practicable, the townships of Gulgong, Cobborah, and Mandooran; from Dubbo to Werris Creek; from Dubbo to Forbes; from Werris Creek to Wellington; from Forbes to Young, *viâ* Grenfell; from Forbes to Wellington; from Forbes to Wilcannia; from St. Leonard's to Pierce's Corner; from St. Peter's to Liverpool; from Cemetery, near Kiama, to Jervis Bay; from Perth, G. W. Railway, to Rockley; from Gundagai to Tumut; from Bourdo to Robertson, *viâ* Burrawang; from Goulburn (or 3rd Bredalbane Plains) to Crookwell; from Tarago to Braidwood; from Wagga Wagga to Tumberumba; from Culcairn to Germanton; from Culcairn to Corowa; from Cooma to Bombala; from Bombala to Bega; from Rolandara to Candelo; from Bega to Eden, Twofold Bay.

NOTES AND MEMORANDA.

THE *Gaceta Industrial* says a concentrated solution of bichromate of potash and glue makes an excellent cement for repairing articles of broken glass. After covering the fractured surfaces with this solution they are brought together and exposed to the action of the sun. This cement resists boiling water.

IN his recent lectures at the College of France, Maurice Levy has given equations which, the *Journal of the Franklin Institute* says, rigorously define the electric field and the magnetic field of a dynamo-electric machine in its permanent state. Although the equations cannot be integrated, he has deduced many consequences, among which he calls especial attention to the following:—The electro-motive force of a dynamo-electric machine is not, as has been commonly thought, proportional to the velocity of its coils; it can only be expressed by an infinite series, arranged according to the integral powers of that quantity.

M. BRARD has communicated some investigations to the French Academy, which give the following results:—(1) On plunging a red-hot carbon into a bath of melted nitrate, an energetic current flows from the bath into the exterior circuit. (2) The melted nitrates become very fluid, and, like greasy bodies, lubricate the heated bodies with which they come into contact. (3) In order to obtain a current it is not necessary to plunge the carbon into the nitrate bath, but it suffices to place a metal capsule containing some grains of the melted nitrate upon the burning carbons. M. Brard is continuing his experiments.

IN an article which appeared in a late number of the *Aéronaut*, David Napoli, President of the Société de Navigation Aérienne, examines the comparative desirability of steam and electric motors for propelling long balloons. He found that a twenty-horse steam engine, working for ten hours, would consume 200 kilogrammes of coal and 1400 kilogrammes of water. An electric engine of 20-horse power, with all its supplies for ten hours' service, would weigh about 1400 kilogrammes, which is less than the bare consumption of material in the steam engine, leaving out of the question the weight of the generator and of the mechanism of transmission.

AT a meeting of the Physical Society a short time ago, Dr. J. Blaikley read a paper on "The Velocity of Sound in Air," in which he described a modification of Dulong's method of measuring it by the wave-length in a pipe lengthened. Dulong did not allow for the partial tones, which are an important factor, whereas Mr. Blaikley does. By means of organ pipes of different diameters, the author has found the velocity to be about 320 metres per second. Mean result with four tubes: one of 54·1 mm. diameter, velocity = 329·73 metres per second; one of 32·5 mm. diameter, velocity = 328·78 metres; one of 19·5 mm. diameter, velocity = 326·9 metres; one of 11·7 mm., velocity = 324·56 metres. The velocity diminishes as the tube is smaller in bore.

MESSIEURS CRAFTS and Pernet have presented some recent communications to the French Academy, relating to the changes which thermometers undergo when they are heated for a long time. In manufactories of printers' ink, where oils are heated to a temperature of 270 deg. C.—538 deg. Fah.—for many days, the most accurate thermometers often become so changed as to indicate errors of ten or more degrees. The *Journal of the Franklin Institute* says M. J. Salleron calls attention to similar changes at much lower temperatures. The areometers, which are employed in sugar refineries where molasses is treated by osmosis, are plunged for many days in liquids which are heated to 95 deg.—203 deg. Fah. Although this temperature is below the boiling point of water, it is sufficient to completely modify the areometers and to soften the glass enough to make them untrustworthy.

A SHORT time ago M. Bosanquet made a communication to the Physical Society on "The Moment of a Compound Magnet," which he showed how to measure by the method already published by him. A compound magnet made up of eighteen small cylinders of magnetised steel placed end to end is hung in a cradle carried by a delicate bifilar suspension, and placed at right angles to the magnetic meridian. The deviation from zero produced by the magnet is noted; then the magnet is divided into two parallel rows of nine cylinders along the cradle, and the deviation again noted. The tangent of the angle of deviation from the east and west line, multiplied by a constant, is the moment of the magnet. The author also pointed out that to define the condition of a permanent magnet it was necessary to know the difference of magnetic potential, the "resistance of the metal, and the resistance of the external space."

DURING the week ending December 1st, in 33 cities of the United States, having an aggregate population of 7,378,100, there died 2709 persons, which is equivalent to an annual death rate of 19·1, a slight diminution from the rate of the preceding week, viz., 20·6. For the North Atlantic cities the rate was 17·7; for the Eastern cities, 20·1; for the Lake cities, 15·1; for the River cities, 16·7; and in the Southern cities, for the whites 22·0, and for the coloured 37·0 per 1000. Of all the deaths 33·1 per cent. were of children under five years of age, the proportion of deaths of this class continuing highest in the Lake cities, where it was 40 per cent. According to the statistics officially published by the American *Sanitary Engineer*, accidents caused 3·6 per cent.; consumption, 14·6; croup, 2·5; diarrhœal diseases, 3·0; diphtheria, 3·9; typhoid fever, 2·9; malarial fever, 1·1; scarlet fever, 2·2; pneumonia, 8·1; bronchitis, 3·2; measles, 0·7; and whooping cough, 0·7 per cent. of all deaths. Diphtheria continues most severe in the Lake cities, in which it causes 6 per cent. of all deaths.

AT the meeting of the Chemical Society on the 20th ult., a paper was read on "The Decomposition of Ammonia by Heat," by W. Ramsay and S. Young. The results obtained may be summed up as follows:—When ammonia gas is passed through a porcelain tube, or an iron tube, or a glass tube, fitted with asbestos cardboard, the amount of decomposition at 500 deg. to 520 deg. is nearly equal and very small. Ammonia, therefore, begins to decompose a little below 500 deg. In contact with a glass surface the temperature at which decomposition begins is much higher: the amount of decomposition depends on the rate of passage of the gas and on the nature of the surface. Thus ammonia is completely decomposed by passage through a plain iron tube heated to 780 deg. By passing ammonia through a glass tube containing iron wire at 760 deg.—76 per cent. of the ammonia was decomposed with copper wire under similar conditions—only 2 per cent. was decomposed. Mr. Warington pointed out the importance of these results in connection with the now common practice of making soda lime combustions in iron tubes.

M. BOURDALOU, having stated in 1864, in his work, "Nivellement Général de la France," that the average level of the Mediterranean is by 0·72 metre lower than that of the Atlantic, this result was received with some distrust by geodesists. General Tillo points out now, in the last issue of the Russian *Izvestia*, that this conclusion is fully supported by the results of the most accurate levellings made in Germany, Austria, Switzerland, and Spain, which have been published this year. It appears from a careful comparison of the mareographs at Santander and Alicante by General Ibanez, that the difference of levels at these two places reaches 0·66 metre, and the differences of level at Marseilles and Amsterdam appear to be 0·80 metre when compared through Alsace and Switzerland; the Comptes Rendus de la Commission Permanente de l'Association Géodésique Internationale arrive at 0·757 metre from the comparison with the Prussian levellings, whilst the fifth volume of the "Nivellements der Trigonometrischen Abtheilung der Landesaufnahme" gives 0·809 *viâ* Alsace, and 0·832 *viâ* Switzerland. The difference of levels at Trieste and Amsterdam, measured *viâ* Silesia and Bavaria, appears to be 0·59 metre. Each of these four results—0·72, 0·66, 0·80, and 0·59—having a probable error of 0·1 metre, their accordance is quite satisfactory, and we may, *Nature* says, admit thus that the average level of the Mediterranean is in fact lower by 0·7 metre than that of the Atlantic.

MISCELLANEA.

THE French Association for the Advancement of Science will probably meet during August in the town of Blois, the birthplace of Denis Papin.

M. VAN RYSSELBERGHE'S invention permitting telegraph lines to be used for telephoning at the same time, is to be applied to the whole telegraph system of Belgium.

THE Universal Maritime, Colonial, and Industrial Exhibition at Antwerp in 1885 is to cover twenty-two hectares. Space will be half the price charged at Amsterdam.

To the names of the recipients of awards at the late Fisheries Exhibition previously published, has now to be added that of Messrs. Hudswell, Clarke, and Co., for their wrought iron pulleys.

A PAPER "On the Shipping Trade, and on the Rise and Progress of Ships and Steamships, including the Trade of Liverpool," by Mr. W. Blood, has been published by Messrs. E. Smith and Co., of Liverpool.

THE *Paris* of the 28th ult. stated that a definitive agreement had been arrived at between the Suez Canal Company and the British shipowners on terms affording legitimate satisfaction to the company's interests.

THE Hove Commissioners have adopted a report recommending the sealing of a contract with Messrs. W. Hill and Co. for the construction of a sea wall, with inclined and timber groynes, for the protection of the foreshore, for a sum of £23,946.

A PRELIMINARY trial trip will take place on Saturday next, leaving Temple steamboat pier, of a steamer of very novel construction named the Stanley, built for the King of the Belgians, for the Association Internationale, for the use of Stanley in the interior of Africa. This steamer is of extremely novel and interesting construction.

THE second general meeting of the International Society of Electricians was held at Paris on 13th December. Mr. George Berger, elected president by a large majority, referred to the great loss sustained by science in the death of Sir C. William Siemens, and deprecated the connection between the scientific members and any commercial or financial enterprise.

THE Jersey Chamber of Commerce has resolved to petition the States Assembly to construct a graving dock in St. Helier's harbour. It is alleged that through the want of such accommodation Jersey vessels have to be removed to other ports for repairs, and that, as the consequence, all the skilled workmen have been compelled to leave the island to obtain employment elsewhere.

THE Wellington, New Zealand, Harbour Board have instructed Mr. Napier Bell to prepare a general plan, with estimates, for wharf and dock extensions, and voted to pay for preliminary studies. Mr. Napier said his plan would be a general one, which could be carried out in sections according to requirements, similar to a general plan drawn by Sir John Coode for Melbourne Harbour.

INTERESTING trials were made last month—December— by the telegraph engineers to the German Government in substituting a Siemens and Halske dynamo-electric machine for voltaic batteries. From the 4th to 7th December inclusive the current was sent simultaneously through from fourteen to eighteen lines with excellent results. Very powerful batteries had before been required.

A RETURN recently laid before Parliament at Sydney shows that the total acreage under timber reserves at the end of 1881 was 4,003,000½ acres; the income received from them amounted to £12,326 12s. 10d., of which the sum of £11,292 18s. 10d. came from rent, royalty, and timber licenses, and £1033 14s. from ring-barking fees. The total cost of forest rangers during the year was £12,591 19s. 5d.; the average rent paid from £1 12s. 1d. to £2 per square mile.

ON February 14th last an order was made by the New South Wales Legislative Assembly for a return of the amounts paid to Mr. John Fowler, C.E., for commission, and the same as regards other engineers. *India and Colonies* says the return has just been published, and shows that the total amount paid for commission to Mr. Fowler was £38,241 3s. 8d. The return, however, does not state the period during which Mr. Fowler has been acting as consulting engineer for the colony.

THE new journal *Woods and Forests* describes a very simple instrument for measuring the heights of trees and other objects. It consists of a board 9½in. square covered with lines drawn parallel and at equal distances and at right angles. A plumb bob hangs from one corner and a sight hole, parallel with one side, is made along one edge. By setting the board, which is pivotted on a pole, so as to look at any selected part of the hole of the tree, then setting so as to look at the top, the plumb bob indicates the height on the parallel squares. The instrument is called a dendrometer, and is invented by Mr. Kay, forester to the Marquis of Bute.

THE city authorities of New York are discusssing plans for largely increasing the water supply, which has long been inadequate. The city is said to require 150,000,000 gallons of water daily, but only gets 95,000,000, the maximum which the Croton aqueduct can deliver. There is a loss of nearly 5,000,000 gallons daily in pipe leakage, and another 10,000,000 in waste of various kinds; while 25,000,000 gallons daily are used in business houses, breweries, factories, &c. The elevated railroads use 1,000,000 gallons per day; the shipping, 1,500,000; public offices, 2,500,000; gasworks, &c., 3,000,000; and the hotels, 1,000,000. The Croton water rents average about 116,000 dols. per week.

WATERWORKS are about to be established at the town of Wallingford, Berks, a successful commencement having just been made in finding a most abundant supply of water. Messrs. Le Grand and Sutcliff, of London, have sunk one of their bored tube wells 55ft. deep into the upper green sand formation. An exhaustive trial of the strength of the spring has been made by pumping at the rate of 120,000 gallons per twenty-four hours for seventy-two consecutive hours, without making any impression upon it. Mr. W. A. Ripley, of Bracknell, is the engineer. This result is of considerable importance to the district, as by the old system of well-sinking a greatly increased outlay would have been incurred in sinking cylinders to exclude the impure land springs.

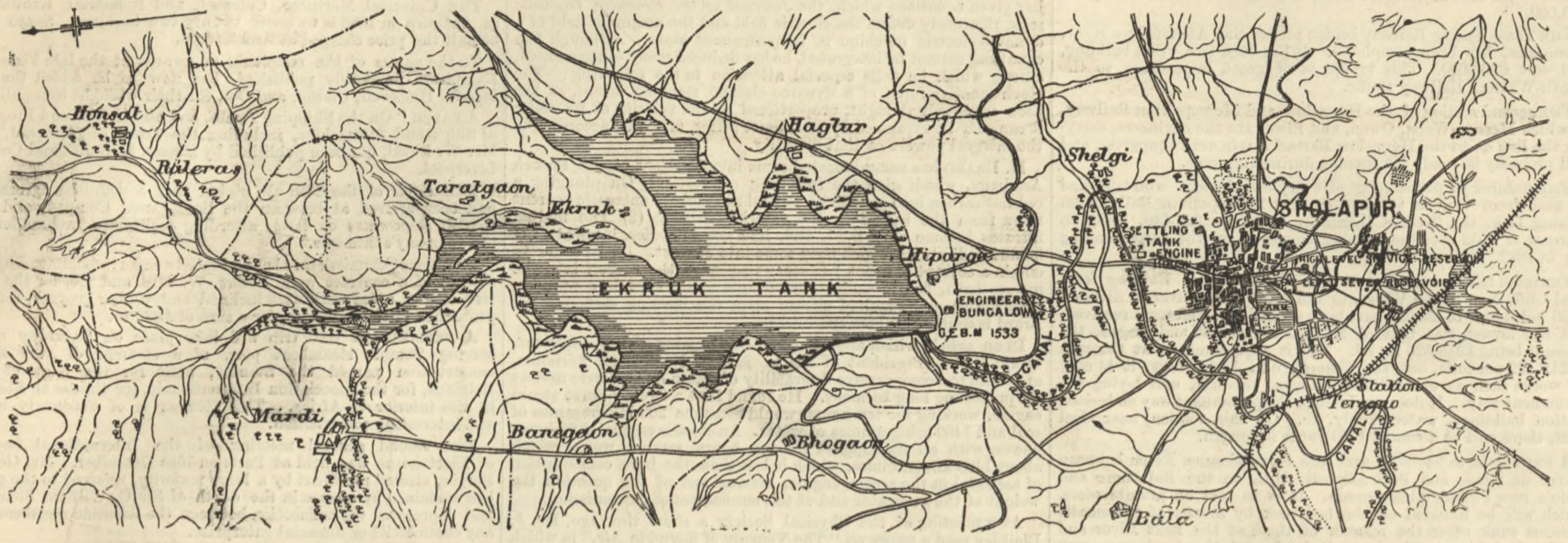
Dingler's Journal recently described the explosion of an open kettle. At a factory in Neusalz a large cast iron wash kettle was used to hold water, into which melted iron was allowed to flow, in a moderate stream, for making iron shot. On October 23rd, 1882, one of the workmen by mistake allowed the iron to flow too rapidly. There was a sudden development of steam, which threw out a part of the water, frightening the labourer and causing him to drop his ladle, so that about 20 kilogrammes—44 lb.—of melted iron fell at once into the water. There was an immediate rapid outburst of steam and a loud explosion, which shattered the kettle into fragments, tore up the wood-work, threw the workman nearly 8ft. backwards, and broke his right leg. Only very small pieces of the kettle were found where it stood; some of them were thrown to a distance of about 50ft. The facts of this explosion have important bearings.

AT Jonkoping, Sweden, is the oldest and largest match factory in the world. It was established 100 years ago, and there are now to be seen specimens of the matches used at the beginning of the present century, consisting of big fagots of wood furnished with a handle and a tip to dip in a bath of sulphur. The wood from which the present kind of matches is made is taken from the adjacent forests, which are divided into fifty sections. Every year one section is cut and then replanted with young trees. The trees are hewn into planks in the forest and cut into slivers in the factory. The boxes are made of the outside of the trees. The factories are on the banks of lakes which are connected with one another by wide canals. Millions of matches are turned out each day. The *Scientific American* says some idea of where they all go to may be obtained from the statement that there are at least 280,000,000 of matches burned each day in the United States or an average of five matches for each person.

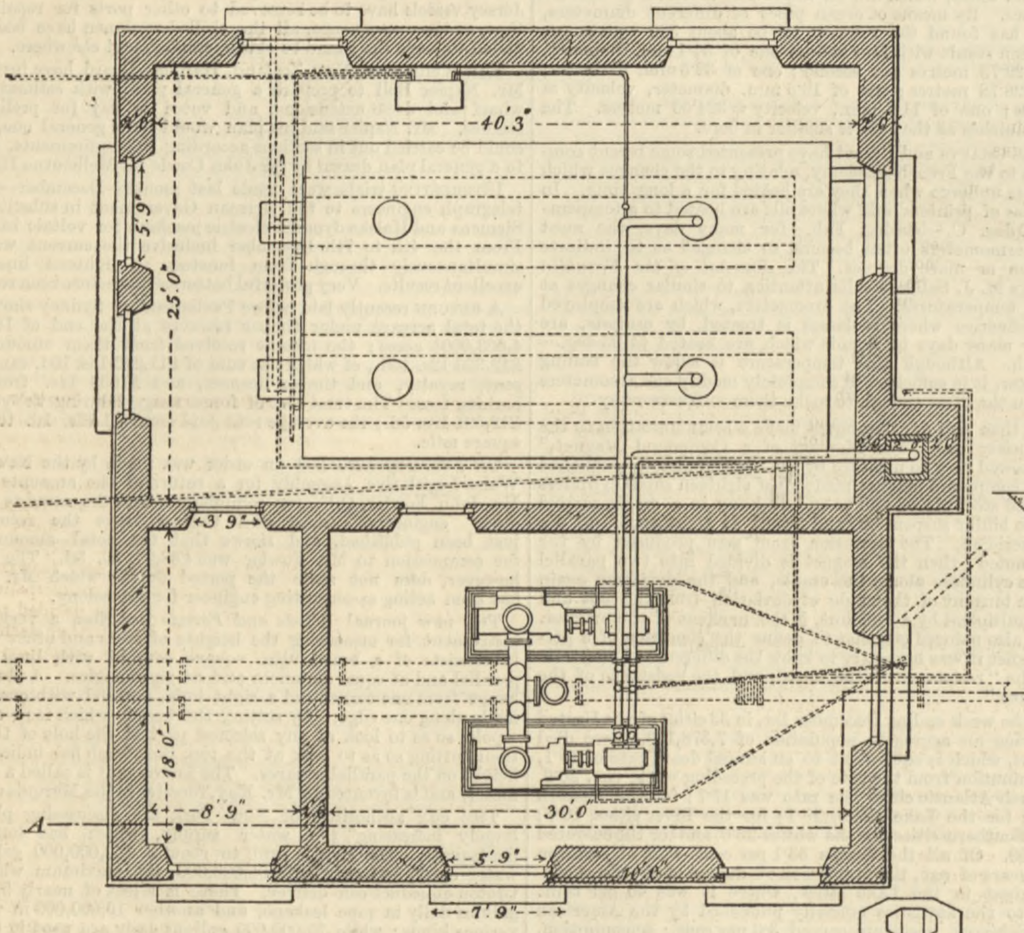
THE SHOLAPUR WATER SUPPLY WORKS.

MR. C. T. BURKE, A.M.I.C.E., ENGINEER.

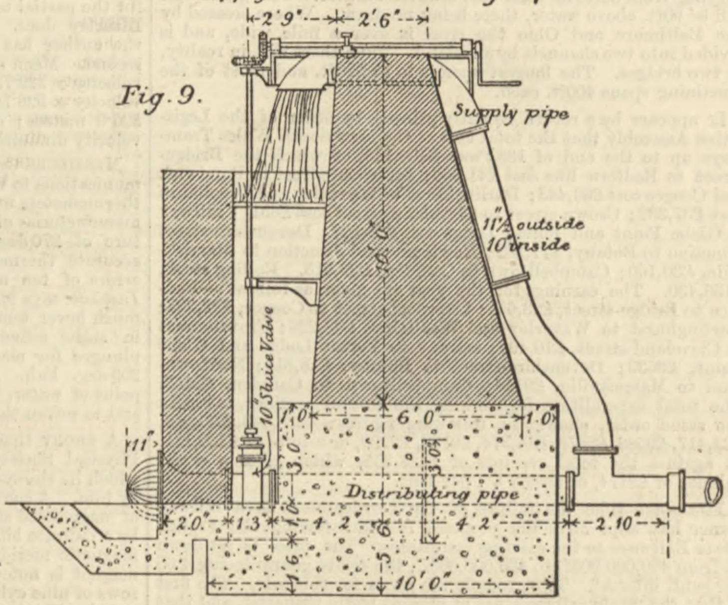
(*For description see page 7.*)



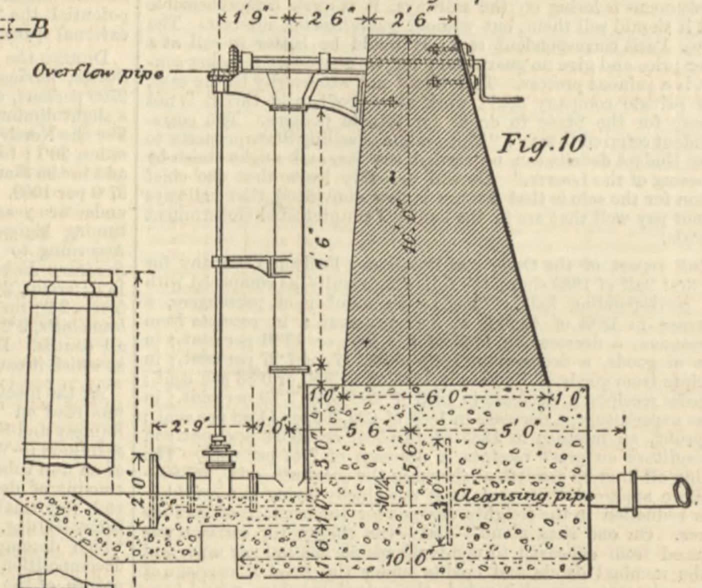
Plan of Engine House. Fig. 3.



Supply and Distributing Pipes



Overflow and Cleansing Pipes



Section on A.B. Fig. 4.

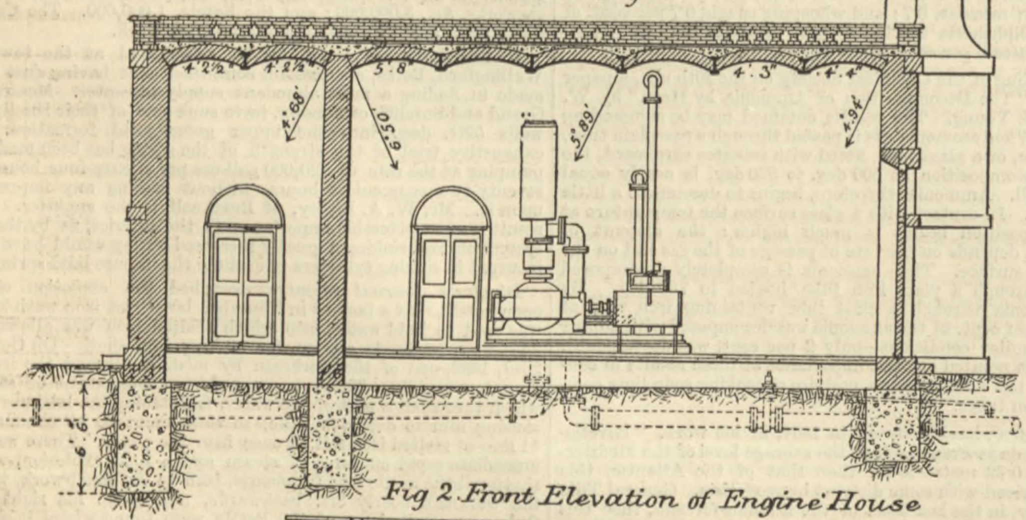
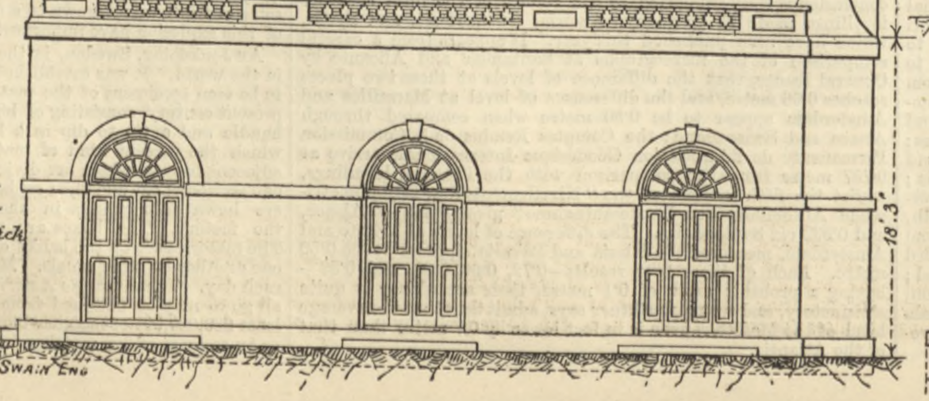


Fig 2. Front Elevation of Engine House



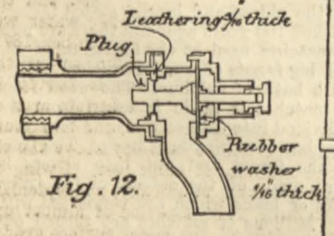


Fig. 12.

Cross Section

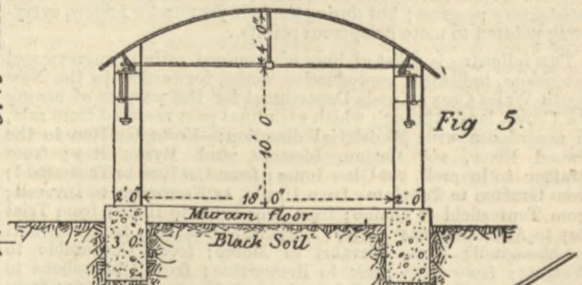
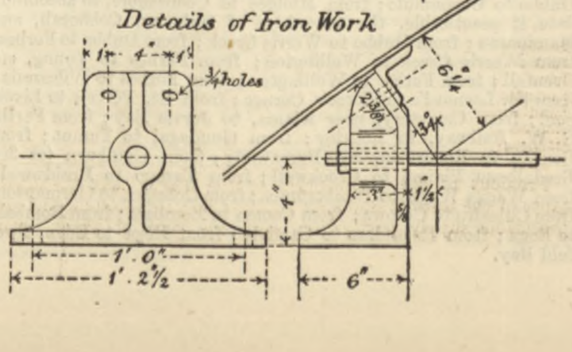


Fig 5

Details of Iron Work



THE SHOLAPUR WATER SUPPLY WORKS.

Fig. 6.

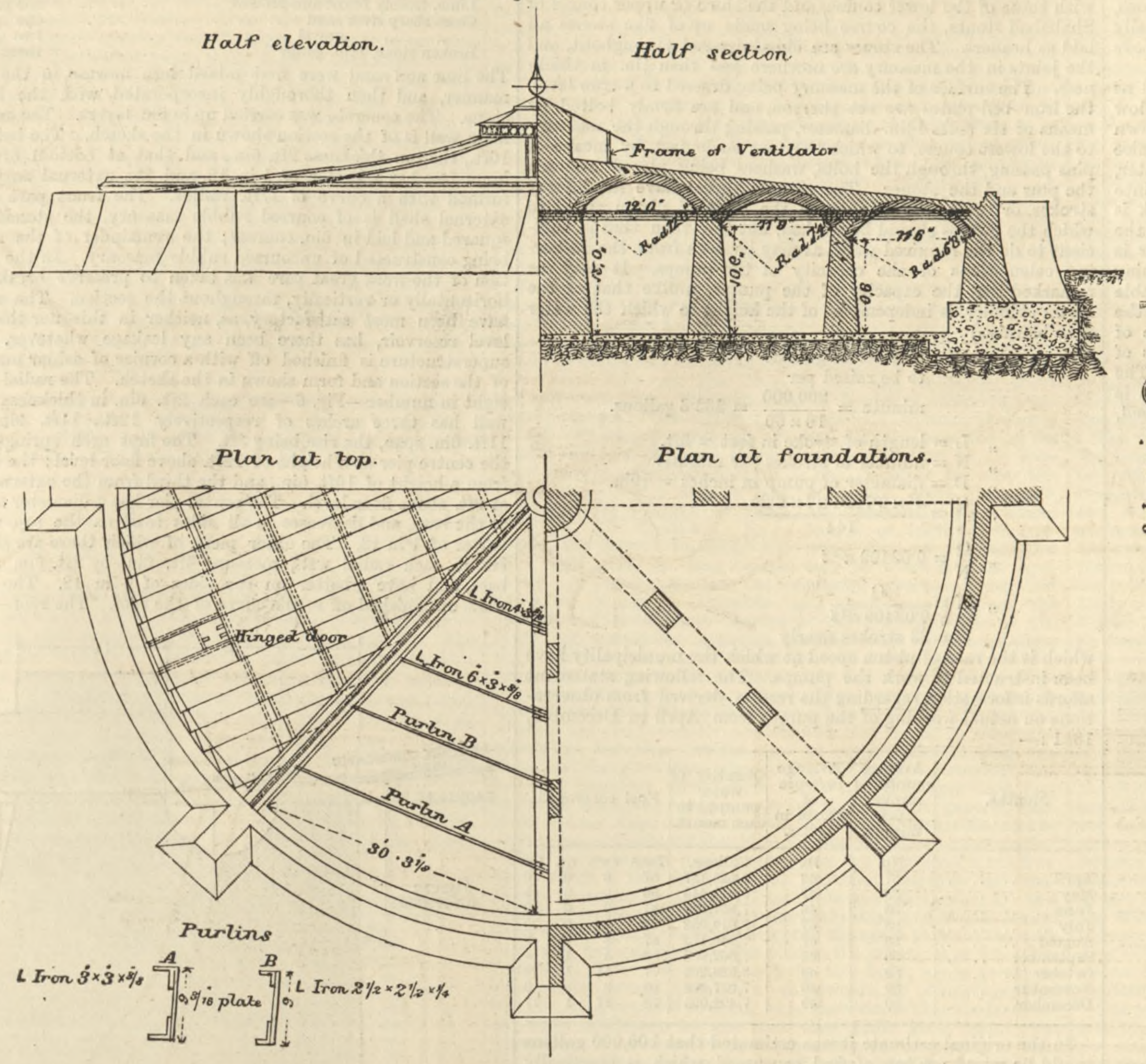
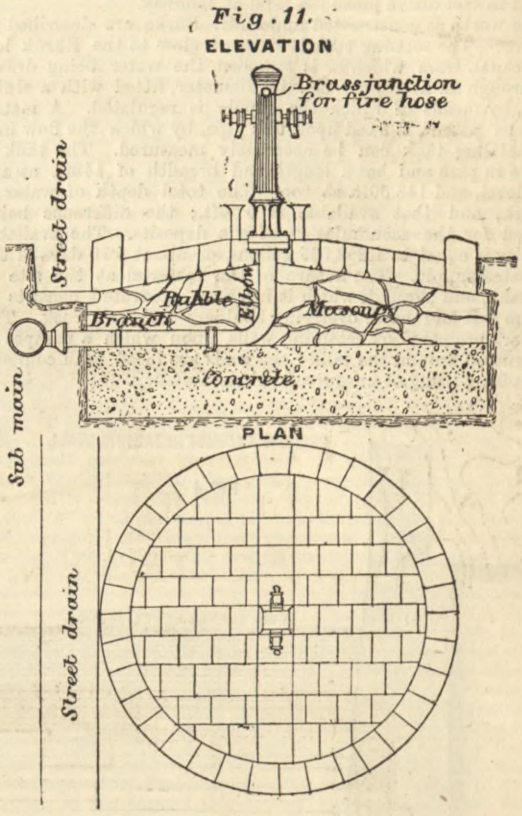


Fig. 11.



FROM a report by Mr. C. T. Burke, A.M.I.C.E, which has recently reached us, "On the Water Supply to the Town of Sholápur," we gather the following information, which will interest many of our readers, though Indian affairs are said, incorrectly, we think, to attract very little attention:—

Sholápur, the chief town of the Sholápur district, is situated in latitude 17°-40' north, and longitude 75°-57' east; its distance from the sea in a direct line is about 184 miles, and its height above "mean sea level," at the site of the "high-level service reservoir," is 1563ft. The population, according to the latest census, that of 1881, consists of 59,437 inhabitants; of this number 2537 live outside the limits of the system of water supply; the number of permanent residents supplied, therefore, equals 56,900.

The rainfall of Sholápur, in common with nearly all parts of the Deccan, is precarious and capricious, as may be seen from the following table, which shows the total fall in each year, as

Years.	Total fall.	Monsoon fall.
	Inches.	Inches.
1870	31·69	19·31
1871	14·99	12·85
1872	37·61	35·44
1873	28·33	23·58
1874	34·67	31·67
1875	24·67	22·92
1876	10·57	8·81
1877	36·28	32·56
1878	69·37	66·77
1879	23·03	19·54
1880	36·23	34·76
Average	31·58	28·93

well as the monsoon fall, from June to October inclusive, for a period of eleven years. The average total fall is 31·58in., and the average monsoon fall is 28·93in. It will be observed that there is a great difference in the fall of rain in one year as compared with another, as well as in consecutive years. In 1876 the amount gauged was only 10·57, while in 1878 nearly seven times as much was registered. In two years the fall gauged was considerably less than half the mean average, and in five years was considerably below this average.

Again, the mean average total fall in the period extending from 1862 to 1871 was only 20·55in., which, when compared with the falls in the succeeding years, tends to show that the large sheet of water of the Ekrúk tank—see the map, p. 6—the area of which at "full supply level" is about seven square miles, exercises a considerable and beneficial influence in increasing the rainfall in its immediate vicinity. In connection with this point, it is interesting to compare the abnormally large fall which occurred at Sholàpur in 1878, with the amounts gauged in the same year at all the táluka or principal towns in this district, as shown in the annexed table marginal abstract; it will be noticed that the fall gauged at Sholápur is nearly twice that registered at any other station in the district:—

Towns.	Distance and direction from Sholápur.		Rainfall.
	Miles.		Inches.
Sholápur	—	—	69·37
Mádha	32	N.W.	29·81
Bársi	40	N.N.W.	34·77
Karmála	64	N.W.	35·01
Pandharpur	40	W.	38·32
Sángola	50	W.S.W.	27·86
Málsiras	68	W.	26·16

Previous to the construction of the Ekrúk tank the inhabitants of the town of Sholápur obtained an unwholesome and very precarious supply, partly from wells, the water of which, owing to their situation, must have been very impure; but the principal supply was derived from what is known as the Sidheshwar tank, a small reservoir situated close to the Sholápur Fort. This tank afforded at best but an uncertain and unsatisfactory supply, as in years of drought it failed altogether; in years of small rainfall the water stored is shallow and insufficient, while even when the water lasts throughout the year, it becomes quite unfit for use before the close of the hot season. The usual accompaniment of such a want of water supply—sickness, epidemics, and much suffering—were the consequence, a state of things which, we are informed by Mr. Burke's report, is almost wholly changed by the abundant supply made available by the completion of the Ekrúk tank.

In 1871 water was let into the principal canal, and from that time this work has afforded a plentiful supply of good water. Its beneficial effects were more especially felt in 1876, when, but for the ample supply available, the inhabitants of this large and populous town would, without doubt, have experienced the dire effects of a water famine. In 1872 Mr. C. T. Burke, B.E., was appointed to act as executive engineer at Sholápur, and, in compliance with an application from the municipality, prepared an approximate estimate, descriptions, &c., of a scheme, and attended at a general meeting of the commissioners, at which Mr. T. Bosanquet, C.S., collector of Sholápur, presided. At this meeting, after much discussion, it was formally decided, by a very small majority, that the municipality were not in a position to undertake the work. In 1876 the question was again raised, and the municipality sanctioned Rs. 960 for the preparation of complete plans and estimates; but, owing to the occurrence of the great famine of 1876-77, when it was found necessary to employ all the available establishment upon relief works, it was impossible to undertake the investigation, which was therefore deferred until 1878, when Mr. Burke prepared and submitted a complete and final report, accompanied by detailed plans and estimates. Three distinct schemes were carefully considered by which the requisite supply might be obtained:—(1) By the construction of a tank on the Shelgi nála. (2) By taking the water direct from the Ekrúk tank and raising it to the height necessary to command the town, &c., by utilising the power generated at the site of the outlet works of the Ekrúk low level canal. (3) By taking the water from a site in the fifth mile of the Ekrúk low level canal, and raising it to the requisite height by steam-power. Sample A was taken from the mouth of the Ekrúk low level canal, and sample B from the fifth mile of the canal at the site from which the supply is now drawn off:—

	A.		B.
Total solid grains per gallon	14·00	..	10·85
Chlorine	0·42	..	0·46
Free ammonia, parts per million	0·02	..	0·08
Albumenoid ammonia	0·14	..	0·15

The sediments in sample A consisted of vegetable *débris* and paramina, and in sample B vegetable *débris* and diatoms. The analysis shows that the water is sufficiently free from impurities, in both cases, to admit of its being used for all domestic purposes without the intervention of filtration. The total amount of solid matter present is so small that no objection can be taken to the water on the score of the presence of mineral impurities.

The ammonia results are, however, enough to frighten Dr. Frankland to death. Mr. Burke thinks they "are only just within the limits usually laid down as admissable in potable water." It will consequently be necessary to take every precaution to conserve, strictly and carefully, the area of land draining into the canal. Fortunately this, he says, can be effected with little trouble and at small expense, as the land lying between the tank and the Shelgi river is at present free from all noxious and polluting influences. If at any time it be found desirable to filter the water, filtering beds can be very simply and inexpensively arranged in the settling tank. Mr. Burke's report, with complete detailed plans and estimates, was submitted to Mr. J. H. E. Hart, M. Inst. C.E., chief engineer for irrigation, who, in forwarding them for consideration to the municipality of Sholápur, remarked as follows:—"The first project is impracticable, and may be discarded, and of the two remaining, I prefer the latter, the cost of which is Rs. 1,93,894, against Rs. 2,95,292, thus showing an economy of Rs. 1,01,398. I also accept Mr. Burke's designs and calculations, and forward them with approval." At a general meeting of the municipality, held at Sholápur on the 29th October, 1878, it was decided to adopt Mr. Burke's project, scheme No. 3. It was further decided at a general meeting subsequently held that the execution of the works should be entrusted to the irrigation branch of the Public Works Department. The money was readily obtained and placed to the credit of the Public Works Department, and the works were commenced on the 6th November, 1878. In preparing this scheme it was assumed that it would be necessary to provide for a daily supply of 50,666 persons, the population estimated according to a return corrected up to 1872; and assuming a daily allowance of 5 gallons per head, the minimum total daily demand was estimated at 253,330 gallons. The question of the requisite daily allowance per head received special attention, and it was decided that 5 gallons would be sufficient, as the wells and small tanks in and about the town would still be available for washing purposes. The actual quantity of water consumed admits of simple and accurate measurements, and the quantities shown in the following table may be relied upon as representing the correct daily and monthly consumption in 1881:—

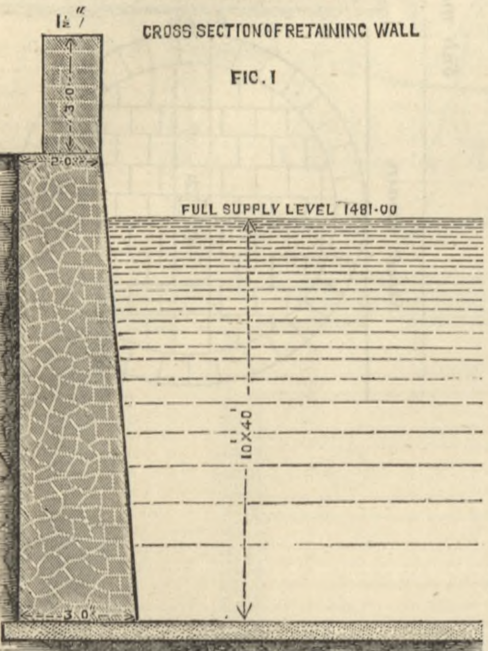
Months.	Rainfall in each month.		Mean maximum temperature in shade in each month.	Consump- in each month.	Average daily consumption in each month.	Average daily consumption per head.
	In.	cts.	Degrees.	Gallons.	Gallons.	Gallons.
May	1	71	107·00	9,071,445	292,627	5·14
June	3	23	96·10	7,857,519	261,917	4·60
July	2	08	90·80	8,014,982	258,548	4·54
August	7	67	89·50	7,946,175	256,328	4·50
September	4	40	87 80	7,562,982	252,099	4·43
October	0	84	90·50	8,028,292	258,977	4·55
November	2	17	84·20	7,037,456	234,582	4·12
December	—		83·90	7,492,055	241,679	4·25
Mean average				7,876,363	257,095	4·52

The water is taken from the low-level canal leading from the Ekrúk tank, in which the supply is practically unlimited. This tank, one of the largest of its class undertaken by the Government, is situated about four miles due north of the town of Sholápur. The accompanying map illustrates the relative positions of the tank and canals, the town, &c. The Ekrúk project was suggested, and preliminary surveys were made in 1863 by Major-General Fife, R.E., and complete plans and estimates were submitted to, and sanctioned by the Government of India in 1866. The works were commenced in December, 1866, and the dam was closed across the river in December, 1869; water was admitted to the low level canal for irrigation in September, 1871. The tank is formed by an earthen dam thrown across the Adhila, a tributary of the Sina river; this dam is 7000ft. in length, and has a maximum height of 76ft. The surface area of the tank, when full, is about seven square miles, the maximum depth of water is 59ft., and the available capacity above the sill of the low-level canal is 3310 millions of cubic feet. Owing to the failure of rain the tank received, practically, no replenishment from October, 1875, to June, 1877, a period of almost unprecedented drought; in this interval the water surface gradually fell, and reached a minimum level on the 9th June, when it stood at 16·25ft. above the sill of the outlet sluice leading to the low-level canal. This is the lowest level to which the water has subsided since the first filling of the tank in the rains of 1870. The available storage capacity at this level is 573 millions of cubic feet, or 3570 millions of gallons, and as the rate of consumption of water supplied to the town of Sholápur in a year—*vide* data given in par. 10—is less than 100 millions of gallons, it is not too much to say that the available supply is practically unlimited. The Ekrúk tank full supply level is 1521·6ft. above height in feet above mean sea level at Bombay.

The works as constructed under Mr. Burke are described as follows:—The settling tank is situated close to the Ekrúk low level canal, from which it is supplied, the water being drawn off through an iron pipe 9in. in diameter, fitted with a sluice valve, by means of which the supply is regulated. A meter, Siemens' patent, is fixed upon this pipe, by which the flow into the settling tank can be accurately measured. The tank is square in plan and has a length and breadth of 146ft. at the floor level, and 148·00ft. at top. The total depth of water is 10·40ft., and that available is 9·60ft.; the difference being allowed for the accumulation of silt deposits. The available capacity is equal to 1,292,705 gallons, or about 5·10 days of the estimated supply. The nature of the material at the site of this tank, and through which it has been excavated, consists of muram soft and hard, overlying boulders and soft rock. The sides are protected by retaining walls, upon which a parapet is constructed around the tank; the walls are faced with coursed, the backing being of uncoursed rubble masonry.

CROSS SECTION OF RETAINING WALL

FIG. 1



A layer of concrete, having a minimum thickness of 6in., has been laid to form the floor, in which shallow wide surface drains have been constructed to facilitate the cleaning of the tank. A scouring pipe, 9in. in diameter, fitted with a sluice valve, is fixed with its centre line at the floor level, to admit of the tank being scoured out when necessary. Two suction or supply pipes, each 8in. in diameter, fitted with strainers, are fixed in the tank, and are connected with the pipes leading to the pumps. An enamelled iron gauge, graduated into feet and tenths, is fixed to the face of the retaining wall, by means of which the rise and fall in the tank is accurately ascertained.

The arrangements, construction, and detailed dimensions of the engine-house are shown in Figs. 2 and 3. It consists of three rooms having the following dimensions:—Pump-room, 30ft. by 18ft.; boiler-room, 40ft. 3in. by 25ft.; store-room, 18ft. by 8ft. 9in.; height of rooms from floor to ceiling, 16ft. The foundations of concrete are laid upon muram; the superstructure is formed of rubble masonry, the stones being squared, and laid in 6in. courses; the arches and parapet are of brickwork; the string course, cornice, key-stones of arches, and the door steps are of ashlar masonry. The rooms inside are plastered and coloured white. The floors throughout are formed of Shahabad flags laid upon a 3in. layer of concrete. The roof is fire-proof, and consists of brick arches resting upon and springing from rolled iron-plate beams; the haunches of the arches are filled in with concrete, by means of which the whole is brought to a nearly level surface. The chimney has a total height of 52ft. 9in. from the surface of the ground. The concrete foundations, 6½ft. in depth, of the chimney are laid upon rock, which was carefully levelled and prepared; the superstructure for a height of 18¼ft. is of block-in-course masonry, lined, for 15ft. in height, with fire-brick 4½in. in thickness, set in fireclay; upon this the chimney is raised, octagonal in cross section, of ordinary brickwork, having three bands of fire-brick placed at equal intervals; the height of the brickwork is 32ft. 5in., which is surmounted with a coping of ashlar work—see Fig. 2. A lightning conductor of copper tube, of 1in. internal diameter, is fixed to the chimney by means of copper holdfasts; the forked end is laid in the ground, and is carried down to a water-bearing stratum. A bungalow has been constructed close to the engine-house for the use of the engineer in charge of the pumps and machinery. This bungalow consists of two rooms and a verandah. A fuel shed has been provided, and is situated at a convenient distance from the engine-house; the internal dimensions are 56ft. by 18ft., the height from floor to the eave of roof being 10ft. The superstructure is of rubble masonry, raised on concrete foundations; the roof is of corrugated iron, being bent to a segmental arch-shape, and tied with wrought iron rods—see Fig. 5—does not require trusses.

The pumping machinery provided consists of two pumps manufactured by Messrs. Tangye Brothers and Holman, of London, and are of the kind known as the "Special steam pump." When worked separately each pump is capable of raising 200,000 gallons in ten hours, or when combined 400,000 in ten hours, and delivering into the "high level service reservoir," at an elevation of 160ft.—including head due to friction in pipes—through a line of piping 10in. in diameter, and about 8500ft. in length. Each steam pump has a steam cylinder 18in. and a water cylinder 10in. in diameter, both having a stroke of 36in. The water cylinder is lined with brass. Cast iron air vessels about ten times the capacity of the barrels of the pump are fixed, one on the supply, and the other on the delivery main, to equalise the flow of water. They are provided with air pumps, pipes, and relief valves. The pumps are set upon a superstructure of ashlar masonry resting on concrete foundations; these latter are 6ft. 9in. in depth and are founded upon hard muram, upon which, allowing an offset of 1ft. on all sides, the superstructure is raised. The dimensions of the ashlar masonry are 11ft. 6in. by 5ft. by 3ft., constructed in courses each 12in. in thickness; the lower course consists wholly of through stones, the second of smaller stones, breaking joint with those of the lower course, and the third or upper course of Shahabad stones, the course being made up of five stones all laid as headers. The stones are chisel-dressed throughout, and the joints in the masonry are nowhere less then ¼in. in thickness. The surface of the masonry being dressed to a true level, the iron bed-plates are set thereon, and are firmly bolted by means of six bolts 1½in. diameter, passing through the masonry to the lowest course, to which they are made fast by means of pins passing through the bolts, washers being placed between the pins and the stones. The manufacturers have fixed forty strokes, or 120ft. per minute, as the limit of piston speed to which the pumps should be worked, but less than that is sufficient to do the required work, as may be seen from the following calculations of the capacity of the pumps. It may be remarked that the capacity of the pumps, unlike that of the steam cylinder, is independent of the height to which the water is to be raised:—

Let Q = number of gallons to be raised per minute $= \frac{200,000}{10 \times 60} = 333{\cdot}3$ gallons.

„ L = length of stroke in feet = 3ft.

„ N = number of strokes per minute.

„ D = diameter of pump in inches = 10in.

$$„ \quad \frac{Q}{N} = \frac{d^2 \times 0{\cdot}7854 \times l \times 6{\cdot}25}{144}$$

$$„ \quad \frac{Q}{N} = 0{\cdot}03409\, d^2 l$$

$$„ \quad N = \frac{Q}{0{\cdot}03409\, d^2 l}$$

= 33 strokes nearly

which is the rate of piston speed at which the municipality have been instructed to work the pumps. The following statement affords information regarding the results derived from observations on actual working of the pumps from April to December, 1881:—

Months.	Average number of strokes per minute.	Average pressure of steam in boiler.	Quantity of water pumped in each month.	Fuel consumed.			
	No.	lb.	Gallons.	Tons	cwt.	qr.	lb.
April	37	48	6,625,127	57	3	0	6
May	38	47	9,071,445	80	3	2	1
June	38	46	7,857,519	87	0	0	10
July	38	47	8,014,982	88	5	0	25
August	38	47	7,946,175	87	8	3	2
September	39	48	7,562,982	83	4	1	4
October	39	48	8,028,292	77	11	1	18
November	39	49	7,037,456	69	3	3	0
December..	39	49	7,492,055	78	17	1	17

In the original estimate it was estimated that 100,000 gallons would be raised per ton of fuel consumed, which is practically correct, as may be deduced from the results collated in the above statement, thus—

The maximum quantity of water raised per ton of fuel consumed .. .. = 115,923 gallons.
The average quantity of water raised per ton of fuel consumed .. .. = 98,239 „
The minimum quantity of water raised per ton of fuel consumed .. .. = 90,300 „

The fuel used consists of the wood of the bábul tree—*acacia arabica*—which being purchased in its green state is not always, when used, as dry as it ought to be; and this accounts for a greater quantity being used, proportionately to the useful work done, in some months, as compared with others. The boilers, two in number, are of the Cornish type, having six Galloway tubes in the flue. Each boiler is 28ft. in length, and 5ft. 1in. in diameter, and a steam dome 3ft. in height, and 2ft. 4in. in diameter; six Galloway tubes are fixed in the flue; each boiler is provided with a fire-box of sufficient size to admit of wood fuel being used.

The site selected for the low-level service reservoir is situated close to the town gateway, locally known as the "Bijápur gate," and is about 5800ft. distant from the engine or pump house. It is designed to supply the town, with the exception of the Sakhar-peit and the suburbs, which are supplied from the high-level reservoir. The general design and dimension are given in Fig. 6. The reservoir is circular in plan, having arched radial walls which support the roof, the thrust of the arches being taken by buttresses, which generally strengthen the external wall. The principal dimensions are as follows:—

Diameter internal at floor level .. .. = 82ft.
„ „ „ top of concrete wall.. .. = 84ft.
„ „ „ full supply level .. .. = 85½ft.
Total depth of water .. .. = 12ft.
Height of floor above floor of settling tank .. .. .. = 58½ft.

The total capacity of this reservoir is 71,224 cubic feet, and that available is 68,711 cubic feet, or 429,133 gallons, which is equivalent to 1·69 days of the estimated daily demand. The whole site of the reservoir was excavated through soil and muram to rock; fissures in the latter were scraped out, at least 2ft. in depth, and filled or grouted with liquid Portland cement mortar. The floor and foundations of the main wall, &c.—see Fig. 6—are formed of concrete, which is composed of:—

Lime, freshly burnt and ground .. .. = one part.
Clean sharp river sand .. .. = one „
„ „ gravel .. .. = two „
Broken stone, 1½in. gauge .. .. = three „

The lime and sand were first mixed into mortar in the usua manner, and then thoroughly incorporated with the broken stone. The concrete was carried up in 6in. layers. The external main wall is of the section shown in the sketch. The height is 10ft., the top thickness 2ft. 6in., and that at bottom 6ft.; the inner face has a batter of 1 in 12, and the external surface is formed with a curve of 17ft. radius. The front part of the external shell is of coursed rubble masonry, the stones being squared and laid in 6in. courses; the remainder of the section being constructed of uncoursed rubble masonry. In the execution of the work great care was taken to preserve break joint, horizontally or vertically, throughout the section. The results have been most satisfactory, as, neither in this nor the high-level reservoir, has there been any leakage whatever. The superstructure is finished off with a cornice of ashlar masonry, of the section and form shown in the sketch. The radial walls, eight in number—Fig. 6—are each 2ft. 6in. in thickness; each wall has three arches of respectively 12ft., 11ft. 9in., and 11ft. 6in. span, the rise being 3ft. The first arch springs from the centre pier at a height of 12ft. above floor level; the second from a height of 10ft. 6in., and the third from the external wall at 9ft. above floor level. The centre pier has a diameter of 10ft. at the base, and decreases on all sides towards the top, with a batter of 1 in 12. The other piers, of which there are sixteen, two in each radial wall, measure 3ft. 6in. by 2ft. 6in. at the base, and have a batter on the sides of 1 in 12. The radial walls are finished off to the curve of the roof. The roof—Fig. 6

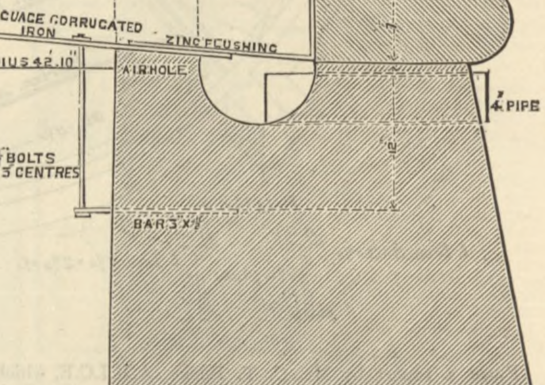
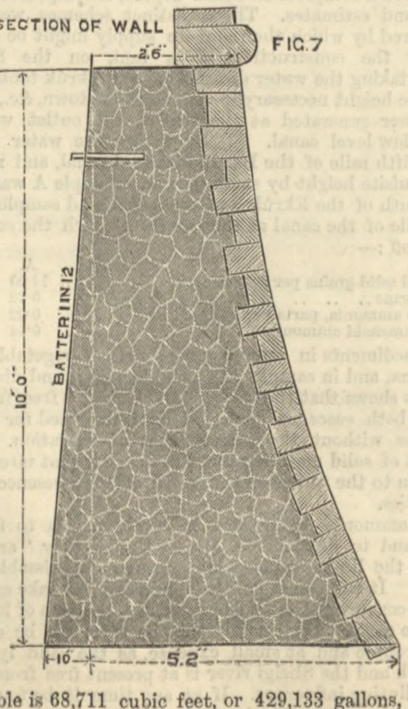


FIG 8

—consists of corrugated iron sheets supported upon iron beams of T and channel section. These beams rests upon the radial walls, and are bolted thereto; they are arranged at distances of 7ft. 6in. from centre to centre. The corrugated iron sheets are of galvanised iron, of 20 B.W. gauge, and are laid with laps of 6in. at the ends and two corrugations at the sides. The sheets are first rivetted together and then laid upon the purlins, and fixed by bolts; the junctions and laps are of galvanised iron 20ft. gauge, having laps of 1ft. on each side. Ventilation has been amply provided for by constructing the roof near the apex 15in. higher than the main roof; the intermediate open space is protected by a netting of wire of ½in. mesh, which effectually prevents birds, &c., from entering the reservoir. The rain water falling on the roof is carried off in a 9in. semicircular gutter, constructed on the top of and around the external wall—Fig. 8—and is discharged through a 4in. down pipe into the road-side drains. All ironwork was first oiled and then received three coats of paint, the last being given after all other work had been completed; the finishing coat for all external ironwork is French grey picked out with black. The arrangement and details of the supply and distributing pipes, where they join the reservoir, are shown in Fig. 9. The supply pipe is 10in. in diameter, and discharges into a small chamber from which the water passes over a weir into a second chamber, and escapes through a small opening into the reservoir.

SECTION OF WALL

FIG.7



The scouring and overflow pipes are illustrated in Fig. 10, which shows the arrangements and all details. Sluice valves are fixed on the distribution and scouring pipes as shown. The "high-level" reservoir is precisely similar in design, arrangement, and details to that described under "low-level reservoir," but is larger, having a diameter at the floor level of 95ft., and a total capacity of 96,399 cubic feet; that available being 88,193 cubic feet, or 549,442 gallons, which is equivalent to 2·17 days of the estimated daily demand. This reservoir is not roofed, and as it is situated on the highest ground in Sholápur, away from all contaminating influences, it is thought that a roof may not be necessary; further, as the water is constantly being changed, it cannot, to any extent, be injuriously affected by exposure to the air. Arrangements have, however, been made for a roof being readily erected should it be found necessary. This reservoir is distant about 8125ft. from the engine or pump-house. The main has a clear internal diameter of 10in., and is laid in one continuous line from the engine or pump-house to the northern gateway of the city, known locally as the Tuljápur gate; thence it is laid along the main street to the southern or Bijápur gate, and from there along the public road to the high-level service reservoir. Close to the Bijápur gateway a branch is taken to the low-level service reservoir.

In calculating the dimensions of this main, it was assumed that the whole day's estimated demand, or 253,330 gallons, would be passed through in ten hours, that is, the ordinary maximum discharge would be 1·125 cubic feet per second. A pipe of 8in. diameter would discharge this quantity with a velocity of 3·28ft. per second, to which, adding 1in. to allow for reduction of section by incrustation, &c., it was decided to use a main of 9in. diameter. Subsequently the diameter was increased to 10in., and through this the average daily demand is discharged with a velocity of slightly less than 3ft. per second. The pipes are 0·562in. thick, 9ft. 4in. over all, 4in. depth of socket, weigh 5 cwt. 0 qr. 16 lb., a deviation of 3 per cent. being permitted.

All pipes and specia castings were proved by hydrostatic pressure to a pressure equal to a column of water 600ft. high. The pipes were then tested on being landed in Bombay, and 2·36 per cent. failed. It may be here stated, that since these works were brought into operation, there has only been a failure in one of the pipes forming the main, that is, 0·1 per cent. of the total number laid. Of the total number of joints, two failed, that is, 0·1 per cent. of those made. The minimum cover, that is, depth of soil above the pipes in the trenches, was fixed at 2½ft. The socket joints were formed as follows:—(1) At least one complete lap of clean white hempen spun yarn was forced to the bottom of the socket; (2) several laps of tarred hempen yarn were then coiled and tightly driven so as to leave a space of 2¼in. clear for the lead; (3) this space being well dried was filled at one running with lead—melted from the pig—flush with the outside of the joint, which was then "set up" at least three times and the lead fringe cut off. Air valves are placed along the line of pipes, and close to the northern gate, at about 3000ft. from the engine-house, a reflux valve has been fixed. "Dead ends" are avoided as far as practicable so as to allow a free flow of water in the pipes. The lengths and diameters of the pipes laid are as follows:—Of 6in. pipes 10,530ft.; of 4in., 9969ft.; of 3in., 12,737ft. Since the works were brought into operation in March, 1881, the following have been the numbers of failures of pipes:—

Diameter of pipes.	Number of failures of pipes.	Percentage on total number laid.	Number of failures in joints.	Percentage on total number made.
6in.	2	0·1	2	0·1
4in.	4	0·3	4	0·3
3in.	3	0·2	2	0·2

Water is delivered throughout the town, &c., by means of stand and pipe posts fitted with suitable taps. The stand posts and masonry platforms are of the design shown in Fig. 12. The stand posts are fitted with Lambert's patent push cocks, of a size and pattern specially designed and made for these works—see Fig. 12. During the progress of the works the municipality made an application requesting that extra stand and pipe posts should be provided, as well as some additional lines of distributing pipes in parts of the town not arranged for in the original estimate, so as to afford increased facilities for delivering water to the inhabitants. An estimate of the probable cost was Rs. 24,905. This increased the original estimate of Rs. 193,894 to Rs. 218,799. The following statement shows the actual cost of the works under each sub-head:—

Items.	Amount. Rs.	a.	p.
Settling tank..	14,291	7	11
Engine-house..	10,032	0	6
Engineer's bungalow	693	2	10
Fuel shed..	1,755	14	2
Compound wall, &c.	1,122	5	0
Special steam pumps	17,940	5	6
The boilers	14,926	7	10
Low-level service reservoir	15,728	8	10
High do. do...	11,739	4	2
Main pipes	38,134	11	4
Distribution	50,114	8	5
Stand and pipe posts	10,592	3	8
Total, works	1,87,071	0	2
Tools and plant..	1,818	12	11
Public works establishment..	28,293	13	0
Grand total..	2,17,183	10	1

Thus the total cost amounted to Rs. 217,184, showing a saving of Rs. 1615 on the amount of the estimate. The following shows the cost, assuming a maximum supply of 5 gallons per head per day:—

Population.	Daily supply at 5 gallons per head.	Nature of supply.	Total cost.	Cost for a supply of 5 gallons per head per day.	Remarks.
	Gallons.		Rs.	Rs. a. p.	
56,900	284,500	Constant.	217,184	3 13 1	

A daily average of 5 gallons per head was exceeded in one month only.

THE BOARD OF TRADE AND MERCHANT SHIPPING.

THE following memorandum on load-line for merchant ships has been issued by the Marine Department of the Board of Trade:—

From the time of the appointment of the Unseaworthy Ships Commission to the present time, the question of overloading has been prominent, and has engaged the constant attention of the Board of Trade. When Parliament thought fit to invest the Board of Trade and its officers with the power of detaining unseaworthy ships, it became their duty to detain ships which appeared to them to be dangerously overladen. In doing this, it was desirable, if possible, to act on certain principles, and it has been the constant endeavour of the Board to arrive at such principles, and to procure the co-operation of the shipping interest in so doing.

In 1875 they invited the Committee of Lloyd's Register, which so largely represents the shipping interest, and the Committee of the Liverpool Underwriters' Registry, to appoint a committee, consisting of representatives of the two registries and of the Board of Trade, to consider the question of load-line. That committee, after holding several meetings, broke up, because the representatives of Lloyd's Registry could not agree with the Liverpool representatives upon the elements of the question to be discussed. In the meantime, it was necessary for the Board of Trade to act, and as their officers required instructions, a certain set of tables of freeboard were prepared, which have been the subject of much misapprehension. They were not, as has sometimes been supposed, hard-and-fast rules, nor were they prepared or used as final decisions of the Board. They were not in the first instance even promulgated or published, but were given to the staff of the Board as tentative rules, and as points of departure, in the application of which to particular cases the officers of the Board were desired to use their own judgment. But the difficulty which is inseparable from the exercise of a discretionary power, and which has been experienced by the Board of Trade in many other similar cases, soon arose. Complaints were made of the discretionary powers of the Board's officers, and shipowners expressed their desire, not only to know what were the principles on which these officers acted, but to have those principles made definite in their application, so that they might be able to know before loading whether their ships would be detained or not. This desire appeared to the Board reasonable, and although the difficulties of preparing fixed rules of freeboard remained as great as before, the Board did their utmost to comply by issuing to the trade the tables above referred to. But in thus complying with the desire of the trade, the Board did not issue these tables as final conclusions; on the contrary, they expressly invited that criticism which has been so abundantly given.

A further step in the same direction has been taken by the Committee of Lloyd's Register, in issuing a set of tables prepared by their own officers. These tables also were issued as tentative, and not as hard-and-fast rules; and although, as might be expected in rules issued by a body which largely represents the shipping interest, they have been less hostilely criticised by members of that interest than the rules of the Board of Trade, they have not met with universal approval. Under these circumstances, it appears to the Board of Trade that it is time to take a further step, and they propose to appoint another departmental committee to consider this subject. In doing this, it is scarcely necessary to insist on the difficulties of the question, or on the various points which will have to be taken into consideration. But it may be useful to advert shortly to one or two points of importance.

So long ago as 1870 a report of the Council of the Institution of Naval Architects was presented to Parliament, containing a strong recommendation that a certain minimum freeboard should be required; what that freeboard would be is shown by the following paragraphs of that report:—

Extract from Parliamentary Paper, 157-1870, referred to above.—* * * * * "There is a minimum height of freeboard which cannot be safely reduced in sea-going ships of ordinary fitment, and it is desirable to fix this minimum height. Freeboard should be understood to be the vertical height of the upper surface of the upper deck—not spar deck—at the side, amidships, above the load-water line. The proportion of freeboard should increase with the length. One-eighth of the beam is a minimum freeboard for ordinary sea-going ships of not more than five breadths to the length, and $\frac{1}{32}$ of the beam should further be added to the freeboard for each additional breadth in the length of the ship this would give:—For a ship of 32ft. beam and 160ft. long, 4ft. freeboard; for a length of 192ft., 5ft. freeboard; for a length of 224ft., 4ft. freeboard; for a length of 256ft., 7ft. freeboard, the beam remaining the same, but, as the addition of a spar deck on long vessels may be considered an equivalent or substitute for the increased freeboard required for extra length, a complete spar deck would leave the freeboard of these extra lengths at the original height of 4ft. It is not considered desirable to offer any recommendations with regard to poops and forecastles. It must depend entirely upon the professional judgment of the designs of a ship, whether looking to her proportions, form, and purpose, the additions of poop and forecastle are expedient and safe. In general, where poops and forecastles are adopted, they should be closed and seaworthy, but their weight may be inexpedient in long fine ships, and there are cases where a light topgallant forecastle, *i.e.*, an open forecastle raised above the level of the upper deck, may be useful in keeping heavy seas out of the ship. In general, spar-decks in long ships are preferable to poop and forecastle, and no diminution of freeboard should be allowed for a poop or forecastle."

The above passage is important, since it shows what is the freeboard which a few years since an important scientific body considered necessary for safety. That freeboard starts with 4ft. as a minimum freeboard for ordinary merchant ships, and in spar-decked ships would require the whole height of the space between the main deck and the spar deck to be added to the minimum of 4ft. The freeboards, deemed then necessary by this body, are so greatly in excess of the present practice of shipowners, or of anything that has ever been required of them, as to show either that the Institute of Naval Architects at the time they made their report was altogether at variance with the practice of the trade, or that the freeboard in actual use has greatly diminished in the course of the few years during which the question has been under discussion. In either event, the difference above referred to illustrates the difficulty of the subject. It must be remembered that this question cannot be regarded from a shipowner's point of view alone. If the interest of the shipowner in bringing home his ship safe were in all cases such as to make that his first object, no legislation and no rules would be necessary. But, under the present state of the law, this is not the case; and the interest of the public, and of the men whose lives are at risk, will be sacrificed, unless the rules are such as to compel the reckless and ignorant to do that which they would not otherwise do. Any rules which are founded on the experience of the inferior class of shipowners will be an evil, and will lower instead of raising the standard.

In the case under consideration, this primary difficulty is much increased by the number of varying data which have to be taken into consideration. Thus the dangers from overloading may be stated to include the following, viz.:—(1) The decks may be swept by the sea and the crew washed off; (2) the sea may pour on to the deck faster than the freeing ports will relieve it, and get into the ship through hatchways or other insufficiently protected openings. (3) the ship may be so heavy that a very slight addition to her weight may sink her; (4) the ship may be deficient in stability; (5) the ship may be too weak in construction to bear the strain of heavy cargo.

The dangers above referred to vary according to many varying causes besides the mere depth of the ship in the water. All the following are different factors which have to be taken into consideration:—(1) General form and size of ship; (2) form of the ship below water; (3) form and construction of deck; (4) strength of the hull; (5) construction and strength of hatchways and all other deck openings; (6) means of escape for water on deck; (7) nature as well as weight of cargo; (8) relative position and stowage of different parts of cargo; (9) nature of voyage; (10) probable weather or voyage, remembering that the seasons differ in different parts of the world.

Out of these the first six alone can be known when the ship is built. The last four differ from time to time, and any rule as to load-line must be so made and applied as to vary accordingly. Thus it is obvious that the number and variety of the dangers to be avoided, and of the different factors to be taken into consideration, make the compulsory determination of load-line one of very peculiar difficulty. And the difficulty is made more formidable by the important consequences which will arise from any mistake. If the load-line is fixed too low, it is a serious detriment to the carrying powers of British ships; if fixed too high, it is a legislative sanction of a dangerous practice.

THE DIFFERENCE BETWEEN THE WEIGHT OF WATER VAPORISED IN THE BOILER AND THE WEIGHT OF THE STEAM ACCOUNTED FOR IN THE CYLINDER BY THE INDICATOR.

By Mr. B. F. ISHERWOOD.

WERE there no cylinder condensation due to other causes than the production of the power, the differences named above would not exist. Supposing the absence of priming or foaming in the boiler, the weight of water and the weight of steam would be equal. Among these other causes is the action of the metal of the cylinder, which alternately takes up heat from the steam and gives out heat to the resulting water of condensation, the former quantity of heat appearing to be greater than the latter as shown by the indicator, but equal in fact when the heat is included which re-vaporises that portion of the water of condensation which is present in the cylinder at the end of the stroke of its piston when the exhaust valve opens, the resulting steam of which passes to the condenser during the exhaust stroke of the piston, and thus escapes detection by the indicator. This re-vaporisation is due to contained heat in the water of condensation, and to the heat of the metal of the cylinder over which this water is spread, and to the less pressure in the condenser than in the cylinder, the interiors of these two vessels being in common as long as the exhaust port is open.

There is also a condensation of steam in the cylinder, due to the heat transmitted into the work of expulsion of the exhaust steam by its own pressure at the end of the stroke of the piston. This heat reappears in the condenser—and likewise in the receiver of a compound engine whose large cylinder is fitted with a cut-off valve—when the inrushing steam comes to a state of rest; the live motion communicated to this steam in the cylinder, at the expense of heat, reproducing the same quantity of heat when extinguished in the condenser—or receiver. But as regards the cylinder, such heat is lost, and escapes detection by the indicator.

Futhermore, there is a condensation of steam in the cylinder when the steam is used expansively, owing to the expansion, *per se*, and is due only to the transmutation of heat into interior work on the steam molecules, this transmutation being independent of any mechanical work done on the piston. The heat thus disappearing is not measurable by the indicator.

The water of condensation due to the transmutation of heat into work when expanding steam is employed as the heat carrier, be that work of what nature, it may, internal or external, is not deposited upon the surface of the metal of the cylinder, but remains suspended in the steam and perfectly diffused throughout the mass in the form of infinitesimal particles which give a cloudy or fog-like appearance to the expanded steam, whereas non-expanded steam, when employed as the heat carrier in doing work, remains transparent, no such water of condensation being present in it. The time of making a stroke of the piston is so short, and the watery particles of condensation are so excessively small and so intimately mixed with the very much greater mass of steam, that both are swept into the condenser together before any separation by gravity can take place.

The water of condensation due to the varying temperature of the metal of the cylinder during a double stroke of its piston, and composing by far the greater portion of the cylinder condensation, is mainly deposited previous to the closing of the cut-off valve, and is spread uniformly in the form of dew over the inner surfaces of the cylinder and its steam passages, whence it is re-vaporised partly during the expansion portion of the stroke of the piston, and the remainder during the exhaust stroke, so that when the cylinder again takes steam these surfaces are dry and comparatively cool. Thus the cylinder acts alternately as a condenser and a boiler, but the re-evaporated steam so obtained in the cylinder produces but little dynamic effort in comparison to its heat cost. It is used upon the piston almost without expansion, and its entire effect from the point of the stroke of the piston at which the re-evaporation takes place, back to the valve face, is lost. Of all the components of loss in a steam engine, this cylinder condensation is the greatest, and the economic advantages of steam jacketing and steam superheating are derivable directly from its prevention. As regards the enormous influence on the economic production of the power exercised by the metal of which the cylinder is made, an answer may here be properly given to the questions: How during the exceedingly short time required for a double stroke of the piston, even in the case of the slowest working engine, can the transfer of so much heat be effected, first from the steam to the metal of the cylinder, whereby a considerable portion of the former is condensed and then from the metal of the cylinder to the water of condensation; whereby the whole of the latter is re-vaporised, as is experimentally shown to be the fact? Indeed, does not the exceeding brevity of the time in which these effects are supposed to be produced furnish a sufficient negative to the possibility of such energetic action by the metal of the cylinder?

The answer is, that the weight of metal composing the cylinder is so much greater than the weight of steam or of water within it per single stroke of piston, and the extent of interior cylinder surface exposed in connection therewith is so large comparatively that no difficulty need be experienced in accepting the fact of the rapidity with which the heat is transferred, notwithstanding that the specific heat of iron at the ordinary temperatures of working cylinders is about 0·115, while that of water at the same temperatures is about 1·015. The heat conductibility of iron is about forty times greater than that of water, and its density about 7·2 times greater.

Taking for illustration the case of a small cylinder in which the maximum weight of feed-water per hour was vaporised in the boiler, the weight of steam entering the cylinder per single stroke of piston was only 0·12825 lb. The interior surface of the cylinder was 1200 square inches, and the weight of cast iron in direct connection therewith was about 220 lb.; consequently, not only did the weight of iron exceed the weight of steam 1716 times, but the latter if reduced to water and spread evenly over the former would form a coating only 0·0031in. thick. So far from there being any difficulty in conceiving that a considerable percentage of this weight of steam could be condensed to water by the metal of the cylinder having a disposable cooling power represented by its weight, its specific heat, and the difference of temperature in the cylinder during a double stroke of its piston acting through the comparatively large extent of surface within the cylinder, the real difficulty would be in conceiving the reverse. Besides which, experiments have shown that pure saturated steam in contact with a cooler metallic body condenses almost instantaneously until heat enough is transferred sufficient to equalise the temperatures of the two bodies. The same considerations show that the water of condensation thus deposited upon the inner surfaces of the cylinder will be re-vaporised therefrom with exceeding rapidity when the pressure under which it was deposited is reduced, by the disposal heat of the metal of the cylinder and by the contained heat of the water of condensation, the latter being measured by the difference between the total heats of vaporisation due to the difference of pressure. The cylinder acts as a condenser during the period of steam admission, as a condenser and boiler during the period of expansion, and as a boiler during the period of exhaust.

BOILERS FOR THE STEAMSHIP ABYSSINIAN.

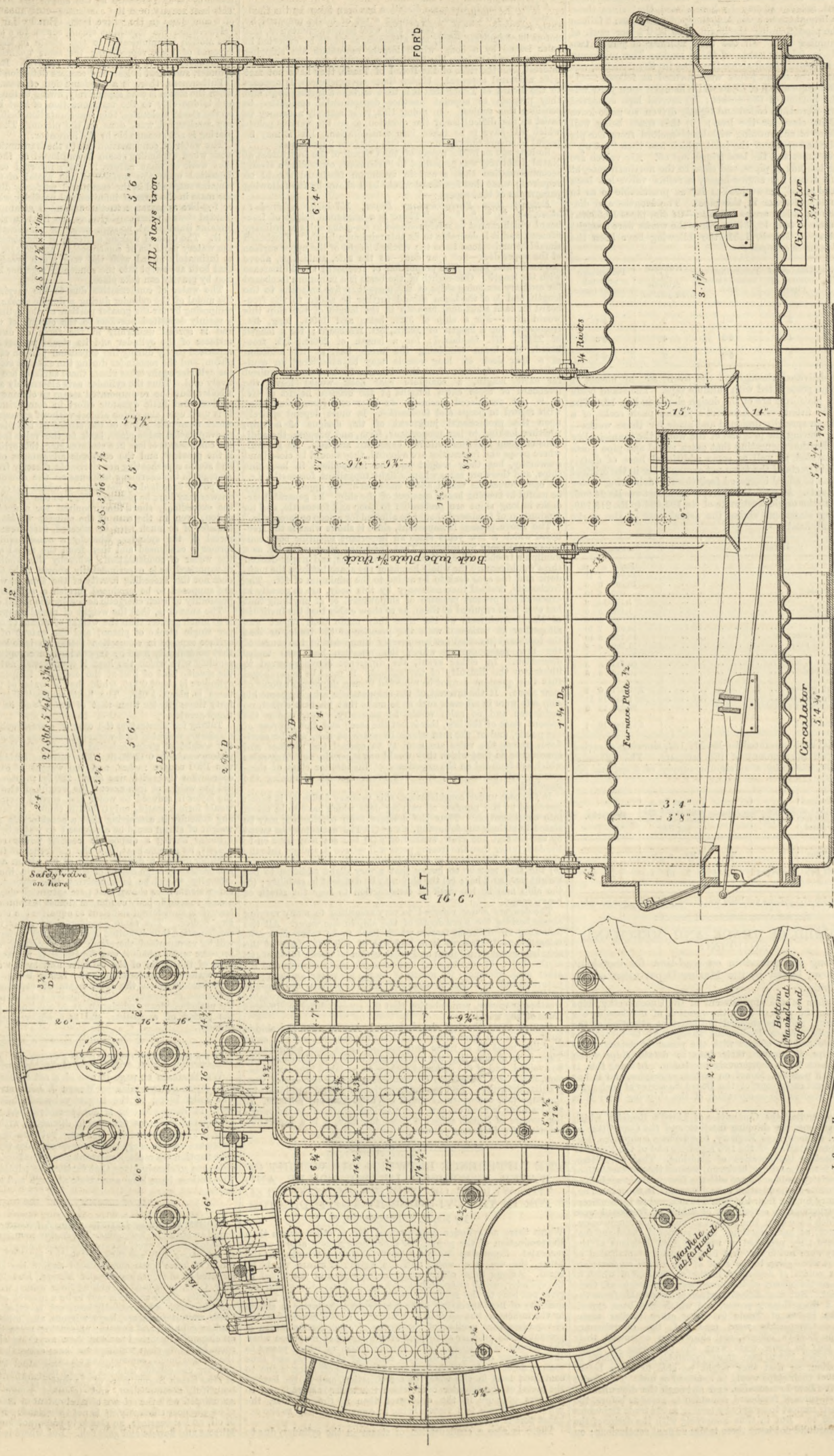
WE illustrate on page 10 one of a set of boilers made for the mail steamer Abyssinian by Messrs. J. Jones and Sons, Liverpool. The boiler is one of the largest yet made, being 16ft. long and 16ft. in diameter. It is double-ended, and has eight Fox's corrugated furnaces 3ft. 6in. in diameter, with grates 6ft. 4in. long. The tubes are 6ft. 4in. long between the plates. Circulators are used to carry the water down from the surface without interruption—a most important consideration. All the dimensions are so clearly given that further description is unnecessary. The boilers have been some time at work and given every satisfaction.

WOMEN AS ENGINE DRIVERS.—The American woman has at last found an outlet for her genius. The engine-room is, it seems, the place in which she can exert her energies to advantage. The surroundings of one young lady are thus mentioned in a Western paper: "A model 60-horse power nickel-plated engine has been recently constructed at the machine shops of Messrs. Duvall and Co., Zanesville, Ohio, to be used in running their works, which are the oldest in the city. The engine is said to be a marvel of beauty, and the room in which it has recently been set is fitted up with massive black walnut furniture, large mirrors, and other adornments, including gold fish and flowers; presenting more the appearance of an elegantly furnished parlour than anything else. This engine-room has plate glass windows on three sides, the entire height of the compartment, commanding an extensive view that exposes it to every one coming into the city by rail. The engine is in charge of Miss Sarah Bogue, niece of the senior proprietor of the works, a beautiful, accomplished, and talented young lady, sufficiently acquainted with the science of mechanism to discharge the duties of an engineer efficiently." Is not this grand. No grease, no smell of oil, no hot bearings, no glands to pack, not an oil can to carry. Mirrors and flowers and gold fish. But where is that young man?

BOILER FOR THE S.S. ABYSSINIAN.

MESSRS. J. JONES, AND SONS, ST. GEORGE'S ENGINE WORKS, LIVERPOOL, ENGINEERS.

(For description see page 9.)



TO CORRESPONDENTS.

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

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

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

FOUNDER.—*A letter for this correspondent awaits his application.*

H. D.—*The Nordenfelt gun was illustrated in our impression for January 21st,* 1881.

LOCO.—*Air pumps or their equivalents are indispensable to all engines, but smaller pumps can be used with surface condensers than with jet condensers, because much less air finds its way into the condenser.*

LATENT HEAT.—*You may put in any curve you please. You cannot open your line until it has been passed by the Board of Trade, but the sharpness of a curve will not prevent the line being worked under suitable conditions.*

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Jan. 8th, at 8 p.m.: Ordinary meeting. Inaugural address of Sir J. W. Bazalgette, C.B., President.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, Jan. 10th: Inaugural address by the President, Professor W. G. Adams, F.R.S.

THE ENGINEER.

JANUARY 4, 1884.

1884.

AN endeavour to look into the possibilities of the near future involves a reference to, if not a review of, the actualities of the past. Hence it is that our annual prospect becomes equally a retrospect. With the past a blank, the future can have no definite expectancy, and no estimate of the probable would be possible. The results of activity, professional, artistic, and industrial, show themselves in trade. Slackness and briskness in trade and agriculture reflect almost equally on engineering prosperity and the activity of the civil engineer. To the state of trade, then, at present and throughout the interval since we were last occupied in this same task, we must turn for an index, or for the means of taking stock, of the useful effect of the past year's labours, and of their application in the year into which we are now launched.

The present state of trade is said to be puzzling, and the results for the whole year considered disappointing. Reasons are sought in various directions as explanations of the alleged depression. Expectations are said to remain unsatisfied. The revival which set in in 1879-80 is held to have been slight, and followed by a constantly increasing slackness. Nowhere, it is said, is there real prosperity. Before searching for the causes of the present alleged bad state of trade, it may, perhaps, be allowable to ask whether the depression, of which so much complaint has been made, really exists? We believe that an impartial view of the facts obtainable all over the kingdom will show that the trade of the country is simply enormous; that it was never so great in some branches and never greater in any. We in England are great grumblers, which is not peculiar; but it is a peculiarity that we believe a good deal in the validity of each other's grumbling? If we ask, Whence comes most of the grumbling? the answer is, everywhere. Who grumbles most? Everybody. Those who have, whether through their fault or not, some real ground for a grumble, start one; those who have none just keep the grumble going, to throw dust; and all base a sufficient excuse for unstinted indulgence in the old pleasure on the fact that profits are low. The disappointment seems to be that no great inflation of prices has taken place. Upon this everyone is to be congratulated. No corresponding and consequent great fall has to be expected. Taken on the whole, the evidence is to the effect that those who are best able to do good work and supply the materials required are not without plenty of orders. The modern steel makers are all busy, and those whose speciality in iron manufacture is lessening in demand in consequence of the growing use of steel, will complain of want of orders. It is unfortunate for the ironmakers, but it is a necessary result of the progress in the art of cheap steel making. The demand for cheap steels has, however, attracted a large number of capitalists, and hence, though there is an enormous quantity of steel to make, there are very many people to make it. In the coal trade there is an enormous output of coal, but prices are low. Those who have best plant, best arrangements and management, other things being equal, will make most profits. Profits are undoubtedly small, per ton of coal, but the aggregate profits are large, and it cannot be expected in these days that a fortune is to be made out of every truckload—at least, not by the colliery owners; that is only to be done by the middlemen. Shipbuilding is now slack compared with what it has been during the last three years. Those who have wished for the improvement of trade by "leaps and bounds" have had it in this, with the result that new comers in the trade have been attracted, and the further result that now the oceans are pretty well covered with ships, there are more to build ships than ships to build. The demand has fallen to something below normal conditions. The increase in the number of shipbuilders reduces this demand so "trade is bad." The same thing holds good in coal—in almost everything. Railway traffic returns show that trade is really good; but that just now it does not increase as fast as traders. Our producing capacities increase at an almost incredible rate. When in the course of a few months the natural increase in demand has caught up to our producing capacity, we shall still grumble; but, probably, only for politic purposes. Great producing capacity caused over competition that has done harm, and this is peculiarly true of the iron trade, which is in so bad a condition that furnaces will have to be blown out and production reduced.

It must be something of very grand proportions now to make an engineer admit it a remarkable engineering feat. The economical limit to span has been nearly reached in bridges already constructed; mountain tunnels have been made up to nine miles in length, and a mile or two more will now hardly call forth special notice; subaqueous tunnels have been made of sufficient length to prove that with modern machinery similar tunnels of greater length may be constructed without calling for any great amount of genius to show the way. Docks and harbours in dozens have been made, many of large size, and a few acres more in area will not secure the engineer the fame that awaited the men who did the first big things. Waterworks, by the side of which Sir Hugh Middleton's feat sinks into microscopical proportions but for its "firstness," are opened with a corporation lunch, and a mention of the name of the mayor, and forgotten. The opening of a great Continent-crossing railway is the affair and talk of a few days. The laying of an oceanic telegraphic cable is mentioned in a paragraph, though only a few years have gone since the progress of the deposition of the Atlantic cable was watched for weeks with unabated interest by millions. That is to say, the record of the past year carries with it no chronicle of an engineering epoch-making event. Several works of public importance have been completed, or made great progress towards that end, but newness has rather characterised the manner of the doing than the thing done. Structural works, including roads, railways, bridges, docks, harbours, sea walls, and so on, are built very much upon the same general lines as they were a dozen years ago, or a quarter of a century ago. The changes which have been made relate chiefly to the machinery and apparatus employed by the constructor or contractor in carrying out these works. In road-making no changes have been made. In railway building excavating machinery has been used on a large scale, and in America an apparatus has been brought into use for sweeping a whole train load of ballast off the trucks without hand labour, by means of a form of double-breasted plough the width of the trucks, which the locomotive, uncoupled from the train for the purpose, drags along the whole length of the level bedded train. We do not know that this has been used in this country, but there seems no reason why a modification of the idea should not be brought into work in constructing railway embankments. "Tipping" formed the subject of an oil painting in a recent Academy exhibition. If some mechanical means could be found for dispensing with horse labour in this work that picture might acquire some interest as an illustration of how things used to be done. In the construction of docks the increasing use of machinery is the chief form of change. In mountain tunnel construction the greater rapidity with which the work is effected is largely due to the use of improved rock drilling machinery, and in other tunnels, such as that under the Mersey, the use of the Beaumont and English boring machine has enormously increased the rate at which the tunnelling can be done. Perhaps an equally great change in this respect is due to the improvement of explosives, the value of which has been specially shown in the Alpine tunnels and in American mining operations. In the longer mountain tunnels and mine headings, the high temperatures met with have proved formidable difficulties; but here again it may be said that the improvements in compressed air machinery have provided the means of working when work would otherwise have been impossible. In the St. Gothard Tunnel, just before the meeting of the two headings in February, 1880, the temperature rose as high as 93 deg. Fah. This, combined with the foulness of the air, produced an immense diminution in the work done per person and per horse employed, whilst several men were actually killed by the dynamite gases, and others suffered from a disease which was traced to a hitherto unknown species of internal worm. If the Simplon Tunnel should be constructed—and French engineers and others seem intent upon it—yet higher temperatures may probably have to be dealt with. The difficulty can hardly be said to be completely mastered, but much has been done in that direction. But by far the most satisfactory solution, in most cases at least, is obtained by taking advantage of the properties of compressed air. Air can be compressed at the end of the tunnel either by steam engines, or by turbines where water is available. This compressed air may be led in pipes to the face of the heading, and used there to drive the small engines which work the rock-drilling machines. That the efficiency of such machines is low, chiefly owing to the loss of heat generated in compression, is a matter of secondary importance in this case. But the result of this loss of heat is that a current of cold and fresh air is continually issuing from the machines at the face of the heading, where it is most wanted, and where it is most efficient as a ventilating help. In the St. Gothard the hottest parts were always some little distance behind the face of the heading. Although in this case as much as 120,000 cubic metres of air at atmospheric pressure were daily sent into the heading, yet the ventilation was very insufficient. Moreover, the high pressure which is used for working the machines is not the best adapted for ventilation. Hence in the Arlberg Tunnel separate ventilating pipes are employed, containing air compressed to about one atmosphere, which is delivered in much larger quantities, although not at so low a temperature. In connection with this question of ventilation a long series of observations have been taken at the St. Gothard, both during and since the construction; these have proved that the barometer never stands at the same level on the two sides of a great mountain chain.

In bridge pier construction compressed air is more than ever used, and the older and more expensive methods of sinking foundations and building piers are being replaced by one which is very much more rapid. As we have already said, the free use of compressed air and air only slightly compressed as used in the Arlberg, will overcome the difficulty of ventilation in the construction of any tunnels that are likely to be made. The working of some tunnels might, however, be more difficult in this respect; but perhaps Mr. Crampton's proposal to make three small tunnels instead of one large one may be looked upon as affording the means of working even such a tunnel as that luckless one under the Channel, the Bill for which was thrown out by the House of Commons on the 24th of July last. Mr. Crampton estimates that, by the adoption of three tunnels, they can be constructed cheaper where ordinary locomotives are used, give better ventilation than in one, that any two of them can be used at pleasure for the traffic, whilst pure air for ventilation passes through the other. Side by side, three separate tunnels are formed, each of sufficient dimensions to allow of a train passing along it. About midway of the length of the tunnels, all of them are connected together by large air passages, so that air may pass freely from one to the other. About midway between the centre of the tunnels and each of their ends is formed a branch at right angles, either above or below the other tunnels, and from this branch openings are formed into each of the tunnels, each opening being provided with doors or valves, clear of the main tunnels. The branch is led to any convenient point, at which a pumping engine or exhausting apparatus may be erected for withdrawing foul air from it. If two of the tunnels are left open to this branch, and the third one shut off from it by closing the door or valves, vitiated air will be drawn off from the two tunnels through the branch, whilst fresh air will enter them, partly through their open ends, and partly at the centre, where it is in communication with the third tunnel, so that fresh air will be drawn along the third tunnel, from the bottom of its vertical shaft, down which air is forced, provision being made for the purpose, and will pass into the other two near their centre, and be drawn through the branch, as above explained; the quantity of pure air being sufficient, so as to dilute the bad gases. By means of the doors above mentioned either any of the three tunnels can be used, as fresh air outlets, whilst the others are used as outlets for the mixed impure air and gas. By this means all the three tunnels will be efficiently ventilated, whilst at the same time the line of rails in one tunnel can be repaired, and the other tunnels used for the passage of trains; the tunnel in which the repairs are going on may be made the fresh air inlet tunnel. It may be here mentioned that the Board of Trade have intimated to the promoters of the South-Eastern and Channel Tunnel Railway Bill that if the bills which have been deposited are persevered with, it will be the duty of the Government to oppose them in Parliament.

In the construction of bridge superstructures no remarkable changes have to be mentioned. The most noteworthy bridge completed in the past year is that connecting New York and Brooklyn across the East River. Of this suspension bridge it is needless to enter into detail here as we gave a full account of it in our impression of the 1st June last. It is remarkable as having a river span of 1595·5ft., towers 271·5ft. above high water, and 78·5ft. below that level, the two main towers containing together 85,000 cubic yards of masonry, and the anchorages weighing 60,000 tons. It is a wire cable suspension bridge, and was altogether thirteen years in course of construction, part of that time being lost by financial difficulties. It was designed by John A. Roebling, the builder of the Niagara and Cincinnati suspension bridges, which are familiar to all interested in bridge construction, and it will probably remain for a long time the longest span suspension bridge in the world. The span is very great, but it is far from what may some day be looked upon as approaching the limit in this direction, although the permanent load is great. The weight of the roadway complete is 6740 tons. The cables weigh 3460 tons, the suspenders 1180 tons, the timber flooring 2760 tons, and the steel rails for the car tracks 660 tons, making the total permanent weight of the bridge superstructure 14,680 tons. A load of 3100 tons can be placed upon it with safety, but it is estimated that the maximum weight of moving passengers and vehicles which can be crowded on it is 1380 tons. The roadway is

85ft. in width, suspended from four steel cables 15·5in. diameter by steel suspenders, attached to steel floor beams 7½ft. apart. Six longitudinal trusses divide the flooring into five parts. The two outer parts are for the use of vehicles. The two inner divisions are laid with steel rails, and provided with endless wire ropes for hauling across the rapid transit cars. Between the two inner divisions and at some distance above them is the space devoted to foot passengers, 15ft. 7in. in width. The total cost reaches £3,000,000.

The most interesting bridge structure at present in progress is the Forth Bridge, the largest ever undertaken. It will consist of two spans of 1700ft., two of 675ft., fourteen of 168ft., and six of 50ft., with a clear headway for navigation of 150ft. above high water of spring tides. The two large spans are two cantilevers, each 675ft. long, with a central girder 350ft. long, the depth of the cantilevers being 350ft. at the piers and 50ft. in the centre. To hold aloft and to maintain the immense weight of steel of which the cantilevers and girder will be composed, piers will be required of corresponding magnitude. The central pier, on the island of Inchgarvie, will consist of four cylindrical masses of concrete and masonry, 45ft. in diameter at the top and 70ft. at the bottom. They will be founded on rock at a depth below high water varying from 24ft. to 70ft., and will be carried up to 18ft. above high water. The length of the bridge will be more than a mile, and of the viaduct approaches 2754ft. The contract has been let for £1,600,000. Considerable progress has been made with the masonry, about 17,000 cubic feet of granite masonry having been set, and the number of men employed will soon reach 800. Some idea may be formed of the magnitude of the undertaking from the statement that the materials required would fill 1000 goods trains of average length and capacity. The whinstone required will, however, be found on the spot, the granite being shipped from Aberdeen, the steel from Glasgow and South Wales, and the Portland cement from different places in England. As it is intended to manufacture the steel superstructure of the bridge on the spot, very extensive works lighted by electric lamps have been constructed at Queensferry, and the plant provided includes about fifty steam engines of various classes, and a large number of especially designed hydraulic tools, drilling machines, and other tools for dealing with the 45,000 tons of steel which will be used in the bridge. The manufacture of the superstructure of the bridge will soon be commenced. All the important members subject to compression will be of a tubular form, as will have been gathered by those who read the paper on the subject read at Southampton in 1882, by Mr. Baker. About three miles of steel tubes, ranging from 12ft. to 5ft. in diameter, and from 1¼in. to ⅜in. in thickness, will be required. Plant, including gas and other furnaces, has been provided for this purpose. The steel plates are heated in gas furnaces, and stamped to the desired curvature in a 2000-ton hydraulic press; the edges planed and the plates temporarily clamped together to form a tube about 400ft. in length. Travelling drilling machines will then traverse the tube and drill all the holes required to rivet the plates together, but this rivetting will not be done until the bridge is being erected, plate by plate, across the Forth. All of the machinery required to commence the manufacture of the tubes in the new works has been designed by Mr. Arrol, one of the contractors, and is similar to that described by us last year in our impression for the 22nd of September, 1882.

To fix the position of the piers of a bridge having two clear spans of 1700ft. and two of 700ft. across a channel 200ft. in depth, is not easy, and a few words may be said about it. The Forth banks are more or less precipitous and the country undulating, so that it was difficult to get a base line for a trigonometrical measurement. At the request of Mr. Fowler, the Ordnance Department kindly sent a party of sappers to recover the old stations used in the Ordnance Survey of Scotland, and to take the necessary additional observations to determine the width across the Firth of Forth. The calculated result differed about 1ft. from that obtained by Messrs. Fowler and Baker. To measure off the 1700ft. that length was first measured with exactitude along a straight piece of the North British Railway, and posts of a certain height fixed at each end. A steel pianoforte wire was then hung from these posts with a sag or droop of 24ft. at the centre, and marks were fixed to each end of the wire to indicate the 1700ft. length. The wire was then coiled on a roller and taken on board a steam launch, from which it was laid across the channel of the Forth. It was then hauled up above the surface of the water till it hung with the original droop of 24ft., when, assuming the temperature to be the same, the marks put on the pianoforte wire should indicate the required span of 1700ft. This process was repeated several times and the wire taken ashore to the railway to test whether it had stretched; but all the observations were in accord. The sensitiveness of this simple mode of measuring the span with a wire weighing only 8 lb. in all will be seen when it is stated that when Mr. Baker slacked out the wire only ¼in. in the 1700ft., an observer in a boat in the centre of the Forth at once signalled there was too much droop in the wire. At another time he signalled that it was too high, but a reference to the thermometer showed the temperature had fallen 2 deg., so that the wire proved itself a most delicate indicator of changes of temperature. It will be here interesting to record that during the storm of the 12th of last month, which seems to have been general in its violence all over the country, the pressures of wind recorded on the boards erected by Mr. Baker were—on the small board, about 1·5ft. square, 38·5 lb. per square foot; on the large board, having an area of 300 square feet, the pressure recorded was 21·5 lb. per foot. At Wexford, at the same time, the maximum pressure recorded on a board about 2ft. square was 28 lb.

A cantilever bridge, somewhat similar in general design, but with the largest span only 500ft., or less than one-third of the Forth spans—has recently been completed over the Niagara gorge, to carry the Michigan Central Railway. The spans have been built out by means of a travelling double jib crane, 66ft. in length, the jib framing projecting 40ft,

Of the tunnel work of the year, first mention must be made of that through the Arlberg. This tunnel is 10,270 metres in length, while the Mont Cenis Tunnel is 12,323, and the St. Gothard 14,900 metres. The first took fourteen years and a-half, and the second about eight to bore; the Arlberg Tunnel took a little over four years. Dynamite has been largely used, and the Brandt revolving rock drill was employed, as well as the Ferroux percussion drill, to supply which with compressed air several streams from the heights of the snow-covered Arlberg were gathered on the eastern side into reservoirs, from which turbines were supplied. On the western side water was passed through pipes under a pressure of about 1500 lb., to work the Brandt revolving borer, which cuts cylindrical blocks from the rock. The gallery was driven on a level with the bottom of the future tunnel, and not on the Belgian system. The two halves of the work were allotted on December 21st, 1880, to two contractors—Ceconi for the eastern part, and the Brothers Lapp for the western side; but the piercing of the galleries, effected in the beginning by ordinary tools, as the nature of the stone did not allow the employment of boring machines, had already begun in June, 1880. On November 13th and November 17th respectively, the percussion and the rotating borers began their work, which advanced on each side at an average of from 5 to 7 metres daily, the greatest result having been achieved in 1882, when 3590 metres were bored; while the St. Gothard Tunnel had a maximum of boring in 1878 of only 2530 metres. Throughout the whole of the time the boring proceeded at about three times the speed reached in the Mont Cenis, while it approached double that achieved in the St. Gothard. The rate gradually increased from 136·6 metres per month to 379 metres per month.

In England the tunnel which has attracted most attention is that under the Severn, which is being carried out by Mr. T. A. Walker. With the exception of four weeks from the 10th October to the 7th November, during which time the work was partially interrupted by the breaking-in of a large fresh-water spring under the Monmouthshire approach, the tunnel works have proceeded with great rapidity during the whole year, the rate for some months having reached about 300 lineal yards of finished tunnel driven and lined each month. The cutting on the Bristol side of the river, which contains more than 800,000 yards of excavation, is about one-third completed. Of the 30 chains of tunnel on the same side of the river and under the land, about 26 chains are completed, and the bridges and culverts are now in a forward state. Under the river itself, from the shaft on the Bristol side, 75 chains of tunnel are finished ready for permanent way. There is, then, half a mile under the river in active progress, and three-quarters of a mile, completing the river length, has been arched from the Monmouthshire side. The drainage heading, from the main shaft to the centre of the river, has been completed and lined with brickwork. The three shafts beyond the river on the Monmouthshire or Welsh side are spaced about 40 chains apart, and from each of these about 25 chains of tunnel has been completed. The cutting in the approach on this side of the river is well advanced, and the material from the cutting is being deposited in a large station-yard, where the trains, before entering the tunnel, will be marshalled. At the point where the large spring broke in on the 10th October, there are but ten chains of tunnel to complete, and this is being left till the other work is completed, and further pumping power provided. The pumps at present at work, or provided as a reserve, are six 15in. pumps on the Bristol side of the river; five 15in. pumps, one 28in., and three 18in. pumps at the outlying shafts on the Welsh side; and at the main shaft on the Welsh side there is a 75in. cylinder engine working a 35in. pump; two 50in. cylinder engines, each working a 26in. pump; and one 70in. cylinder engine, working a 28in. and two 18in. pumps. There are now being erected at this point, in addition to the above, one 70in. engine with a 37in. pump, one 70in. engine with a 35in. pump, and two 60in. engines each with 31in. pumps. With regard to the great spring which burst into the tunnel on the 10th October, the spring had been flowing at the rate of about 3000 gals. per minute for six months through the top heading, and probably this represents the whole permanent volume of the water to be dealt with; but on the date above mentioned, the men in the lower heading tapped the same fresh-water spring at a depth nearly 20ft. below the top heading, thus draining to that depth all the water stored in fissures in that extra depth. Such an occurrence had not been unprovided for, and strong head walls had been built across both top and bottom headings, with iron doors and sluices as a safeguard against any probable inrush of water. The water ran in at first at the rate of nearly or quite 30,000 gallons per minute, slackening after three days to about 10,000 gallons per minute, and the pumping power at that point being about 11,000 gallons per minute after the first week the water was steadily lowered in the workings, and when it seemed to be clearly ascertained what the ultimate quantity to be dealt with was, the door was shut and the works were cleared of water in three or four days. The pumps now being erected will raise 14,000 gallons per minute in addition to the 11,000 already provided for. It is expected that the whole of the brickwork of the tunnel will be finished before the end of this year. At some future time it may be found possible to make use of Poetsch's system of freezing up springs and undesired water supplies like those which have caused so much trouble in this tunnel. This system we have lately described.

The tunnel under the Mersey is the most important part of the Mersey Railway, of which we recently gave a full account. The distance between the shafts at Liverpool and Birkenhead is about a mile, of which some 1300 yards are under the river itself. The main tunnel is for a double line, and is lined and inverted throughout with brickwork and cement. It is preceded by a drainage heading, 7ft. in diameter, chiefly driven by the machine already mentioned. This heading is now approaching completion, the intervening distance between the faces being at last report about 160 yards, but it is now about 80 yards. This heading is being cut from two faces through solid sandstone rock, at the rate of about 35 yards per week, partly by hand and partly by machine. The tunnel itself is being excavated from several faces. The water does not show any considerable increase, and is readily dealt with by the pumping machinery on the two sides of the river.

Amongst the proposed engineering works of great magnitude is the Manchester Ship Canal, of the present state of which we give an account in another page.

The Panama Canal is, perhaps, the most prominent thing in its way. The first sod was cut on the 1st of January, 1880, and work was begun about fourteen months after. It has been commenced from both ends of the canal, and various points as well on the proposed line. There are 26 large workshops in full operation, and the plant employed in excavation comprises 18 dredging machines, 72 excavators or steam navvies, 94 steam engines for the workshops, over 3000 wagons for removing earth, 28 locomotives, 19 steam tugs, and 74 barges. If the canal is completed, vessels leaving London, Liverpool, or Havre for San Francisco, by using the canal will shorten the voyage by no less than 10,500 miles; from London, Liverpool, or Havre for Sydney by 6600 miles; and from the same ports to Valparaiso by 4200 miles; and to the Sandwich Islands by 8400 miles. The greatest difficulty to be overcome is the fearful unhealthiness of the country through which the canal has to be made. The rate of mortality has apparently been decreased by special attention to housing the labourers. Small wooden stilt houses have been erected on high points for 10,000 labourers. The sickness among those labourers was 10 per cent., 5 per cent. only of which was due to fever, and this, at the date of the last report referring to the subject, was considered very small. The number of men employed is now large, but not the 20,000 which it was boasted would be there at this date. The Canal Company has opened a large hospital, and the latest accounts from there stated that there were only 25 persons in the hospital. The canal, which is to be sixty miles in length, has been divided into ten sections, and each of these sections has been let to a distinct contractor, so that the time on any one of those sections of six miles is supposed to be the measure of the time it will take to construct the canal in its entirety. The earth and rock to be excavated is estimated at about 140 millions of cubic yards, and this is expected to be removed by the end of 1888. The general width of the canal when completed will be 136ft., but where it passed through rocky portions of territory, the width will be reduced to 86ft. The uniform depth of the canal will be 28ft., so that it will admit all vessels drawing 26ft. 6in. to pass safely from end to end.

Since M. Dingler, the chief engineer, has been on the spot several causes for increasing the estimated cost have turned up. The tides in the Atlantic and Pacific differ very materially. At Colon, on the Atlantic, the difference between high and low water mark is not more than 2ft.; whereas at Panama, on the Pacific, the average variation in the height of the water is 13ft., and is sometimes no less than 19ft. 6in. Moreover, high water at Colon is about nine hours later than at Panama; therefore, when it is high or low tide at Panama the tide at Colon is half way between high and low. The maximum difference which could exist between the level of the waters of the two oceans would therefore be equal to half the height to which the tide rises at Panama on the Pacific. If the canal communicated freely with the two oceans, there would be an alternate current from the Atlantic to the Pacific, and from the Pacific to the Atlantic, the duration of each current being about six hours. It may be said that there would moreover be no slack water, as the level of the water in the two oceans is reached at the moment when the tide runs the strongest—that is to say, at half water at Panama. By comparison with the canals and rivers which empty themselves into the Bay of Biscay, M. Dingler, however, estimates that the rapidity of the currents in the canal would be something like 6ft. 6in. to 8ft. per second. To keep the promise made by M. Ferdinand de Lesseps, and to satisfy the requirements of navigation, it is necessary that vessels should be able to pass out of the canal into the Pacific and enter it from the ocean at all times of the tide without either difficulty or obstacle, and without preoccupation concerning currents produced in the canal by the tide. To realise this, M. Dingler explained in his last report that it will suffice to establish lock chambers at the Panama extremity of the canal. To enable vessels of all dimensions to enter and pass out of the canal at the Pacific end at all times, M. Dingler proposes that it should be made to terminate in three branches, each furnished with a lock chamber, capable of containing a vessel 180 metres long, one branch to be used by vessels entering the canal, the second for ships passing out into the ocean, and the third to be employed when one or other of the entrances may be under repair. To avert the danger of floods during the heavy rains, it is also proposed to create an immense reservoir in the upper valley of the Chagres. M. Dingler also advises the creation of one large siding, about 5 kilos. long, half-way between Colon and Panama, where two trains of as many as twenty-five vessels each could pass each other without either inconvenience or danger. The proposed tariff is 15f. per ton, which is somewhat different from that of the Suez Canal which the Government accepted in July, in the scheme announced on the 11th, and discarded on the 23rd of that month. The Corinth Ship Canal, commenced in May last year, seems to present few difficulties except in the removal of the enormous mass of 8,000,000 cubic metres of rock in the mountainous parts. The canal will be nearly four miles in length, and vary in width from 328ft. to about 70ft., the depth being 26ft. The estimated cost is about one million sterling.

The canal from St. Petersburg is now about two-thirds completed. It was commenced in 1876, and work proceeds leisurely. The canal starts from the mouth of the Neva, where it will open into a large basin, and proceeds southwards for nearly two miles. In this part of its course it will have a navigable width of 207ft. Taking a wide curve, it will then join the canal which goes direct to Cronstadt; and from the same point a branch will proceed to meet the Neva above St. Petersburg. It will have a uniform depth of 22ft. The soil is easy to work, consisting almost entirely of clay, sand, and gravel, and a total quantity of 47,737,000 cubic yards of ballast has been extracted, being about two-thirds of the whole. The remainder will be excavated by the end of next year. The dredgers employed are all English, except two small ones made at St. Petersburg, and one in Belgium; they number altogether ten, and are capable of excavating a total of 188,354 cubic yards in ten hours' work. There seems to be no hurry about this job.

Turning now to railway work, we are first reminded of the ceremonious opening of the Northern Pacific Railway. Of this some account was given in our pages as recently as the 23rd of November, so it is unnecessary to refer further to it here. In England the most important line of railway in course of construction is the Hull and Barnsley line, upon which some of the fastest work ever done in this country has been completed, under Mr. Shelford and Mr. Bohn. The whole line, with the new docks at Hull, is in a forward state, the great rapidity with which the work has been executed by Messrs. Lucas and Aird being due to the enormous plant which they have brought to bear on it, as well as about seven thousand navvies. On the railway sixty locomotives have been used, and eighty more in the dock, the excavation of the fifty acres of which has been remarkably rapid owing to Mr. Abernethy's use of hydraulic excavating, lifting, and tipping machinery. In commencing the work, the hydraulic engines and pumps which will form the permanent plant for the working of the dock cranes, coal tips and other machinery, was fixed, and this has been used to work the excavating machinery, with the result that the dock will, though of large size, be completed with about three years of work. This railway and dock scheme has always been very popular in East Yorkshire, and, in fact, may be said to have been demanded by the inhabitants, so as to overcome the delays and cost which attended carrying coal from Barnsley to Hull on two different lines and delivering at a dock also separately owned. Vessels entering Hull with cargo often left empty to load with coal elsewhere owing to delays; and when it is remembered that a few hours' delay will sometimes be of great importance to a shipowner, the value of a through line from a rich coal-field with a fine dock provided with every necessary in the way of machinery will be recognised. The line is of first-class order; the sidings will almost everywhere be arranged without dead ends, and stand-by lines for local trains will be provided at almost all stations to enable express trains to pass without delay. A commencement will soon be made with the Halifax and Huddersfield extension, and the other authorised works by which a connection will be secured with the London and North-Western Railway, so that the company's lines will then form part of a through route between Liverpool, Manchester, and Hull. The proposed extension commences near the Cudworth station, on the Midland Railway, by junctions with that line and the Hull and Barnsley original undertaking, now nearly completed; and it proceeds west, through the Flockton coal-field, to Huddersfield, and thence by direct route to Halifax—a total distance of about thirty miles.

The 10th of this month will be the anniversary of the opening of the Metropolitan Railway. A little less of vestryism, and the line then opened might by the 10th have been circular. The twenty-first birthday of this mole train service is to be celebrated, and it is said that the entire staff of about 1000 has been invited. We do not know how this celebration is to be carried through with the men absent nor how the line is to be worked while a thousand of them are away. Mr. Bell will, however, no doubt manage this; but it is to be regretted that the Inner Circle completion link will not be ready for opening at the same time. The line itself is practically completed, but the stations, and the many things which on a line that cuts through so much property, sewer pipes, and so on, are comprised in "finishing," remain to be completed. The stations will not be ready until June next, though a great deal of the ironwork is now being put together. Of a good deal of the work on this very expensive piece of railway we gave a full account in our impression for the 9th March last.

In the construction of the permanent way of railways, nothing notably new has been done during the year. In the near future there is no doubt that the more general employment of iron or steel permanent way will be noticeable, and it may be desirable to encourage this, not only because of the growing scarcity of timber, but for the same reason that the Belgian Government has been petitioned to follow the example of Germany in this matter, namely, to increase the consumption of home produce.

During the year considerable progress has been made with the work of the Vyrnwy water supply scheme for Liverpool, but the Manchester Thirlmere scheme has in its engineering aspects been almost wholly stopped by the enormous award to the Countess who owned lake property and rights, an award which has greatly increased the difficulties attending the purchase of property along the route of the aqueduct. If many such awards as that above mentioned were made, public works would receive a great check, especially if any claim were allowed for the water itself, like that set up in this case. The award gave a sum which was equivalent to about ninety years' purchase of the property concerned.

During the year we have several times commented upon the Brighton beach and the groynes erected to prevent the loss of foreshore. The result of the work there carried out indicates the necessity for a different form of groyne; and here, as in a good many places, there is no doubt that a form of open-work groyne would be much more successful. In many places it is useless to try to stop the sea. To break it up and take the velocity out of the water, and so dissipate its energy, is what is wanted, so that the back wash may have but small velocity. The Hove Commissioners have now determined to expend about £30,000 for wood groynes and sea wall.

The private Bills in Parliament this year promise a lot of work in the future, the total number being 294. Of these 134 are railway Bills, 27 tramway, 1 canal—namely, the Manchester—31 water, gas, and lighting, no less than 26 harbour, dock, and port, 32 town improvement, 9 road and bridges, and 34 miscellaneous.

The Clyde Trustees have formally lodged completed plans of proposed wharfage extension works, the construction of which they seek to have authorised in the ensuing session of Parliament. In this new Bill the trustees ask power to construct two quays or wharves in the burgh of Partick, two almost immediately adjoining the western boundary of Govan, and one at Dalmuir, about eight miles down the river; while they also request to be authorised to acquire and work the ferry of Irskine, one mile and a-half beyond Dalmuir. Should the powers sought for be granted, the harbour of Glasgow will be very materially enlarged, and both shipowners and shipbuilders will be considerably benefitted by the acquisition. The immediate cause for the proposed extension is the necessity for providing wharf and quarantine accommodation for the Canadian cattle trade, which has assumed very large dimensions during the past two years. The present landing place for Canadian cattle is at Plantation Quay, on the south side of the river above Govan; but as this portion of the harbour is required for the main entrance to the new docks at Cessnock, the local authority have received notice to leave in Whit-Sunday next. The present limits of the harbour are such as to make the erection of a new quarantine station impossible, hence the present application for powers to extend further down the river. The plans of the new works and additional lands bearing the name of Mr. James Deas as the engineer for the contemplated extensions were, according to statute, deposited on the 30th ult. These show that the first of the proposed quays will be situated on the north side of the river at Meadow-side. It will be fully 600 yards in length, the face of the wharf coinciding with the top of the present river bank. A large portion of ground is proposed to be acquired in connection with this new quay. The second projected wharf—also situated on the north side of the river, and near above—will be fully 500 yards in length, the face of the wharf coinciding with the top of the present slope. The ground proposed to be acquired in connection with this wharf extends from the river bank to Dumbarton-road. The third and fourth wharves proposed are situated on the south side of the river, the first of these being about 170 yards in length, and occupying the present vacant ground between Fairfield and Linthouse shipyards. The second of these two quays will be between 1100 and 1200 yards in length, and will be the most extensive of the works embraced in the new Bill. It will be situated on the lands of Shieldhall, and the ground proposed to be acquired in connection comprises the whole land of Shieldhall estate, about 80 acres in extent. This land already possesses the advantage of a railway connection with the Glasgow and Paisley joint line. The south line of the river, in way of this wharf, will be slightly straightened, the work in connection with which will be effected by dredging. The fifth of the proposed wharves is to be erected on the north side of the river at Dalmuir, immediately east of the Clyde Trustees' works, and has been designed chiefly to afford people in the district the advantage of river passenger steamers. The need for such a wharf in this rapidly rising locality is now evident enough, but when the Singer sewing machine factory, employing about 3000 hands, and Messrs. J. and G. Thomson's engine works, employing half that number, are in full working condition, the accommodation now proposed will have become imperative. The remaining item in the parliamentary notice is the proposed acquisition by the trustees of the Erskine horse ferry, which has so long been the subject of litigation. In the interest of the industrial public, the ferry cannot be too soon put into working order, and under the management of such a body as the Clyde Trustees, the boon would be certain to be efficiently maintained.

Up to the present hour the sale of gas has suffered no appreciable damage from the advent of the electric light. That the gas interest will receive some check from the new illuminant is very probable, but for some time to come the effect can scarcely be anything more than a retardation of the advance which gas would otherwise make. The demand for artificial light grows with the increase of population, and is further fostered by habits of refinement and luxury. Where large areas have to be illuminated the electric light comes in as a formidable rival to gas, especially where pecuniary considerations are not paramount. The attractions of the late Fisheries Exhibition at South Kensington were greatly enhanced after dark by the effective illumination due to the electric light. The presence of this competing agent also has an effect in beating down the price of gas; and we lately commented on the fact that while in the course of fourteen years the consumption of gas in London had been doubled, the gas rental of the companies had only risen by about one-half. According to a parliamentary return issued last month, the capital of the gas companies throughout the United Kingdom at the close of 1882 was £32,934,935, or an advance of £2,348,313 on the previous year. The capital invested in gas undertakings by the local authorities of the United Kingdom at the close of 1882 was £17,326,183, being an advance of £3,286,600 in the twelve months. Thus the total capital devoted to the manufacture and distribution of gas at the end of 1882 was over £50,000,000, as compared with less than £45,000,000 a year before. The actual amount invested by the local authorities is not capable of being ascertained with perfect accuracy, owing to the capital being in some cases employed for various purposes in addition to the gas undertaking. Still, the figures are sufficiently near to the fact, especially in estimating the yearly progress. Judged by these figures, the gas interest would seem by no means languishing. Last year we referred to sundry new modes of burning gas which were coming into vogue, designed to develope the illuminating power of the commodity, and to cheapen the cost of light. Methods of this kind are receiving trial somewhat extensively, and there can be no doubt that from year to year there has been considerable progress made in the art of consuming gas to advantage, both for lighting and heating purposes, but more especially the former. One point connected with the use of gas is the maintenance of a proper quality in the public supply. The quantity of gas consumed can be readily ascertained, though there has been some controversy occasionally on this point. As for the lighting power and the purity of the gas, it has been thought that London was sufficiently protected by means of the testing stations established and conducted under the authority of the Corporation and the Metropolitan Board. But latterly it has been discovered that, owing to complications among the numerous gas mains in the metropolis, consequent on the amalgamation of companies, a large quantity of gas goes entirely untested. The Metropolitan Board, having detected the omission, have communicated on the subject with the Gas Referees appointed by the Board of Trade, and steps are being taken to extend the system of gas-testing, so that by no possibility shall gas fall below the proper standard without being officially observed. Another matter of interest consists in the progressive amalgamation of the metropolitan gas companies. On July 1st the London Gas Company became absorbed in the Chartered, thereby reducing the number of gas companies in London to three. More recently there has been a proposal to absorb the South Metropolitan Gas Company into the Chartered, in which case the latter company will have the entire command of the field, with the exception of the Commercial. But the scheme of amalgamation with the South Metropolitan Company is powerfully opposed, and inasmuch as it contemplates alterations which seemingly demand the authority of Parliament, the probability is that the Board of Trade will refuse to sanction the scheme.

The water companies, not only of London, but of the country at large, have been suddenly hit in a very unexpected manner by a legal decision, which prescribes that "annual value," unless otherwise defined, shall mean "net value." Accordingly, these companies, in levying their charges, are henceforth to have reference to the rateable value of property, instead of the rack-rent. They may, indeed, show in some cases that the "net value" is something more than the value assessed to the rates, but the difference cannot be much, and is scarcely worth a contest. The companies generally express their willingness to accept the decision of the House of Lords in the Dobbs case, but it is not unlikely that they will seek to recoup themselves by a more rigid enforcement of their statutory rights in making up their accounts against the consumer. The agitation on this subject will give renewed force to the demand for placing the water supply in the hands of the local authorities. The idea that this can be accomplished by means of competition is popular, but the expectation is fallacious, unless towns are willing to undergo enormous inconvenience and loss. London is of all places least likely to submit to a second system of water mains, however anxious the inhabitants may be to avenge themselves on the companies. As for changing the sources of the supply, this might be effected without any great disturbance of the streets, but would involve a very heavy outlay. Concerning the quality of the water there is less alarm now than formerly, thanks to the investigations of other chemists than Dr. Frankland. Even the latter has moderated his tone, and frequently testifies to facts which are favourable to the London water supply. The chief bitterness now is in reference to the price. This also touches the question as to the terms on which the London water companies shall be bought up, if ever that transaction is to be effected; and there is great rejoicing among their adversaries in the prospect that the profits of the companies will be curtailed by the judgment of the law lords in the late appeal case. The Corporation of the City have given notice of a Bill for the coming session of Parliament, which is to regulate the water companies in almost every particular, prohibiting back dividends, preventing increased charges founded on the quinquennial valuation of property, and providing that the domestic supply shall be given by meter where so demanded. The Metropolitan Board are going to introduce a Bill of another kind, simply giving them power to expend money to promote legislation on the water question for the future, or to institute legal proceedings in reference to the supply. Power of this kind would enable the Board to introduce a water scheme if they saw fit. But the statements of the Home Secretary make it appear that the water supply of London will be left substantially where it is until some new form of government is given to the metropolis. The Southwark and Vauxhall Water Company are going to Parliament once more with a Bill to extend their statutory limits and to enable them to effect agreements with other companies. It will be remembered that last August a deputation from certain suburban localities waited on the Home Secretary complaining that they were subject to the large metropolitan water companies, and wishing to be independent of them. Whether these parties would be gainers by setting up on their own account may be doubted. There are engineering reasons why the London water companies, large as they are, should undergo amalgamation. Neither does the example of Richmond, in exercising its power to oust the Vauxhall Company, tend to encourage separate local efforts. In the provinces it does not appear that the water supply is always well administered by the local authorities. The waste of money in some cases is extraordinary, and this is a failing from which the companies are generally free. One source of costliness in the water schemes of the present day is the enormous compensation demanded by landowners. It is a serious question whether the claims of property have not been carried too far in this respect, the necessity of the towns having been too often made the opportunity for exorbitant demands, which have been unfortunately conceded.

Whether the "sewage problem" is any nearer its solution now than at the beginning of 1883 is scarcely made apparent by the events of the past year. Some progress is doubtless being accomplished in a quiet way, and somehow it comes to pass that we hear very much less than formerly as to the pollution of rivers. Yet the Rivers Pollution Prevention Act of 1876 is frequently condemned as useless. When we hear of this statute it is generally in connection with some suspension of its provisions for a period of time, and when one respite expires another is granted. The Thames Conservancy Board, under their own Act, manage to obtain convictions against offenders, but the penalties never seem to be paid. The unfortunate Lower Thames Valley Main Sewerage Board is still alive, with Sir Thomas Nelson as chairman, and is seeking for a Provisional Order to carry out a scheme in which precipitation by chemicals will play a leading part. As usual, there is opposition, no persons being willing to have sewage works established on or near their property, or in the vicinity of their residence. The Royal Commissioners appointed to inquire into the complaints relative to the metropolitan drainage outfalls have ceased to take evidence, and may be supposed to have their report nearly ready. Should they decide against the perpetuation of the existing outfalls, and recommend that the sewage be discharged at points more remote from the metropolis, the prospect will not be a very agreeable one for the ratepayers, although it may have its attractions for the engineer. The inquiry has no bearing on the water supply; but it is alleged that the river is so polluted by the discharge from the outfalls as to be offensive, contaminating the atmosphere and affecting the health of the contiguous population. If this be so, it is to be feared that many other rivers in England are in an unsatisfactory state. But the most serious effect of sewage—or pollution which ought to be carried off by means of sewers—is that which arises when there is an admixture with the water supply. Local authorities are often remiss in this matter, and the danger especially affects small communities. Yet the statistics of mortality show that the health of the people is improving, and that zymotic disease is on the decline. Where certain forms of sickness break out it would often appear that the milk supply is the chief vehicle of contagion. People who scrupulously filter the water they drink are unexpectedly poisoned by the contents of the milk pail. The mixing-up of cesspools and wells in villages and small towns is the most direct form of drainage poisoning extant. It only needs one step more, and the milk becomes the prolific nidus of the zymotic germs, diphtheria or fever being forthwith distributed at the tea-table.

In mechanical engineering nothing startling has been produced during the past year. At the same time progress has been made. It becomes daily more difficult to effect improvements on existing devices. We do not mean for a moment to assert that a time is approaching when no further advance in mechanical science will be possible, but it was obviously much more easy to reduce the consumption of fuel from 30 lb. per horse per hour to 10 lb. than it is to bring down the consumption from 1½ lb. to 1¼ lb. The quantity of inventive power in the world seems to be pretty constant, and it is always at work. The fruits of its labours appear principally in the patent-offices of this and other countries. It can hardly fail to strike the thoughtful man that the number of patented inventions in every-day use is extremely small compared to the number of patents taken out by sanguine inventors. Much that is really, and in the fullest sense of the words good for nothing, is patented. A proportion of inventions is never touched because the inventors lack capital. There remain inventions which are really ingenious, yet practically useless, either because something better is already in existence, or because they will not pay. This is *the* test in the present day of the utility of an invention. If by working it a profit may be earned, the invention will be called, and is, good. The most exquisite device which it is possible to produce must be regarded as valueless unless it can be worked at a profit. This is a very unsentimental view of the question; but it is the correct view, and much money and disappointment would be saved if inventors as a body would keep it carefully before them. Furthermore, we would warn the inventor to make himself thoroughly acquainted with the circumstances and conditions of the trade which he proposes to benefit, before he spends much money or thought in inventing. Above all, let him stand in awe of theories imperfectly supported by facts. Certain processes and trades are carried on under conditions apparently so bad that they can easily be improved upon; but it will usually be found that a good reason exists to account for what may appear to the outsider to be stupid mistakes. We might cite several instances; one will suffice. About two years ago the use of ventilating fans for drying ricks began to be talked about. The Royal Agricultural Society carried out an elaborate and costly series of experiments at Reading, in 1882, to test the value of the system, and of a number of fans hurriedly patented to provide for its wants. The result was practically a failure. The trials proved that the fan was not a substitute for sunshine and fair weather; and that, although it might be possible to dry grass in this way, it was not possible to make hay. A very pretty theory fell to the ground. It is not, perhaps, too much to say that the inventor ransacks the earth for some subject on which to exercise his talents; and as this process has now been going on for a considerable period, it becomes, as we have said, daily more difficult to invent something which is at once new and good. Indeed, the world must look more to the discoverer than to the inventor for its future progress towards that perfection, mechanical and otherwise, which some people imagine it to be capable of attaining.

In the whole range of the mechanical arts nothing will be found which possesses such universal interest as the production of power, or development of energy, whichever our readers like to call it. As regards the steam engine pure and simple, little need be said. The non-compound engine bids fair to become extinct, because the compound engine is all round a better machine. That it is more economical to use high-pressure steam than low is certain, and the compound engine provides a better way of using high steam than the simple engine does. This is entirely apart, however, from the consumption of fuel. If theory and practice alike are good for anything, then it is certain that a non-compound engine may be made which will burn as little coal as the compound engine; but when it is made it is not as good as its rival. Its valve gear must be more complex, its turning more irregular, and the strains set up in its parts greater. All these things have to be taken into consideration. A glance at the history of the compound engine will suffice to show that if it could not be turned out for about the same price as the engine which it superseded, there would have been no supercession. The first compound engines used at sea were complex; but they were perhaps as economical in fuel as anything since produced, but the shipowners would not have them. Nothing worth mentioning was really done in compound engines until the happy thought struck some one to build a compound engine, like any other two-cylinder engine, only with one cylinder smaller than the other, the smaller exhausting into the valve-chest of the larger. This solved the whole problem in a moment. It is a curious fact that the name of the man who first did this is not known. The compound engine has grown up in some mysterious way, but the author of really the greatest improvement made in marine engineering for many years remains, so far as the world at large is concerned, in obscurity. If proof of what we say be wanted, we may point to the portable engine and its congeners. Many varieties of compound engine have been recently exhibited, by, for example, Messrs. Aveling and Porter, and Messrs. Burrell. These things appear at a single show, and no more is heard of them; but the case is different with the common type, in which two cylinders, big and little, lie side by side. We may cite the engines made by Messrs. Fowler, of Leeds, who produced the first compound semi-portable in 1879, and Messrs. Richard Garrett and Sons, who made the first successful compound portable not long afterwards. Now nearly all the principal agricultural engineers make compound portable and semi-portable engines.

While dealing with this class of machinery we may say a few words concerning the direction which progress is likely to take during the year on which we have just entered in traction engines. That these when of considerable power are likely to be compound need hardly be said. The most probable alteration in other respects will be the adoption of springs. There can be no doubt that a road locomotive properly mounted on springs is a better machine than one without them. Almost from the first attempts were made to use springs of some kind, and the experiments undertaken ended for years in failure. The problem is one apparently not difficult of solution, yet it would seem that there is more in the background than appears at first sight. We have during the last twenty years seen a great number of spring wheels and systems of springs, brought out, and the inventors or manufacturers have invariably stated that the problem was solved, and as invariably they have given up building engines so fitted within a very few months. We confess that we now look on all such assertions with incredulity. The spring carried traction engine has yet to be produced unless Messrs. McLaren, of Leeds, have solved the problem; and we imagine that they have, because they continue to make and sell engines fitted with their wheels, and spring wheels besides. This, so far as we are aware, no one else is doing, or has ever done to the same extent. We may perhaps remind our readers that the spokes in the M'Laren wheel are made of steel plates, bent to an elliptical form, so as to impart a slight, yet sufficient elasticity to the wheel. Such a wheel would have been impossible a very few years ago, because the steel required could not have been obtained of the proper quality at the price. Now little difficulty is encountered in getting what is required.

The transition from traction engines to steam tramways is very easy and consistent. In the production of engines for this purpose steady progress is being made, always by adhering to principles which ought to be sufficiently obvious. Steam tramway locomotives are not toys, and they must be made very strong and very simple. We hear much less of breaks down and failures from wear and tear than we once did. Three firms in this country seem to have the whole trade in their hands, namely, Messrs. Merryweather and Sons, of Greenwich; Messrs. Wilkinson, and Messrs. Kitson, of Leeds. On the Continent there has recently been a good deal heard of Honigmann's system, and a few words concerning it will not be out of place here. It has long been known to chemists that if steam be condensed in a solution of caustic soda, the temperature of the solution will soon become higher than that of the steam. This phenomenon is not peculiar to soda salts. It is also manifested by lime, though in a less degree; and many years ago Mr. Perkins, of high-pressure steam notoriety, proposed to utilise this property, but did nothing in the matter. M. Franq is well known as the inventor of a fireless locomotive, which is used to some extent on the Continent, and in the year 1882 he, according to his own statement, which we see no reason to doubt, thought of utilising caustic soda—sodic hydrate—in a way which will be understood in a moment. In company with M. Lentz, of Dusseldorf, he carried out some experiments, and in March, 1883, M. Amclin, a chemist, was employed to make further researches. In May, 1883, Herr Honigmann, a German chemist, patented the use of caustic soda, and ever since a paper war has been waged as to priority of invention. The nature of this war will be readily understood when it is borne in mind that one is a Frenchman and the other a German. The best of the joke is that the soda has, up to the present at least, proved of very little value for the intended purpose. The fireless locomotive has in lieu of a boiler, a cylindrical vessel which is nearly filled with water. Into this steam is blown until the water is heated up to the same temperature as the steam. A quantity of the steam is condensed during the process, and on reducing the pressure the whole of this steam is liberated again from the water, or more strictly, fresh steam equal in quantity is produced, and may be used to work an engine. Thus, for example, if the water has a temperature of 60 deg. to begin with and the steam one of 360, corresponding to a pressure of about 154 lb. absolutely, then each pound of water can take up 300 units. In theory, all the steam put into the water, which may amount to as much as one-fifth of its whole weight, will be given back again as the pressure falls, and will be available for working an engine. It is thus possible to store up energy equal to the development of 15 or 20-H.P. for two hours. The invention is at least twenty years old, and was first brought into a practical shape by Dr. Lamm, an American. He forced hot water into the receiver, M. Franq blows in steam with the same result and more convenience. It is clear that losses will take place from radiation, and that a great deal would be gained if the vessel could be kept hot. The soda is used to impart heat. In practice, while the engine is at work, the temperature never falls below about 280 deg. If the temperatures have a wider range, of course better results can be had. In using caustic soda the ordinary receiver was placed, during the first experiments, in a casing surrounding it, the space between being filled in with dry soda. The exhaust steam from the engine entered below, rose through the soda, and escaped above. The heat then given out by the soda of course was imparted to the water in the receiver, and aided to maintain its temperature, but this plan did not answer, as the soda did not get the steam equally, and modifications were made. To the *Moniteur Industriel* we are indebted for the following particulars of one experiment. The engine ran 8·37 miles in 3 hours 49 minutes, from which must be deducted two stops of 11 and 7 minutes respectively. The track was only 80 metres long, so that the engine had to be stopped and reversed at each end. The weight of soda solution carried was at starting 732 kilogs. with 15·7 per cent. of water; at the end of the experiment the proportion had risen to 43·8 per cent.; in all 377 kilogs. of water were evaporated. Up to the time of the first stop the load consisted of a wagon containing 17,200 kilogs.; subsequently this was replaced by two wagons weighing together 13,200 kilogs. During the first hour the temperature of the water remained unaltered. The soda solution rapidly rose 7 deg. or 8 deg. Cent., and then slowly fell 3 deg. The steam rose 5 deg. in temperature and the soda lost 5 deg. while the engine was standing. At the end of the run the temperature of the solution was 157 deg., that of the steam 147 deg. It is clear, then, that a certain advantage was gained; but it must be borne in mind that the solution has to be re-concentrated to restore the soda, and the whole gain will be less than the value of the fuel required for this re-concentration. Again, the soda deteriorates, becoming carbonised by the carbonic acid in the air; and the weight to be carried is greatly increased; so that, on the whole, no real pecuniary advantage appears to be gained, but the reverse; but it does seem, on the other hand, that an engine can be made to run somewhat further with than without the soda. Herr Honigmann, of course, regards this as a paramount advantage.

Transferring our point of view, we may consider the direction being taken in railway locomotives. The most startling novelty in this direction last year was Webb's compound engine. Of these there are now, we believe, about a dozen at work, and they are said to give great satisfaction. As the inventor is also the judge and jury in this case, the public must use their own discretion in arriving at an opinion. The engine ought to be successful as a machine; as to economy in fuel, it is said to save about 20 per cent.; but other locomotive superintendents venture to think that as good results can be got without compounding. There seems to be no dispute, however, that compounding goods engines which have to work up heavy banks might prove very useful; and we shall not be surprised if engines of this kind are designed, if not constructed, during the year. At present, however, no one in this country is following Mr. Webb's example, although compound engines are being made both on the Continent and in the United States. In locomotive construction generally the tendency is to build heavier and heavier engines. The weight, indeed, of all our passenger rolling stock is increasing slowly but surely. The latest developments may be regarded, perhaps, as the new engines with 19in. cylinders, 26in. stroke, and 7ft. coupled wheels, being built by Mr. S. Johnson for the Midland. These will be fitted with Joy's valve gear. Mr. Worsdell, of the Great Eastern Railway, is also building heavy engines, of the type illustrated last summer in our pages, and fitted with Joy's valve gear. The excentric and link motion no longer enjoy complete popularity, and it is not improbable that before long they will be entirely abandoned in favour of Joy's gear, or some other of the same class, such as Marshall's.

In the race for cheap power the steam engine is, for the time being, the winner, but its supremacy is imperilled, in some fields at least. The gas engine is constituting itself a formidable rival. Steam and gas engines both belong to that class of fluid motors in which the working fluid has first to be made and then thrown away; and in this respect it differs from the hot-air engine, in which the working fluid is provided free of cost. Steam and gas have alike to be made before they can be used, and the question for the user is which can be made most cheaply, taking into account the weight of both required to produce a given result. A very good steam engine will require 20 lb. of steam to give out one horse-power. A good gas engine will require about 20 cubic feet of coal gas weighing ⅔ lb. The heat developed in the combustion of 1 cubic foot is equivalent to the evaporation of ·68 lb. of water from 62 deg. Making a proper deduction for the imperfection of boilers, it may be taken that 1 cubic foot would produce ·4 lb. of steam, so that 20 cubic feet would give 8 lb. of steam, and 60 cubic feet would be required to produce steam enough to develope 1-horse power; consequently it is three times as economical to burn gas in the cylinder of an engine as it is to use it to generate steam to drive an engine. The most noteworthy advance that has been made is the successful adaptation of "water gas," or hydrogenated carbonic oxide, as a working fluid. This, as we have already pointed out, must in no way be confounded with coal gas. In fact, it is obtained from coke from which all the coal gas has been expelled. With this Mr. Dowson has succeeded in obtaining a horse-power for 1½ lb. of coal per hour. It only remains to be seen on how large a scale the system can be worked. Owing, however, to the high speed of rotation at which the gas engine must be driven, and the violence of the impulses, which renders very strong crank shafts indispensable, it seems unlikely that large engines can be made on this system; possibly, 100 indicated horse-power is the maximum. It by no means follows, however, that this will generally limit their range of utility. Nothing could be more easy, for example, than to arrange —in the case, let us say, of a large cotton mill—ten engines side by side, all driving one crank shaft, with suitable couplings of course. In this way we should have 1000 indicated horse-power at once; and the breakdown of any one engine would represent but a partial loss of power. An overhead gantry would enable the broken-down engine to be removed and replaced by another in a very short time. The multiplicity of engines would get over the great objection which is now urged against the gas engine, namely, its want of regularity, which, no doubt, seriously detracts from its usefulness for some purposes, such as driving electric light machinery.

We have alluded incidentally to hot-air engines. It is now at least thirty years since Ericsson startled the world with the hot air engines of the ship called after him. This vessel had four cylinders each 14ft. in diameter and 6ft. stroke. The number of revolutions per minute was nine, and the horse-power about 300, obtained with 560 lb. of coal, or say 1·86 lb. per horse per hour, a result wholly unequalled at that time. From 1852 to 1883 men have worked hard to produce a really effective practical hot-air engine, and they have failed to make anything useful of more than 20-horse power; and yet there can be no doubt that such an engine is thoroughly capable of displaying wonderful economy. The superlative difficulty lies in devising means of heating the air satisfactorily and preventing, at the same time, the utter ruin of piston and cylinder. On a small scale, this seems to admit of being done, as in the Bucket caloric engine; but not on a large scale. It would seem, again, that difficulties are encountered in adopting the system to a small motor for domestic purposes. We have repeatedly pointed out, we may here remark, that a domestic motor, something about 1-man power, is much wanted; but we appear to be as far from it as ever, unless, indeed, electricity steps in and helps us. But from all that can be seen, it would seem that the successful inventor of a domestic motor might make his money and retire long before his machines will be superseded by a regular supply of electricity from street mains. The conditions to be complied with by the motor are, however, not very easy of fulfilment. We think, however, it is not impossible that gas might be used as the working fluid. A steam motor may be made which will rarely require replenishing with water, and will be clear of feed pumps and injectors; but it would occupy rather more space than is desirable. Yet there might be a field for such an engine, and the advantage of having power enough available to drive, let us say, a sewing machine, whenever we choose to light a gas jet, is obvious enough.

There is reason to believe that the tonnage of steamships built in 1883 is the largest on record; but there can be no doubt that it has been in excess of the real requirements of trade, and that there will be a considerable falling off this year. But new enterprises are being undertaken which will prevent our shipyards from being altogether idle. In marine engineering the tendency is all in favour of higher and higher pressures. The Atlantic trade claims consideration first. The Cunard Company, following the example of the Guion Line, has ordered two very large steamers from Messrs. John Elder and Co. These vessels will closely resemble the Oregon, and will be propelled by engines of 12,000 or 13,000-horse power. The Oregon was in some respects the sensational ship of last year. Great things were expected of her; but they have not come to pass. Her machinery has broken down, pistons having cracked. With the ruin of the engines of the Austral, by the same firm, before our eyes, it is not too much to say that Messrs. Elder have been unfortunate with their machinery of late, and vigorous measures will have to be taken to maintain the high reputation of the firm. Much is still heard about reducing the time spent on voyages across the Atlantic, but there is little hope that this will be accomplished this year at all events. Like most other things, it is a question of money to a considerable extent; and it is found that it will only pay to run high-speed steamers during about four months of the year, when the great tide of passenger traffic sets in between England and North America. For the rest of the year the great Atlantic steamers will have to be laid up in dock, or run at a dead loss. The results obtained in the past are not very encouraging. It is, if startling, nevertheless true that all that has been accomplished in the last ten years is a reduction in the duration of Atlantic voyages by about 14 hours, while the consumption of fuel has risen from 90 tons to 250 tons in the twenty-four hours. It is true that such vessels as the Alaska or Oregon are more commodious than their immediate predecessors, but this has nothing to do with the question of speed. It is impossible to obtain any information as to the consumption of coal per horse per hour in such ships; but we have every reason to think that it is comparatively high. Their engines are nominally compound; but the steam is admitted for some 90 per cent. of the stroke into the high-pressure cylinders, and the ratio of expansion is probably not more than four or five to one. The first consideration is speed, and to secure this economy is cast to the winds, and the engines are driven as hard as they can go without the slightest consideration for the quantity of coal burned; big boilers and plenty of them being held in more repute than economical machinery. The Atlantic trade is peculiar in this respect, and we must turn to other routes than that from Liverpool to New York in order to find evidences of real advances in marine engineering.

The triple expansion engine has been so successful that it is not improbable that it will ultimately supplant all other types of compound engine. Messrs. Denny, of Dumbarton, are building two sets; Messrs. Napier, of Glasgow, have in hand three sets of 5000-horse power each; Messrs. Blair, Richardson, and Thomson have each in hand one set. Messrs. Shaw, Saville, and Co. are now running ships to New Zealand, and it is for two of these that Messrs. Denny's engines are intended. The New Zealand Steam Shipping Company is running monthly boats direct to New Zealand. The voyage is about 13,000 miles, and is made in forty-five days, or even a little less. The ships burn 50 to 60 tons a day steaming at 12½ knots. Shaw, Saville, and Co.'s Albion line is intended to compete with this company, and to have a speed of about 13 knots. The engines are of very peculiar type. They have four cylinders and two cranks. The cylinders are arranged in pairs, tandem fashion, the small on top of the large cylinders. The first small cylinder takes steam from the boilers for about five-eighths of the stroke, and exhausts into the valve chest of the second small cylinder, where it is further expanded, and then passes into the valve chest common to both the large cylinders, so that there are three expansions although there are four cylinders. The same result would be obtained if a fourth small cylinder were mounted on the top of the central or high-pressure cylinder of a triple-cylinder engine, like those of the Orient, and it is not improbable that this type of engine will be made. The engines which we have just described will be supplied with steam having a pressure of 165 lb. to the square inch, the heaviest ever carried at sea. The boilers will have steel shells 1¼in. thick, and Fox's corrugated steel flues. We understand that since Mr. Fox adopted steel for his corrugated furnaces, not one has come down or given the smallest trouble. New machinery has been erected for their manufacture. The steel plates bent to make a furnace are welded by a special machine. A length of about 10in. of the seam is brought by a double gas blow-pipe and a reducing flame to a welding heat. The flue is then shifted a little way on, and brought under a very small steam hammer running at a high speed, which welds the seam perfectly in less time than it will take to read this. The gas flame is all the while at work on another length of 10in., and thus the process becomes almost continuous. The furnace tube is then heated all over in a special furnace, and shifted on to a corrugated horizontal roll; below this are two other similar rolls, which are raised by hydraulic pressure, and caused to rotate, and in this way the furnace tube is rapidly corrugated between them. The results obtained are so far superior to those got with the old process of corrugating iron furnaces on the beak of an anvil under a steam hammer with a corrugated tup, that it is not too much to say that the corrugated flue owes its existence to-day to steel. Nor is this the only recent application of machinery to the manufacture of marine boilers. A company has been formed, and will start during the year at Barrow-in-Furness, for the manufacture of rolled steel boiler shell hoops, without a weld, up to 16ft. in diameter, 1in. thick, and 4ft. 6in. wide. This will at once augment the strength of boiler shells by 25 per cent. for a given thickness of plate. Only transverse seams will then have to be rivetted. The machinery required is, we need hardly say, of a very heavy type, and it is being made by a very eminent Manchester firm. There is therefore no reason to doubt that the scheme will be entirely successful.

It may be asked, Will not steam of such a pressure as 165 lb. cause a good deal of trouble? How will packings and piston rings be got to stand it? No difficulty is anticipated, and with the advent of the boiler rings referred to above 200 lb. on the square inch will certainly be carried. As difficulties arise ingenuity overcomes them. The Aberdeen, working with 125 lb., has run from this country to Australia with one set of packings, which were in capital order at the end of the run, never having been touched the whole way. These packings are Belldam's patent, and are made of asbestos and soft metal, so put together that a species of incorporation appears to take place between the two.

One of the most important points for consideration in designing machinery for very long voyages is that it shall not break down. On this score the triple expansion engine possesses great advantages. If an accident happens to any one of the cylinders the other two can be used. It is only necessary to hang up the disconnected piston, draw the slide valve, and regulate the pressure according to which cylinder has failed. In fact, the ship may be said to carry always a reserve engine; a competent engineer might, indeed, manage to complete a voyage with one cylinder only if two failed. Again, everything that can be made interchangeable is interchangeable, and a spare length of crank shaft is carried. Mr. Thomson, of Southampton, is now introducing a new screw shaft coupling which is receiving much attention. If the shaft breaks the coupling or clamp is put on the broken part, and the ship goes on her way. There is nothing new in the use of clamps to mend shafts. They were suggested in this journal many years ago, and various modifications have since been patented. It has been found in practice, however, that considerable difficulty was met with in getting a clamp in two pieces only to grip with sufficient tenacity a shaft probably ragged and distorted. Mr. Thomson's coupling is, to meet the objection, made in three pieces, and so easily adapts itself to inequalities. Under the conditions which now obtain a ship might with perfect safety undertake a voyage to New Zealand without any masts or power of spreading sail; and it begins, indeed, to be doubted whether masts are after all worth the trouble and expense which their presence entails. Before dismissing this branch of our subject, we may add that the sailing ship trade to Australia bids fair to be entirely superseded by steamers. Between the Peninsular and Oriental Company, the Orient Company, and Messrs. Milburn, there is now a steamer almost every week for Australia, and these vessels are now carrying Government emigrants, who, until recently, were always sent out in sailing vessels. The steamships always go by the Cape, picking up the favourable trade winds thence, and return by the Suez Canal, so as to avoid head winds in the trade latitudes.

In torpedo boats there have not been made the striking advances such as we have been able to record during the last few years. A large number of second-class boats were delivered to the English Government early last year by Messrs. Yarrow and Co. and Messrs. Thornycroft. The highest speed recorded was with one built by the former firm, when 17·27 knots, on a two hours' continuous trial, was obtained, which, for a craft 63ft. long by 8ft. beam, is a somewhat remarkable result. The second-class boats built by both the above-named firms for the Admiralty are provided with steam impulse gear invented by Messrs. Yarrow and Co. This system was tested by the Government authorities at Portsmouth in March last, and found to be thoroughly efficient and a considerable improvement upon the plan previously in use. At first, in the smaller craft, the torpedoes were lowered into the water by means of a sort of cradle at each side, and were discharged from the boat by means of their own propelling machinery. This, however, was not found to give satisfaction. Of the new type of boat there are eleven in the service. Nine have been received at Portsmouth from Messrs. Yarrow and Co. and Messrs. Thornycroft and Co. for the trial of their impulse gear, after having undergone satisfactory steam trials on the Thames. The steam ejecting apparatus of one of the former maker's boats was tried at Portsmouth last March, by Mr. Mayston, of the Steam Department, and Captain Markham and Lieutenant Galway, of the Vernon. Mr. Andrews, of the Admiralty, was also present on the occasion. In this boat both the propelling engines and the impulse gear differ slightly from those which have hitherto been received into the service. The vacuum in the surface condenser is produced by an air-pump and a centrifugal circulating pump, which are worked by a small compound engine, which also works the feed pumps. By these means the vacuum can be maintained when the main engines are at rest, and consequently great facility of starting is secured. The ejecting apparatus consists of a couple of troughs, fitted parallel to each other forward, and having a slight dip downward. In these the torpedoes, which are 14ft. long and 14in. in diameter, are placed, the stops and guides being so arranged as to accommodate either the Woolwich or Fiume projectile. At the rear end of the troughs are the impulse steam cylinders, to which steam is admitted from the boiler by means of an equilibrium valve. The cylinders are 6in. in diameter, while the thrust of the pistons is 7ft. When the steam is suddenly let in, the torpedoes are expelled from the troughs as from a gun. The diameter of the cylinders in the Yarrow boats is greater than in the Thornycroft craft, so that increased velocity of impulse is obtained. The use of equilibrium valves, instead of the ordinary slide valves, is another innovation by means of which the steam is so easily admitted that Captain Markham's condition of acceptance, viz., that a man should be able to pull the trigger with one hand while steering the boat with the other—is capable of being realised. From a report published at the time we learn that after the torpedoes had been received on board from the Vernon, a preliminary run was made alongside with a pressure of 80 lb. This being deemed satisfactory, the boat was taken up Porchester Creek, and two more runs were made, the first with a pressure of 60 lb. while the boat was steaming at 12 knots, and the second with the full pressure of 120 lb., the boat passing through the water at about 16 knots. The first shot proved highly successful, nothing finer being desired than the straight line which it maintained in the water. The second torpedo, however, on leaving the boat, dived under water and buried its snout in the mud, the air bubbles indicating the spot where it had sunk far in the rear. As it was thought this failure might be due to the lifting of the bow of the boat when driven at great speed, and the consequent change in the position of the troughs, relatively to the water, experiments were subsequently made to determine the actual rise of the bows at various speeds, and with boiler pressures rising from 60 lb. to 120 lb. It was, however, found that the maximum rise did not exceed $\frac{7}{10}$in. per foot, which is considered as the normal ratio. On the second day of the trials three more torpedoes were discharged under way, the engine going at 80 lb., 100 lb., and 120 lb. pressure. The whole of the runs were successful, from which it is inferred that the failure of the previous day was owing to some defect in the torpedo itself, and not in the firing gear.

In sea-going torpedo boats a few have been built, one of them, the Childers, by Messrs. Thornycroft, is now undergoing trials at Portsmouth. All sea-going torpedo boats as now built are provided with a curved deck forward covering the torpedo tubes, at the after end of which is the conning tower. There are two funnels, so as to allow of the passage of the torpedo; in fact, they are all similar in all essential particulars to the Batoum, built four years ago by Messrs. Yarrow, which, as a matter of fact, was the first of this class of sea-going boat.

The electrical launch constructed by Messrs. Yarrow and Co., in conjunction with Messrs. Siemens Brothers and the Electrical Storage Company, must be recorded as an important advance towards the introduction of electricity for the propulsion of vessels; and what these experiments may ultimately lead to no one can tell.

Concerning ships of war and guns, we have not space to speak, nor is there, indeed, much to be said with which our readers are not familiar. Breech-loaders are rapidly replacing older guns with us, as they have done with other nations; but it seems to be pretty generally held in the service that they are not so trustworthy as the muzzle-loader. The battle of guns and armour is waged now as fiercely as it was twenty years ago, each success of the gun being followed by a corresponding improvement in the armour. But it would appear that the end is within measurable distance, and that the gun will score a qualified success. We fancy that nearly all that can be done has been done for armour. Steel-faced plates cannot be far from perfection, but who can say that of the guns? Comparatively light weapons now do work which not long since would have been regarded as impossible. The credit for latest achievement in this direction is due to Sir J. Whitworth, and was obtained at Southport on August 11th last, with a 9in. hexagonal bored gun made of fluid pressed steel for the Brazilian Government, in the presence of Admiral Azevedo and Captain Carvalho, of the Brazilian service. The gun weighed 20 tons; the projectile, 34·4in. long, 403lb.; charge, 197lb. A plate of Brown's iron, 18in. thick, was erected at 90ft. from the gun, placed against a hoop 37in. long filled with hard rammed damp sand, behind which was placed a steel and oak backing 7in. thick. This was supported by a cast iron plate, 19ft. 6in. long, 5ft. wide, and 14in. deep, held in position by baulks of timber all well bedded and covered with damp sand. The projectile, after perforating the 18in. plate, passed through the sand, and then through the steel plate and oak backing, broke up the cast iron plate, and finally buried itself it the sand at a distance of 17ft. from the face of the target and a depth of 4ft. below the cast iron plate. Previous to penetration, a range of 7876 yards was obtained with an elevation of 10 deg. So far as we are aware, this result is absolutely unparalleled with a gun of this weight.

The use of steel rapidly extends in every department of engineering, but it must not be forgotten that this is a somewhat different material from that produced a few years ago. Much greater certainty of quality has been attained, and it is worth notice that less has been heard for a long time past about porous ingots than used to be the case. The simple device schemed by Mr. Gjers, viz., soaking pits in which steel ingots are suffered to keep themselves at a high temperature, has proved an immense success, and may no doubt tend to the further improvement of the metal. As to the use of steel for ships one fact is sufficient to give here. Last year Messrs. Sir W. G. Armstrong, Mitchell, and Co., of Newcastle-on-Tyne, launched seventeen ships. The largest had a tonnage of 2657, the smallest was 15 tons, the average was 1387 tons. All these were of steel save six. It will not be out of place to say here that the gigantic establishment of the North-Eastern Engineering Company at Newcastle-on-Tyne will be amalgamated with the firm of Messrs. Alexander Leslie and Co., of Hepburn, who will take charge of the shipbuilding department, Mr. William Allan remaining chief of the engine works.

Notwithstanding the depression which seems to be falling over the shipbuilding industry generally, extensions more or less important are being carried out in existing yards throughout the various centres, and entirely new works are even being established and spoken of. The Tyne district, which has been so largely augmented of late, is still seeking fresh acquisitions. At Bill Quay Messrs. Skinner and Wood are establishing a new yard, which is in a forward state of preparation. Messrs. Armstrong, Mitchell, and Co. are rapidly pushing forward a new yard and plate works at Elswick, the most of the offices, workshops, &c., being completed; and the extension of a large quay is commenced. It is reported that a number of influential Tyne gentlemen have formed a company to make dry docks and engine and boiler works in the district on a very large scale. It is to take the title of "The River Tyne Dry Docks, Engineering, and Boiler-making Company, Limited."

On the Clyde, while no such new works or projects are afoot, there are numerous extensions to shipyards and engineering works, the vigorous prosecution of which seems to some an indication that the shipbuilders look upon the present cloud as only transient. Messrs. McMillan and Sons, of Dumbarton, in addition to having erected, some little time ago, handsome new offices and acquired additional ground, have just finished the erection of extensive and lofty shops for their joiner work and for ironworking machinery, which will be well equipped. The new shops are on the north side of the yard, and the new position will enable the builders to construct and launch much larger vessels than heretofore, and give very much improved accommodation for machinery and workmen. The smithy accommodation has been found inadequate for the work within recent years, and the erection of a substantial new smith's shop, enclosing the old one, has been effected. When the roof of the new shop is thoroughly completed, the old smithy will be demolished, and its area taken into the new shop.

Messrs. J. and G. Thomson, of Clydebank, are removing their engine works from Finnieston-street, Glasgow, to handsome new premises, just about completed, in immediate proximity to their shipyard. Powerful sheer legs, capable of lifting as much as 120 tons, have just been erected at the side of their tidal dock; these sheers were made by Messrs. James Taylor and Co., of Britannia Works, Birkenhead, and this immense facility, coupled with the completed engine works, will enable the firm to finish all their vessels without taking them to the harbour or cranes of Glasgow. Equal facilities are being added to the yard of Messrs. Denny Brothers, of Dumbarton, whose new tidal dock and extended yard covers an area of 43 acres. Messrs. Day and Summers, Southampton, are supplying a pair of sheer legs capable of lifting 100 tons, which are now being erected alongside the new dock. A recent and noteworthy acquisition to the establishment of Messrs. Denny is the system of telephonic communication between all the departments of the extensive works, and also to the engineering works of Messrs. Denny and Co. and to the Dennystown Forge, about three-quarters of a mile distant. The system, which is most complete, extends also to the residences of the several partners of both firms, and it has already been found of great advantage in facilitating the work in both establishments.

In the South Wales district several projects are afoot, some of which have already taken practical form. A new slipway and dry dock are about to be constructed at Newport, on the east side of the river Usk. Contracts in connection with the works have just been let, and a ballast jetty and other preliminary works are to be erected forthwith. A company, called the Windsor Slipways Shipbuilding and Engineering Company, is about to start with a nominal capital of £140,000 the establishment of a large shipbuilding and repairing yard on the western side of the Taff. The site, which is over 20 acres in extent, will be leased for 250 years from Lord Windsor. It has a river frontage of 1000ft., and it is believed that at neap tide there will always be 25ft. depth opposite the works at high water. Two slipways, one 900ft. long, capable of accommodating vessels of 5000 tons, and one 900ft. long for 3500 tons vessels, are projected, together with a gridiron 400ft. long, two shipbuilding berths, and a wharf with sheer legs. The whole of the works are to be completed within eighteen months.

It is unsatisfactory to write the word failure in connection with any undertaking, yet that seems to be the only term applicable to electrical progress during the past year. Undoubtedly the year commenced with great promise. "Only let us get the Provisional Orders, and work will be commenced at once," was the cry of the companies. Well, they have the Provisional Orders, but where is the work? The cry is still for time. The truth of the matter is that with perhaps half-a-dozen exceptions the Orders were intended to be used as levers to force money from the public. The money has not been forthcoming, and the holders of the Orders have no money to carry out the work. Electric light speculation has turned out a sorry business, but perhaps the tremendous depression will prove the best thing in the end. It will necessitate careful estimation in lieu of reckless statement. The proceeds of actual work, and not the probable rise in shares, will be looked forward to as the gain of the investor. Prices of apparatus will not be inflated, but bear some approximation to their real value.

Electrical work is becoming rapidly divided into distinct branches—each branch requiring separate consideration. In days quite recent, inland telegraphy was almost the sole subject we had to notice of the applications of electricity. Then telegraphy was split into inland and submarine. The introduction of the electric light in 1878 added another branch; then came telephony, and to these may safely be added the transmission of power. Indeed, we are not sure that medical electricity cannot claim a distinct niche for itself, and we must not overlook electro-metallurgy, which is the contemporary of telegraphy. These branches are severally distinct from the other, each requiring special knowledge for its successful pursuit. Of course there are certain principles common to all—these are the principles of the science of electricity. The arts of telegraphy, telephony, electro-metallurgy, &c., are specialistic. The applications of electricity seem destined to play a far more prominent part than hitherto in the history of engineering, and certainly the work connected with submarine telegraphy, and even with inland telegraphy, requires attainments of sufficiently marked a character to deserve the consideration of all engineers. If, however, electric lighting and the electrical transmission of power are destined to occupy a far lower position than some enthusiasts imagine, something very much approaching to a revolution, as things go now, will have to take place. Less important may seem electro-metallurgy; but it must be remembered that the nickeling of the bright parts of machinery is becoming a trade of large dimensions; and although nothing much as yet of a practical character has been done in the melting of refractory materials, the experiments of Siemens and Huntingdon are not of the nature of failures. Further, more than one—as yet uneconomical—attempt has been made in the direction of extracting ores partially by electrical methods. Electric lighting was no new thing in the laboratory, but it came upon us as practically possible in a somewhat startling manner. It is not, therefore, beyond the bounds of possibility that any year may see the adoption of the metallurgical operations indicated above. There is no danger in keeping these possibilities in mind. It is, indeed, preferable to do so, inasmuch as these very operations may be utilised in the case of emergency. The art of electro-plating has long since assumed enormous proportions, and employs capital and labour to a large extent in Birmingham, Sheffield, and London.

The transmission of power is in the embryonic stage. The success of the electric railway at Berlin and at the Zankerode Colliery probably acted as an inducement to a trial of electric railways in Britain. The first line on more than a toy scale, was that constructed through the energy of M. Volk at Brighton. This short line of a quarter of a mile has been very successful, and is now being extended about a mile. Starting from the Aquarium, it will be carried to the free pier, and ultimately by a tunnel and skirting the town, to the Downs. The line is constructed upon the shingle, close to the sea wall, in a very inexpensive manner. The existing line has been worked by an Otto gas engine of 2-horse power, driving first a D_3 Siemens dynamo, which was after a while replaced by a small Weston dynamo. The cost per passenger per mile, allowing 15 per cent. depreciation in plant, has been about 0·6d. The following details have been previously given, but may be repeated:—Engine, 2-horse power, Otto; current, 18 ampères; electro-motive force, 55 volts; weight of motor, 2·75 cwt.; weight of car, 7·00 cwt.; load, twelve persons, 1 ton; gradient, 1 in 100; mean speed, seven miles an hour; daily journey, 25 to 30 miles; daily average of passengers, 350. The other electric railway—that at Portrush—is of greater pretensions, being from six to seven miles in length. This, however, has been so recently described by us that we need but recall it to memory.

Professor Fleeming Jenkin at Southport exhibited during the British Association Meeting his "Telpher"—a barbarous word derived from Telegraphy and Phosphorus, with neither of which electric railways have anything to do—and described the "nest gearing" used in its construction before the Mechanical Section. Professor Jenkin has since at the opening of the session at Edinburgh University described the scheme of "Telpherage," which he is working at with Professors Ayrton and Perry. The pith of this scheme is as follows:—A frame made to run on a line of rods carries an electric motor. An electric current is conveyed from a stationary dynamo to this motor, or to motors. The motor is geared to a chain of "nest gear" by means of which the frame and the attached buckets or skeps are moved. The experimental line at Weston consists of two sets of rods supported by crossheads on posts 60ft. apart. The line is divided into sections of 120ft., and each section is insulated from its neighbour, alternate sections being insulated from the ground, but not from each other. The sections not insulated from the ground are also electrically connected to each other. The train is 120ft. long, consisting of seven buckets and a locomotive, and will carry a useful load of about 15 cwt. The motor used is that of Ayrton and Perry. The scheme, as we say, is altogether in the experimental stage, so that no data as to cost are forthcoming. The value of such a line compared with an ordinary light electric railway cannot as yet be ascertained; but no doubt, if successfully carried out, it will have advantages under certain conditions and circumstances that, whatever the relative values, the "telpher" system would be preferred to any other.

The electrical transmission of power in other phases is wholly a question of the future. Theory is pretty clear as to what is required in the matter of electromotive force in order to transmit power economically over considerable distances, and also as to the requirements of a good motor, but we do not know that the motor is yet forthcoming. Till lately opinions differed about the using of alternate current machines for the transmission of power; but Hopkinson, Gordon, and others point out that transmission is possible, although at present they do not agree that such transmission is economical.

Leaving till last the consideration of the most important—or rather the most prominent—development of electricity we may dismiss in a few words the branches telegraphy and telephones. Progress in telephones has been far too slow, the reason being the exorbitant price charged for the luxury. Telephony recalls the question of overhead wires. Mr. Preece, in his paper before the Institution read a few weeks ago, rather favoured overhead wires. Sometimes an extreme case has advantage in the argument. Assume that the greater the number of subscribers upon a telephonic system the more valuable it is, and suppose every house connected. Further, let us become more civilised and have every house more burglar proof, and fire-guarded by connection with police and central stations; add to this that the telegraph wires be overhead, and every house electrically lighted, many of these wires being overhead, and suppose—but enough, who would or could agree to it? Shall we agree then that in large towns overhead wires are a nuisance? The use of bronze wire lessens the evil; the systematic arrangement of the wires would lessen it still more, but still the evil remains, though of lesser degree. Those who have been able to use the telephone system speak very highly of its value. We, therefore, if it is so useful, would like to see it within the reach of all. As regards inland telegraphy, the postal authorities have been busy preparing for a sixpenny tariff; otherwise there is nothing special to record. The service has proved remunerative during the year, the revenue amounting to £1,750,000, being an increase of £60,000 over the preceding year. When we come to cables we have to consider work of a far different character from that of constructing land lines. In cable work, pluck and perseverance must be superposed upon knowledge and ability in order that success may be attained. One of the best, if not the best, pieces of work done by cable engineers was effected by the Telegraph Construction and Maintenance Company's steamship Scotia last month. A fault, or a series of faults, had developed in the Brazilian Submarine Company's cable midway between St. Vincent and Pernambuco. The fault was localised in cable lying in water from 1000 to 2000 fathoms deep. It is very easy to talk or write about the picking up a cable in these depths, but few attempt to realise what the work really means. Some five or six thousand feet below the surface lies a thread some inch perhaps in diameter; this thread must first be found. Considering that the sea bottom is not exactly a billiard table, and the instruments used are not as sensitive as our fingers or an elephant's trunk, the getting this thread upon the grapnels is no easy task. Miles of dragging are sometimes done before the cable is found. Even when the line is found it has to be brought to the top, spliced, and returned. Those only who have undergone the anxiety of bringing up the cable know the intense eagerness manifested to see the cable safely buoyed or on board. It may break at any moment, and then all the previous labour is lost, the work commences again, and so on till successful. But to our tale. The Scotia left Greenock on November 1st, commenced work on the cable ground on November 16th, grappled the cable, spliced it successfully and completed the work on December 5th, Captain Cato in command. Work similar to this was done by the Eastern Company's steamship Volta, the Porthcurnew-Lisbon cable being repaired in 1900 fathoms. The new cables laid during the year, although not giving a total so great as in some former years, are fairly numerous. The Silvertown Cable Works have been busy manufacturing for the Spanish Government, to connect the Canary Isles with Spain. The work is not yet complete, and will form part of the cable history of 1884. It is said that Messrs. Siemens are busy manufacturing cables for two fresh Atlantic lines, of which more will be heard in 1884. The Telegraph Construction and Maintenance Company has ships in the East laying, or about to lay, a cable, under a concession from the French Government, from Cochin China to Tonquin. The cable was manufactured on behalf of the Eastern Extension Company, which company will also lay a cable to connect Hong-kong with Tonquin. The foregoing constitutes the work to be done. During the past year the Eastern Company triplicated its Suez-Aden cable. The length of this cable is 1402 knots, and is wholly brass-covered. The Eastern Extension Company has laid some 922 knots connecting Hong-kong-Fouchow, Fouchow-Shanghai. The Great Northern Company has laid some 1370 miles of cable, connecting Vladivostock Nagasaki and Gutzlaff. The cables of the three companies just mentioned have been manufactured and laid by the Telegraph Construction and Maintenance Company.

We must now briefly touch upon the delicate question of electric lighting. There has been during the year a constant succession of improvements in the apparatus used. We have now better arc lamps, better incandescent lamps, and better dynamos than we had twelve months since.

The improvements in arc lamps have mostly tended towards simplification, economy, and steadiness. Those in incandescent lamps have tended towards greater length of life and the use of a smaller current to give normal results. It will, perhaps, be remembered that a short time ago a correspondence took place in our columns relative to the Cruto lamp. One correspondent praised the lamp. Another pointed out that the results of experiments at Munich gave it the lowest position of any lamp exhibited. Since that correspondence Herr Goetz has published the results of experiments upon improved lamps of this type in the *Centralblatt für Electrotechnik*. The results show that in point of economy the Cruto lamp distances the Swan lamp. For instance, a light of 15 to 16 candles, requires under the former system about half the power necessary under the latter. With regard to the length of life of incandescent lamps, we may mention a fact given us by Mr. Swan concerning the lighting of his house at Bromley. He stated that only two lamps had been destroyed in some nine or ten months' constant use—only one, in fact, had gone under the ordinary conditions of use. It must be remembered, however, that Mr. Swan keeps his electro-motive force constant by the use of secondary batteries. This use for secondary batteries seems to us to render them all-important adjuncts to successful lighting. At the recent meeting of the Swan Company it was stated that 180,000 of these lamps had been made and sold during the year. The majority of these have been used in isolated installations; indeed, we know of no case where the Swan lamp has been used in connection with central station lighting. The Victoria installation is being rapidly completed, and will be the first such station. Mr. Edison, on the contrary, can boast of a number of central stations. In New York some 10,000 lamps are connected from one centre. At the Holborn Viaduct a thousand lamps or so are connected; and there are several such stations on the Continent. The French company has successfully carried out several installations of this kind, *e.g.*, at Milan, where 6000 lamps are in use; at Amsterdam, where there are two installations of 1000 lamps each, &c. This latter company has, during its brief working history, carried out 215 permanent installations, using 31,339 lamps in France, Germany, Austria, Italy, Russia, Holland, Spain, and Belgium. The English Edison Company has also done a large amount of work, especially in ship lighting, as has the Swan. The firm which, during the year, has perhaps been the most successful is that of Crompton and Co. They have greatly enlarged their works at Chelmsford, and have been busily employed during the year. We have never hesitated to say that whatever success the electric light has attained in England is due, in a great measure, to the energy and ability of Mr. Crompton. He made us really acquainted with arc lighting; he probably did more to introduce the Swan lamp than anyone else. Last year he brought out the compound machine, which is being so extensively imitated, and which is practically self-regulating. Besides that he, in conjunction with Mr. Kapp, has also introduced measuring instruments, which are stated to give excellent results, and Messrs. Hartnell and Willans have devised an electric governor manufactured by Messrs. Crompton and Co. The Swan and Edison companies, as we have said, have carried out a considerable work in ship lighting. The latter has introduced the Hopkinson-Edison machine—a machine which, as is indicated by the name, is a modification of the Edison dynamo by Dr. Hopkinson. This latter gentleman has done good work in electrical matters. He was the first to introduce the characteristic curves found so useful in all that relates to dynamos. He worked at the question of transmission of power by means of alternate current machines; and he has invented a meter, and has greatly increased the efficiency of the smaller Edison machines by the modifications referred to above.

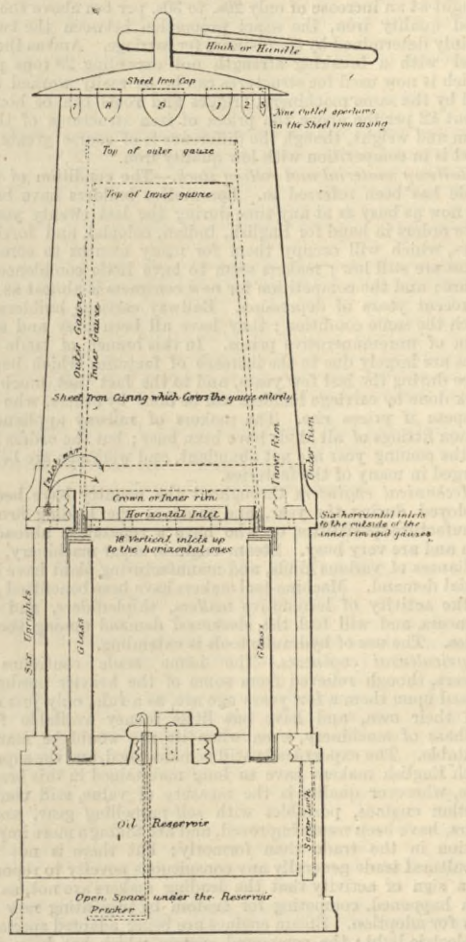
With regard to actual installations, it is not necessary to give a mere list of such work, but we may be allowed to mention that Mr. Crompton has extended the installation at the Law Courts; has fitted up the Law Courts-chambers with Swan and arc lamps. The Edison Company has extended the installation at the Houses of Parliament, and has lighted up the Holborn Restaurant, also Gatti's, while Eberles Hotel and others are lighted by Swan lamps. A large number of country and town mansions has been lighted, as have the Ocean Collieries and several tin-plate works in South Wales, and dye works and factories in the North of England and in Scotland. Mr. Crompton tells us that a great demand for the improved Crompton-Crabb arc lamps arose in the early autumn, and has continued keeping a great part of their works running day and night to supply the orders. M. Volk has lighted up the Pavilion at Brighton, using Swan lamps and Siemens' machines; and several theatres in London, in Manchester, and elsewhere are now lighted almost solely with incandescent lamps, and, altogether, though progress in general lighting is slow, there is a large and steady work being done in these isolated installations.

In concluding our review of the present position of engineering and its linked branches of industry, we cannot refrain from calling attention to the apparently rapidly extending practice of State interference in industrial pursuits of all kinds, which is opposed to the old principle of Free Trade. It seems to be taken on certain questions as proved that the Government must interfere in directions where its interference never was dreamt of formerly; we express no opinion here on the merits or demerits of the system, we only call attention to it. The Government regulations of the hours of labour in factories, the control of juvenile labour, the inspection of factories, and official interference in many other ways, are accomplished facts. It is worth considering where the interference will stop. It is quite possible to stamp out trades and inflict much hardships with the most benevolent motives. So long as the influence of Government is well and wisely directed there is no danger; but much harm may be done by enthusiasts possessing but half knowledge of their subject, and manufacturers, shipowners, colliery proprietors, and others will do well to keep their eyes open and take care of their own interests, always bearing in mind, however, that capital, knowledge, talent, and skill have their duties as well as their rights.

THE MARSANT SAFETY LAMP.

RECENTLY a paper, "On the New Marsant Safety Lamp for Mines," was read before the members of the Manchester Geological Society by Mr. Joseph Dickinson, H.M. Chief Inspector of Mines, and a summary of this paper was at the time given in our Lancashire notes. Since then a number of experimental tests with the lamp have been carried out by Mr. Dickinson, with the result that certain modifications have been introduced, and an improved "Marsant," made in accordance with these tests, has been introduced into the Altham Colliery, the scene of the recent disastrous explosion. We have been furnished by Mr. Dickinson with a record of the details of these experiments, and it will interest our mining readers to know the results of these experiments and the course adopted in testing the lamp. The tests were carried out at the Celynen Colliery, Monmouthshire, and, by the kindness of Mr. J. T. Green, the manager, the special apparatus at the above collieries was made available for the purpose. The lamp was tested by being put into a tube or pipe and exposing it to quick and varying currents of an explosive mixture of lighting gas, nearly all the series of tests being made three times with the following results:—First test: The Marsant lamp, as sent by M. Marsant, and as described in the paper read by Mr. Dickinson, went out, but gas continued burning under the gauze. A Celynen Mueseler lamp, tested at the same time, went out entirely. The Celynen has a shield about 2in. in depth around the bottom of the gauze

The Marsaut Safety Lamp.



cylinder, resting on the top ring over the glass, and has also a strip of tinned iron, about $\frac{1}{4}$in. broad, strapped round the part of the chimney close to the underside of the gauze disc or diaphragm, which projects $\frac{3}{16}$in. at one side, to prevent gas burning underneath the disc in explosive currents. Second test: The Marsant, with the addition of a strip of tin-plate, about $\frac{1}{4}$in. in width, placed from the top to the bottom against the inner side of the inner gauze cylinder. The lamp went out as before, but gas continued burning under the gauze as before. The Celynen Mueseler went out entirely. Third test: The Marsant, with the addition of a strip of safety-lamp gauze, dividing entirely the inner gauze cylinder from top to bottom. The lamp went out, but gas continued burning under the gauze as before. The Celynen Mueseler went out entirely. Fourth test: The Marsant, with the addition of a third gauze cylinder placed outside the two other gauzes. The lamp went out, but gas continued burning under the gauze as before. The Celynen Mueseler, divested of its gauze cylinder, but in other respects as before, went out entirely. Fifth test: The Marsant, with the outlet apertures at the top of the outer casing so covered as only to admit of the lamp burning freely, went out, but gas continued burning under the gauze as before. The Celynen Mueseler and an Evan Thomas lamp went out entirely. Sixth test: The Marsant, with the outlet apertures covered as in No. 5 tests, and with all the side inlet holes covered, and also with about one half of the inlet space at the top of the crown or inner rim covered—all the air having to come up the vertical holes, and just enough air allowed for the lamp to burn brightly. The lamp went out, and then, with one flash of gas under the gauze, it went out entirely. The Celynen and the Evan Thomas also went out entirely. This was repeated three times with the same results. About twenty tests were made. In none of them did gas fire outside the Marsant; but in those cases where gas continued burning underneath the gauze, and where it so burned for about half a minute without going out, Mr. Dickinson observes that it seems probable that it would have fired through, if the test had been continued long enough.

These tests, Mr. Dickinson adds, show indisputably that if the Marsant lamp is to be used where it may be exposed to a current of explosive gas, a change in the construction will be required. M. Marsant has tried a movable ring for closing the air apertures, so as to extinguish the lamp. A ring for this purpose would enable a person in an emergency to extinguish entirely the lamp as at present constructed; but unless he closed the apertures gas would still continue burning underneath the gauze, and might fire through eventually in an explosive current. To be safe, therefore, and independently of any such closing having to be done in an emergency, the lamp should be self-extinguishing. To secure this, Mr. Dickinson urges that the inlet and outlet apertures should only be so large as to admit of the lamp burning freely, and that apparently the whole of the inlet should be up the vertical holes without any through the side inlets; and that the outer casing should not be removable, as it is now, but should be fixed either to the cage or be locked. The lamp, with the size of the inlet and outlet apertures thus limited, loses some of its advantages. It at first burns dimly if the casing is put on cold; but that is overcome in a few moments as the casing becomes warmed. The light then given is good, but not quite equal to that with the large apertures, and it goes out more readily when tilted. Apparently, however, some drawback of this kind is inseparable from a good and safe lamp. Based upon these trials, a lamp on the Marsant principle, but with smaller inlet and outlet apertures, has been made by Mr. Teale, and, as already stated, has been introduced into the Altham Colliery. This improved lamp was tested at the Celynen Colliery on the 12th ult., and Mr. Green, the manager, reports as follows:—"I have severely tested the lamp, and find that while there is sufficient ventilation, it goes out quickly in sharp currents of gas and air, and, in fact, acts in a satisfactory manner. I see one objection to the casing being fixed to the lamp, and it is this—occasionally we find that in pushing the gauze up home the bottom flange of the same becomes a little displaced. In the present modified form this could not be observed, and I think a valuable addition would be made to the lamp by fixing a male and female screw on the ring and the bottom of the case respectively, so that an inspection of the gauzes might be obtained after they were up in their places, by simply unscrewing the case and pushing it upwards." The accompanying engraving illustrating the lamp is self-explanatory.

SHIPBUILDING TIME.

WE referred some time ago in THE ENGINEER to the question of the periods of construction of vessels, and gave an instance of a firm which had published a list of the vessels built, and the time of construction. We have now before us a statement of the promised and the actual deliveries of steamships built at a prominent shipyard at West Hartlepool. It embraces 33 ships, and extends over a period in which there was a strike of the helpers. The actual time of delivery varies from 189 days from the date of the order to 431 days, the average being 328, all days being included. Without referring now to the question of the delay or otherwise, it is worth notice that the building of vessels of varying tonnage, capacity, and power is proceeding very satisfactorily when, despite the pressure of work that has been known during the past two years, the average time between contract and delivery has been reduced to 328 days, including several vessels that were delayed from two to six weeks by reason of a strike. In the future it is probable that the time will be further abridged, because with the check that has of late been given to the shipbuilding trade, there will be a larger staff when needed to be put on any one vessel for which expedition may be needed, and there will be greater concurrence of work between shipbuilders, engine builders, and other workers. It is evident that this will have its bearing on the cost of the vessels, and also on the trade generally, because now that there is a possibility of greater rapidity of execution, orders will not be poured in so rapidly as they have been. The course of the shipbuilding trade has during the past three years been such as to call less than at some times for economies. This is being changed, and it is well worthy of notice that one of the chief of these that can be effected is the extracting of a fuller employment from a given amount of capital, the making of each berth more useful by building more vessels thereon in a given time. It would be interesting to learn what has been the experience of other shipbuilders on this question.

THE NEW PATENT LAW.

THE following letter has been addressed to the Editor of the *Times*:—

SIR,—Complaints have been made by several correspondents with reference to some defects that appear in the new Patent Law, or may result from its working. Will you let me refer to two prominent points?

It has been stated in general terms that any unauthorised use of a representation of the Royal Arms will render the person using liable to a penalty of £20, under Section 106 of the new Patents Act. It should be explained that the statute, in fact, only enacts that where any person without proper authority uses, in connection with any trade, profession, or calling, the Royal Arms or similar arms "in such a manner as to be calculated to lead other persons to believe that he is carrying on his trade, business, calling, or profession" by authority of Royalty or the Government, he shall be liable on summary conviction to a penalty of £20. The clause is especially aimed at any wrongful use of the Royal Arms, so as to enable articles to which they are attached to pass as having been patented under Royal grant, when such is not the case. The clause would also probably hit any person wrongfully holding himself out to be a Royal tradesman, but to suppose that it is applicable to any ancient use of a representation of the Royal Arms that could deceive no one for an instant is absurd.

Again, it has been pointed out that a notice has been lately issued from the Patent-office stating, in effect, that no application for a patent dated in 1883 can be accepted as coming under the provisions of the Act of 1884. This, it is alleged, may be a hardship in the case of a country applicant who cannot sign his application on January 1st, 1884, and get it delivered on the same day at the Patent-office, while a town or suburban applicant can do so. It would, no doubt, be a hardship if two concurrent inventors should desire to apply both on the same day—January 1st, 1884—and both for the same invention, the town applicant would have priority in point of date. Considering that out of 119,614 applications for patents made from 1852 to 1882, inclusive, such a case has only been recorded once, as I believe, the contingency of its happening is remote. If it should happen it may possibly be equitably dealt with under Section 116 of the new Act. The notice from the Patent-office is a warning that a line must be drawn between the operation of the old and that of the new law, and that no applications actually drawn and dated in 1883 can come under the new Act, which only takes effect from the beginning of 1884. No one who has carefully studied the provisions of the new Patent Act and the rules made under it can fail to see that those who framed them have endeavoured to provide as fairly as possible for the interests of patentees, on fair conditions. There will be found, as happens in the working of all new systems, cases where hardship or temporary friction may occur, but if the new system be judiciously and liberally worked, and patentees be intelligent and docile in learning to take advantage of the improved law and practice, there can be no doubt but that they will as a class be largely benefitted.

Let me, however, repeat that the working of the new and improved system ought to be, and may probably be, provided for liberally, and further give my reasons. It is true, and one rejoices at it, that patentees have been relieved from the heavy charge (£20) formerly paid on obtaining a patent, and will henceforth pay only £4, so that, with like numbers of applications, the income receivable by the Patent-office as regards this particular item will be reduced to a fifth, while the increased charges, especially for the new system of examination, will be very considerable. Without waiting for recovery of revenue from increase in applications, though much may be expected from this source, there will be, and are, as the Patent-office accounts show, abundant means available to meet any reasonable increase of working charges. The number of applications for patents during ten years, up to and including 1882, averaged yearly 5135. The number of patents granted in those ten years averaged yearly 3506. The payments made by patentees to the Patent-office averaged yearly £172,240. Deducting all salaries and expenses—but including a small sum under "Designs and Trade Marks Account"—the surplus income paid by the Patent-office into the Treasury has averaged for ten years the large sum of £135,985. In the above figures the duties payable to the Crown, as ordinary stamp duties on Crown grants of patents, are not reckoned. They would be and were paid into the Treasury as of course, but the surplus income derived from fees paid by inventors stands upon a different footing. The total amount of that surplus income received by the Treasury from the Patent-office since 1852 down to and including 1882 actually amounts to £2,372,775! Taking that large and still accumulating fund into account, and the existing annual surplus of £135,985, the case is clearly made out that the necessarily increased expenses of properly working the new system may be, nay, already are, abundantly provided for.

Some who, like myself, watch with interest the working of the Patent Law are afraid that the Treasury has been educated into too fond an affection for the goodly surplus funds which it has received from the Patent-office for so many years that it has come to count upon them, and look for them yearly, as of right and as its own. But, on the other hand, we hope that the Patent-office will henceforth be stoutly backed up by the Board of Trade in insisting that the increments so received by the Treasury shall be available for the proper needs and benefit of patentees who unquestionably earn them.

I remain, Sir, yours obediently,

11, New-square, Lincoln's-inn, Dec. 31st, 1883. T. ASTON.

ENGINEERING TRADE IN 1883.

THE following half-yearly engineering trades' report, issued on the 1st by Messrs. Matheson and Grant, of Walbrook, contains a great deal of interesting matter in a small space:—

MANUFACTURING engineers are, for the most part, busy throughout the country, though only at moderate prices; but in the iron and steel trades the depression which we referred to in our July report has increased, and seems likely to become worse. On the Continent there is in most districts a similar condition of affairs—activity in the leading branches of engineering and low prices in the raw material. In America, where manufacturers depend entirely on a home demand, trade is much worse than it is here, where the numerous markets available tend always to diminish the effect which a falling off of trade in any one country might produce. The Bank of England rate of discount, which has ranged during the last half-year between 4 per cent. and the present rate of 3 per cent., shows a want of confidence among investors; but there are ample funds available and accumulating for new enterprises when trade improves.

Coal.—The rise in price which took place at the beginning of last year has been fully maintained; the total output has been greater than in 1882, and colliery proprietors have, after some years of depression, been making fair profits. In the Midland Counties the actual or threatened strikes have caused prices to rise during the last few months, but to a large extent merely from the competition of steel makers, engineers, and others, to provide a store of fuel. Prices will probably fall to their old level, but there is a gradual tendency towards higher wages among the colliers, which is likely to tell on all metallurgical operations during the early future if trade improves.

Iron.—Prices fell gradually but almost continuously during the whole of the past year, and a further reduction appears probable in all kinds of iron. There is no improvement in the American demand; much of the shipments thither during the last half-year have been on old contracts which are hardly likely to be renewed, and the lessened activity in English shipyards will tend still further to diminish consumption and to depreciate prices.

Steel.—A momentous period seems to have arrived in this important trade, and the radical changes in the position both of steel and iron, which, as the natural outcome of the Bessemer inventions, have been approaching since 1873, are likely to show some curious developments during the coming twelve months. The simple processes of steel making are now thoroughly understood, and the steel works have increased out of all proportion to the demand, each extension being justified by the plea that local advantages or the cheaper methods which are to be introduced will distance all competition. Contracts for steel rails on the rigid conditions imposed by the leading railway engineers can now be made at from £4 5s. to £4 15s. per ton, and as the standard of price will be that of the cheapest maker, it is probable that even lower prices will be reached. A low cost is only possible where a large output keeps down expenses, and in the struggle to secure orders for this reason, it is likely that the whole trade will fall into the hands of those who have the local advantages of close contiguity to materials or to suitable shipping ports, and to those who, by reason of having their own collieries, may find an indirect profit in continuing to make rails at a low price. The manufacture of steel for shipbuilding kept pace with the unprecedented activity in that branch of trade, and prices are now falling as that activity is relaxed. With the reduction which is now taking place in the demand for steel, competition will still further disclose its real cost as compared with that of iron, and hasten the time when iron made by puddling will be superseded for most structural purposes. In some forms of steel prices have been fairly maintained: thus the demand for locomotives and rolling stock of all kinds has benefitted the makers of tires and axles, and the leading Sheffield firms have been profitably employed with both home and foreign orders. The makers of steel castings are busy.

	Per ton.																	
	January, 1880.			January, 1881.			January, 1882.			January, 1883.			July, 1883.			Jan., 1884.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Steam coal, f.o.b at Cardiff ..	0	8	9	0	9	6	0	10	9	0	11	0	0	12	0	0	12	0
West Hartley coal, f.o.b. at Newcastle ..	0	8	6	0	8	6	0	9	0	0	9	0	0	10	0	0	9	6
Pig iron at Glasgow, No. 3	3	6	6	2	12	6	2	11	0	2	9	0	2	7	6	2	3	6
Pig iron at Middlesbro', No. 3	2	12	0	2	0	0	2	3	0	2	2	6	1	19	6	1	16	6
Iron ship plates at Middlesbrough	8	5	0	6	15	0	7	2	6	6	10	0	6	0	0	5	12	6
Iron bridge plates in South Yorkshire ..	9	0	0	7	5	0	7	15	0	8	0	0	7	10	0	7	5	0
Steel ship and bridge plates.	14	0	0	12	0	0	10	10	0	10	0	0	9	10	0	8	10	0
Iron rails, f.o.b.	7	0	0	5	15	0	5	10	0	5	0	0	5	0	0	5	0	0
Steel rails, f.o.b.	8	5	0	6	10	0	6	10	0	5	5	0	4	15	0	4	10	0

Scrap iron and steel.—Prices have continued to fall since the date of our last report. America has practically ceased to buy, having material enough at home to supply the diminished number of rolling mills that are at work. The market for old material is in much the same condition as in the summer of 1879, when depression was followed by a period of inflated prices. The price of old iron rails has been upheld by the shipment to Italy of about 40,000 tons during the year. From 49s. to 51s. per ton for heavy scrap iron, from 60s. to 63s. for double-head iron rails, and from 64s. to 66s. for double-head steel rails, are the present free-on-board prices here. Old flange rails are, however, much cheaper, and cheaper in steel than in iron.

Iron and steel shipbuilding.—After three years of unprecedented activity the natural reaction has arrived; the principal shipyards are only partially employed, and new steamers can be contracted for at prices at least 20 per cent. less than those of last January. Wages on the Clyde and at other shipbuilding centres had become so inflated that the present change was inevitable: but it is probable that there will be a recovery in the demand for steamers when moderate prices are reached. Meanwhile, the iron and steel works, the marine engine factories, and the numerous subsidiary trades which have found profitable employment during the last few years, share in the lessened demand.

Bridges and structural ironwork.—The output of bridges during the past year has been very great, but the extension of factories and the introduction of labour-saving processes have so increased the power of production that contracts are more quickly executed than formerly, and the slightest lull in the giving out of new orders is immediately felt. Prices remain unaltered, except as they follow alterations in iron steel. From £13 to £16 per ton for iron bridges and £15 to £20 for steel bridges are inclusive rates. Numerous bridges of very large size are being built, and many more are projected in India and the Colonies, the successful construction of deep-water piers and long span girders giving special encouragement to engineers. Steel is gradually being employed for small as well as large structures, especially where heavy loads have to be carried, as it is becoming evident that the advantages of steel are not confined to cases where the total cost can be brought down to that of iron by a reduction of weight, but are to be obtained by maintaining the same, or nearly the same, weight, the additional strength so gained being much greater than the additional cost. Steel can be bought at an increase of only 20s. to 30s. per ton above the price of good quality iron, the exact proportion between the two being mainly determined by the distance for carriage. And as the ductile steel with a breaking strength not exceeding 28 tons per inch which is now used for structures can be as easily worked as iron, and by the same machinery, bridges and roofs can be bought for about £2 per ton above the prices of iron structures of the same form and weight, though the difference is of course greater if the steel is in competition with low quality iron.

Railway material and rolling stock.—The condition of the rail trade has been referred to. Locomotive builders have been and are now as busy as at any time during the last twenty years, and have orders in hand for English, Indian, colonial, and foreign railways, which will occupy them for many months to come. But prices are still low; makers seem to have little confidence in the future; and the competition for new contracts is almost as keen as in recent years of depression. Railway carriage builders are in much the same condition; they have all been busy and all complain of unremunerative prices. In this branch of trade the low rates are largely due to the increase of factories which has taken place during the last few years, and to the fact that much of the work done by carriage builders can be done by others, who at once compete if prices rise. The makers of railway appliances and station fittings of all kinds have been busy; but the orders in view for the coming year are not abundant, and workmen are being discharged in many of the factories.

Mechanical engineers throughout the country have been well employed during the year, and most of the leading firms who manufacture specialities, or who have a reputation abroad, have been and are very busy. Steam engines, sugar machinery, mining appliances of various kinds, and manufacturing plant have been in special demand. Machine-tool makers have been benefitted greatly by the activity of locomotive makers, shipbuilders, and marine engineers, and will feel the slackened demand among the latter trades. The use of hydraulic tools is extending.

Agricultural engineers.—The home trade continues dull; farmers, though relieved from some of the heavier burdens that pressed upon them a few years ago are, as a rule, only just able to hold their own, and have but little money available for the purchase of machinery, even when its use would be manifestly profitable. The export trade still remains good, and the supremacy which English makers have so long maintained in this branch of trade, wherever quality is the measure of value, still continues. Traction engines, portables with self-propelling gear, and road rollers, have been much improved, and are taking a more important position in the trade than formerly; but there is not in the agricultural trade generally any conspicuous novelty to report, and it is a sign of activity that the leading makers are not, as has so often happened, competing for custom by presenting new inventions for adoption. Steam engines are being adapted specially for the electric light; the compound system which has been so successfully tried in portable engines appears likely to be generally adopted; the use of steel is extending; and the advantages of much higher steam pressures than were usual a few years ago, seem at last to be recognised by and ventured on by users. An interesting official report has lately been received by the India-office concerning the agricultural machinery tried in India, from which it appears that the use of English implements is making but slow progress, a notable exception being a special kind of small sugar-cane mill sent from this country, which is finding great favour among the peasant cultivators, and rapidly superseding the wood and stone mills of native construction.

Portland cement.—An active export demand to supply the new railways, docks, and other public works going on in various parts of the world is at present coincident with a similar activity at home, and the available supply from the factories can barely keep pace with the combined demands made upon them. Although a large proportion of the trade is being done at old contract prices, the real value has risen, and new contracts can be arranged only at an advance of about 6d. per 400 lb. cask. The manufacture of Portland cement has been growing rapidly during the last few years, and the increasing output from the factories in the London district, which from their local advantages nearly monopolise this trade, points to its becoming in a few years one of the leading staple industries of the kingdom.

Protective tariffs abroad are still causing much discontent among English manufacturers who seek in foreign restrictions rather than in increased competition at home the cause of diminished profits. In the United States there is again some small agitation in favour of reducing the duties; but public opinion is not yet ripe for a radical change, nor would a change be of much advantage to manufacturers here, except in the general good that freedom of trade affords. For, when the prices of imported commodities fall, workmen's wages, while in effect maintained, will also fall as the purchasing power of their money is increased, and American makers will then by their immense natural advantages not only hold their own against most kinds of imported goods, but will compete with us in the neutral markets, from which their present high cost of production shuts them out. In Mexico, although the United States is seeking special advantages, there seems a disposition to put us on the most favoured terms; in Spain the differential rates which have for the last few years permitted the importation of engineering goods from Germany and Belgium to the exclusion of similar English goods seem likely to be removed. In Australia the protective policy which has wrought such ill effects in Victoria is being urged in New South Wales in the name of, and by the votes of, the working classes. Tenders are invited for 150,000 tons of steel rails to be made in that colony, and delivered after the year 1886. The great mineral wealth of the country must ultimately be utilised, but with the present sparse population, a policy which may have been endurable in a populous, self-contained country like the United States, is premature in Australia. And if, as is suggested as an alternative, the rails are only made in the colony from imported pig iron, ingots, or blooms, even the supposed advantages will be small, and out of all proportion to the burden imposed on the community.

Public works at home and abroad are likely to increase. At home the principal railway companies, besides promoting new lines are spending much money in widenings and enlarged stations. The railway tunnels under the Mersey and the Severn and the new Tay Bridge are well advanced. The new docks at Tilbury, on the Thames, are half finished; those at Hull are nearly completed; and at Cardiff important improvements are being carried out. For the coming Session of Parliament there are 295 Private Bills deposited for railway and other schemes, and most of them appear to be well supported. Abroad, a large proportion of the works in progress are supplied with material from England, and are under English engineers. In India, the railways are being steadily but slowly extended, and if independent lines were encouraged, capital would be forthcoming for the purpose. In Australia, New Zealand, Tasmania, and South Africa, new lines are being constructed which will not only increase the demand for material, but will open up these countries to mining and other enterprises, which wait only for means of communication. The present war in China, though it may hinder and postpone will ultimately encourage engineering enterprise in that vast country. In conclusion, though the immediate prospects for engineers do not appear very bright, no diminution in the volume of trade is likely to occur, and if there be lack of profit or employment it will arise mainly from excessive competition at home.

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

(*From our own Correspondent.*)

THE chief feature of the South Staffordshire iron trade in 1883 has been the great demand for sheets of all descriptions. This has led to a larger output than at any previous period in the history of the trade. Prices of sheets for the galvanisers and for ordinary merchant purposes have fluctuated considerably but not violently. When the year opened they were £7 10s. per ton and upwards for singles, £8 5s. easy for doubles, and £9 to £9 2s. 6d. for lattens; while at the present time singles are quoted £7 15s. upwards, delivered Liverpool; doubles, £8 to £8 7s. 6d.; and lattens, £1 additional.

Plates have not sold at all actively. During the last eleven months £9 has been the official quotation for boiler plates, but supplies have been abundant at £8 10s., and tank plates have all along been offered at £7 per ton upwards.

In the high-class bar trade those firms have done most who have sold at 10s. per ton less than the marked bar houses. The price of marked bars has seen only one change. Early in February the three principal houses felt that it was impossible to uphold the £8 standard, since other houses had for some months been selling at £7 10s. A 10s. drop was declared and £8 2s. 6d. became the quotation for Round Oak iron, and this quotation remains.

Second and third-class bars have sold well at from £7 to £6 15s. for the former, and at £6 10s. to £6 for the latter.

There has not been the United States demand for hoops and strips which had been hoped, but the mills have been steadily occupied at about £6 10s. per ton easy for export qualities, and £7 for superior sorts.

Pig makers have not had a satisfactory year.

In January 10s. was the quotation for hot-blast all-mines, but in actual business 67s. 6d. to 65s. was about the figure. Before the year had three parts run 62s. 6d. had become the selling price, and this rate continues. Part-mine pigs have ranged between 55s. to 45s., and cinder pigs between 42s. 6d. and 38s.

A disastrous ironworkers' strike against the advice of the men's authorised leaders, extended through July and into August. The men struck against a reduction of 6d. per ton declared under the sliding scale. They were, however, unsuccessful, for the drop had to be accepted.

Upon 'Change in Birmingham this—Thursday—afternoon more business was transacted than last week. Yet this was not large, since buyers generally preferred to postpone operations until the quarterley meetings next Wednesday and Thursday.

The best report was given by thin steel makers. These are particularly well off for orders, which are arriving from the United States, Australia, Russia, Germany, Italy, the Brazils, and other foreign markets, as well as from large consumers at home. Good working up sheets were quoted at from £10 to £11 per ton for singles; while stamping sheets, doubles, were £13 to £13 10s. per ton. Mild steel is being increasingly used for these sheets. Charcoal sheets for deep stamping purposes are in good sale, and for best sorts £20 per ton is obtained.

East Worcestershire tin-plate makers reported themselves active on account of Australia, the Continent, America, and elsewhere, and they made no complaint as to prices.

Merchants' sections of iron sold tamely. Good bars were £7 to £6 15s., and common £6 10s. to £6. Nail rods were to be had at £6. Hoops were £6 7s. 6d. to £6 15s. and £7. Gas tube strip ranged from £6 2s. 6d. to £6 5s., and on to £6 7s. 6d. Bedstead strip was an average of £8 5s.

Pigs were slow of sale, but one or two vendors of hematites reported an increased demand. Their prices ranged from 57s. 6d. to 60s. for grey forge sorts of Cumberland and Welsh manufacture. Staffordshire part-mines were 50s., and common 40s. to 37s. 6d. Derbyshire pigs realised 46s., and consumers of Northampton's would not generally give more than 45s. The furnaces now blowing number 42.

The prospects of the iron wire trade of Birmingham are greatly improved by the determination to which the railway companies serving this district have come. Wire declared "undamageable" will now be carried from Birmingham to London at a 15s. per ton rate, instead of the 19s. 2d. rate charged in the past year. To Liverpool the charge will be 11s. 6d. instead of 14s. 2d. Rates for other places have been fixed upon the same basis. In the item of carriage from the ports equal justice will be now meted out to foreign and home manufacturers alike. Pending a final arrangement, the through rates under which the German wire firms have had an advantage in English markets will be withdrawn, and the charges will be as from the ports.

Upon Birmingham 'Change to-day, and in Wolverhampton yesterday, a memorial prepared by the Ironmasters' Association was being signed, desiring that the Board of Trade will verify the 112 lb. weight in accordance with the practical requirements of the heavier trades.

The bridge, girder, and roofing trades continue active. One large engineering firm in the Dudley district has its workmen employed extensively on Australian orders, and many of the workmen have made, and are still making, considerable overtime. In addition to contracts in hand for the Government of New South Wales the construction of a new iron bridge for that colony has been begun.

Machinery continues to steadily supplant manual labour in certain of our light industries. Recently I noticed its increased use in nut and bolt making. The same tendency is now more than ever observable in the lock trade, manufacturers putting down new mechanical apparatus which allows of a much greater outturn than before at a considerably reduced expenditure, while the quality of the goods, it is stated, does not in any way suffer.

Electrical apparatus is also being increasingly adopted in some of the light trades. One of the departments to which it is more than ever being applied is that of tinning and bronzing light ironfoundry of an ornamental and useful description for furnishing purposes. The nickel platers, too, are supplying themselves with improved machinery of this character.

Of late great progress has been made in the casting of such light goods as I have just indicated. This is especially noticeable at Willenhall, where the considerable firm of John Harpur and Co. assert that they are now producing these castings in every way equal, if not indeed superior, to the American goods.

The Birmingham, the Wolverhampton, and the Walsall Chambers of Commerce are inclined to accept the explanation of the Board of Trade to the manufacturers in Derby of ranges and stove grates, as applicable also to other descriptions of hardware elsewhere made, upon which it has been customary to impress or attach the Royal Arms and the word "Patent," though it may be that, technically, no right is claimed to the use of those distinguishing marks. The Board has intimated that it has no intention of attempting to enforce the provisions of the new Act in the cases which the deputation from Derby brought before them; yet the adoption of the designations mentioned will be hereafter less frequent than before.

The Dudley, Sedgley, and Wolverhampton Tramways Company, which was defeated last session in its effort to work its lines by steam, now proposes to limit the extreme external breadth of any engine or carriage to 5ft. 6in. The engines, as provided in the Provisional Order which has been issued, may go at a rate not exceeding ten miles an hour, subject to regulations by the local authorities. The application of the company to the Dudley Town Council for permission to use steam was on Tuesday granted.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The new year is throughout Lancashire so much of a holiday season that during the past week there has been practically little or no business doing in either the iron or the coal trades. There has been no meeting of the Manchester iron market since Friday last, and the members of the Coal Exchange are not holding a meeting at all this week. Ironworks and collieries have also been closed for three or four days, with practically very little work at all being done at many of the pits during the week.

The Friday's meeting of the Manchester iron market brought together a moderate attendance, but there was not much attempt at actual business. One or two moderate sales of local and district brands of pig iron were reported on the basis of 45s. for Lancashire and 44s. 10d. for Lincolnshire forge less 2½ delivered equal to Manchester, and there were a few offers at low figures. Beyond this, however, I did not hear of anything being done. I may, however, add that the year opens with both local and district makers of pig iron holding firmly to their prices on the present basis of quotations. In manufactured iron, however, the market if anything shows a tendency towards weakness. The average run of prices at present is nominally £6 to £6 2s. 6d. for bars, £6 7s. 6d. for hoops, and £7 15s. for sheets delivered into the Manchester district, but there is little or nothing doing.

In the engineering branches of trade the year opens with very fair prospects of continuing activity in some departments, and tool makers report fairly good orders coming forward. During the year pretty general activity has been maintained throughout nearly all branches of this industry. In all descriptions of railway plant and rolling stock there has been quite a push of work all through the year. Locomotive builders have had their shops full of orders largely for abroad, although some of the continental contracts taken in this district have proved anything but profitable, and have, I understand, only been carried out at a loss. All branches of the tool-making trade have also been busy, especially in heavy classes of work. One cause which has contributed largely to this has been the exceptional activity in marine engineering, and the demand for tools in connection with the iron shipbuilding yards. But apart from this class of work, there has been a good demand for general machine tools of special design which has kept makers well employed. Amongst the large engineering establishments work has also been generally fairly plentiful, and during the year a large weight of exceptionally heavy plant has been turned out for various ironworks both at home and abroad. The boiler-making trade has been tolerably well employed, the leading makers having had orders sufficient to keep them fully going. In the small stationary engine trade work, as a rule, has only been of a hand-to-mouth character, and in the cotton machine making trade activity has not been general. A few of the large firms, chiefly in the Oldham district, have been very busy, but many of the cotton machine makers in Manchester and other districts have not been more than indifferently employed. So far as the actual weight of work doing generally in the engineering branches of trade is concerned, there has not been much to complain of during the past year, but, as I have many times pointed out in my "Notes," the prices at which this work has been taken have, as a rule, been on so low a basis that they have left very little margin for profit. The men have reaped the best advantage from the past year's activity; they have had full employment at relatively high wages in proportion to the return obtained by employers for the products of capital and labour. So far there has been no attempt to interfere with wages in this district except on the very outskirts at Barrow; and Lancashire has not been disturbed during the year by any disputes between employers and employed, such as have taken place in other districts. Unless, however, engineers can make more out of their plant and labour, the question of a reduction in wages is pretty nearly certain to force itself to the front before very long.

It will be interesting to notice the kind of record of the past year given by the trades' society organisations connected with the engineering branches of industry. The returns issued by the Amalgamated Society of Engineers show a steady demand for men all through the year, the number of unemployed members not having varied more than 1 per cent. during the whole twelve months, whilst it has never exceeded 2½ per cent. of the membership. The secretary of the Moulders' Society sums up the past year as "not having been a bad one;" whilst the Steam Engine Makers' Society refers to the past year having been "a fluctuating and disappointing one." From the commencement of the year until April the number of men out of employment gradually decreased until it touched the lowest point reached since 1875; but from April to November the number of unemployed members gradually increased until it got to the heaviest record since May, 1881. Since November, however, there has been an improved demand for men, and the number of unemployed has considerably decreased. With regard to the future prospects of trade, an extract from the report of the Steam Engine Makers' Society for the close of the year, will indicate the view taken of the outlook from the men's point of view:—"We are free to confess," says the secretary of the above society, "that the outlook is not very cheering, and although there has not been any panic or disastrous decline in trade, we are afraid that in certain districts wages will be tampered with to an excessive extent. There is an old adage that 'a straw shows the way the wind blows;' and if that theory be correct, we are afraid that before the new year is far advanced we shall have to contend with encroachments of a serious nature. As is well known, the shipbuilding trades have been more extensively employed during the past three years than at any period since the introduction of steam to ocean-going vessels. Of late the orders have not been so numerous, and although the decline is only as yet talked about, steps have already been taken to reduce wages. During the past month notices have been posted or rumours circulated at Newcastle and in the northern ports generally, that with the beginning of February, 1884, wages of shipbuilders would be reduced to the same rates as ruled previous to 1880. This means a lower wage to our class of from 4s. to 5s. per week, if the capitalists can carry it into effect. An important step in this direction has been taken at Barrow, where the very essence of the Newcastle notice was posted at the early part of this month, for the men were called upon to stand a reduction at the rates named. Our advice, as a council, to our members was to resist any reduction, on the principle that if they accepted or compromised it would extend to other localities. As at other places our members were not numerous enough to carry out our instructions, the larger body were advised to accept the 5 per cent. reduction, which an aggregate meeting decided to do. When the men waited upon the manager of the firm to tell him of their compromises, he appeared to reluctantly accept their offer, but said if trade did not improve by February they would have to enforce the other 2s. reduction. This simple remark sounds ominous, as it forces the opinion that united action is being agreed upon by all the leading shipbuilders to take advantage of a quietness in trade that we think is only of a temporary nature. To accept at one time of a reduction, in some cases equal to 15 per cent., is an operation that we believe our members will resist to the uttermost, and if extreme measures are resorted to on the employers' side, may lead to a serious rupture, and such an one as our trade has not had for many long years past. We hope it may be averted; but in the meantime we cannot guard our interests too carefully, and see that we prepare for any emergency that may arise hereafter."

In the coal trade there has been little or nothing doing during the past week. Prices are nominally unchanged, no announced reduction of quoted list rates having been made, but if anything there is a tendency towards weakness in the market. At the pit mouth the average prices may be said to be about as under: Best coal, 10s. to 10s. 6d.; seconds, 8s. to 8s. 6d.; common, 6s. to 7s.; burgy, 4s. 6d. to 5s.; and good slack, 3s. 6d. to 4s. per ton.

The renewed agitation for an advancement of wages, set on foot at the Miners' Conference, held in Manchester during the past week, is regarded with indifference, and the very tone of the resolutions passed at the Conference shows that the delegates themselves are fully aware that any movement for higher wages at present must be utterly futile.

The announcement that Messrs. Alexander and Henry Brogden had filed petitions for liquidation has been made when business is practically suspended in this district for the holidays, and it is difficult to ascertain what is the current of feeling with regard to the matter; but no doubt it will be a prominent subject of discussion at the ensuing 'Change meeting on Friday. It may, however, be said that the announcement of the failure was not altogether unexpected in this district. Although the firm have a business establishment in Manchester, the actual business done here has of late years been very much contracted, and from inquiries we have made it does not appear likely that Messrs. Brogden's failure will be very seriously felt, so far as it has any direct effect upon the iron trade in the district of Manchester.

Barrow.—I hear of no important change having taken place in the hematite pig iron trade, which still continues very dull. Little business of any extent has been done during the past week, the orders coming to hand, on both home, American, and foreign account, being practically nil, and it is noticeable that there is a great lack of activity displayed by buyers. Makers all round show a great desire to accept orders at the present low prices. Stocks all round are very weighty, as the output exceeds considerably the deliveries. Prices are unchanged, the quotations of last week ruling. Mixed parcels of Bessemer are selling at 46s. 6d. per ton net at works. Steel makers at present are the chief consumers of Bessemer iron. They are, however, in receipt of but few good contracts; yet they manage to keep the men in all departments well employed. The make in both the rail and merchant departments has been heavy. The demand for mild steel for spring and cutlery has not increased as fast as was expected, but the sales are very fair. Rails are quoted at from £4 10s. to £4 15s. per ton net at works.

Shipbuilders are in a low condition, and they have little work on hand. It is pleasing to notice that the strikes in some districts which existed have all been amicably settled.

Iron ore is in quiet demand at unchanged prices.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

BUT few transactions in Cleveland pig iron have recently taken place. It is therefore difficult to say at what level prices really stand. Buyers are ready to give 36s. per ton for No. 3 g.m.b., prompt delivery, but sellers are scarcely yet willing to accept so low a figure. There are merchants who offer small lots at 36s. 1½d., but makers, as a rule, remain firm at 36s. 3d. to 36s. 6d. per ton. Grey forge iron is nominally 34s. 6d. per ton. The value of No. 3 g.m.b. has fallen about 7s. 6d. per ton during the year, the average price throughout being only 39s. 6d.

The quarterly meeting of the Cleveland Iron Market will be held at Middlesbrough, on Tuesday, January 8th.

Holders of warrants ask for 3d. to 6d. per ton more than makers' iron can be had for; consequently no sales are made.

The stock of Cleveland pig iron at Messrs. Connal's Middlesbrough store was reduced 781 tons last week.

There are scarcely any sales to report of finished iron. Some works were started on Monday last, but most remained closed until the 2nd inst. There is no change in prices to notice, quotations being as follows:—Ship plates, £5 15s. per ton; shipbuilding angles, £5 10s.; and common bars, £5 12s. 6d., free on trucks at makers' works, cash 10th, less 2½ per cent. discount.

It is expected that Monday working will now be resumed at the majority of the rolling mills, though many of the men and some employers are still averse to it.

At a meeting of the Cleveland Ironmasters' Association, held at Middlesbrough on the 27th ult., a deputation of blast furnacemen was present, and the wages question was fully discussed. The men asked for an advance of five per cent. on the standard rate of wages over and above the rates of 1879. They also asked to be paid time and a-half from one o'clock on Saturdays till six o'clock on Monday morning, and demanded that the blast furnaces to be put in slack blast for twelve hours every Sunday. The masters are willing to abide by the old sliding scale, but say it is quite out of the question for them to make the concessions the men desire, as trade is bad and conpetition keen. The deputation said they would put the masters' reply before their comrades, and would send a definite answer on or before January 12th.

At a meeting of the Durham Cokemen's Association, held on the 22nd ult., it was reported that the mineowners had refused to entertain the men's application to raise the basis of the new sliding scale 10 per cent. above the old one. The following resolution was passed:—"That we do not agree to the renewal of the sliding scale, or any other mode of arranging our wages in future, until an arrangement is entered into with the coalowners providing that non-unionists shall receive no benefit from the arrangements entered into between the coalowners and this Association."

The accountant's certificate under the Northumberland coal trade sliding scale has been issued for the quarter ending November 30th, and shows the net average selling price of coal to have been 5s. 3·04d. per ton. The wages of underground workmen and banksmen will thereby be reduced 1¼ per cent.

Work is entirely suspended at Messrs. Bolckow, Vaughan, and Co.'s Eston Steel Works this week. The firm insist on a reduction of 10 per cent., and are not willing to submit the matter to an arbitrator as the men demand. About 4000 men are idle, and there is at present no prospect of an amicable arrangement being come to.

The shipbuilding returns for the Tyne and Wear have been issued, and show that 159 vessels have been launched on the Tyne, of which twelve were of steel. The total tonnage is 216,573 tons. On the Wear 122 iron vessels and four steel vessels were built, with a tonnage of 212,313. This is an increase of 8167 tons for the Tyne over 1882, but a decrease of 151 tons for the Wear. The total tonnage of vessels built on the Tees in 1883 was 81,795 tons; at Hartlepool, 67,066 tons; and at Whitby, 13,662 tons.

A strike has taken place at the Bowesfield Ironworks, Stockton, which shows how slowly and with what difficulty ironworkers learn to act temperately, and with common sense. The delegate to the Board of Arbitration, a puddler by trade, considered himself justified, in virtue of his position as representative, in neglecting his work to the extent of being absent from his ordinary duties about one-half of his time throughout the year. During his remaining time he was attending to, as he says, or "hatching up," as the firm say, an endless crop of disputes. For time so lost he was compensated, by a liberal interpretation of the Board rules, to an average extent of about 30s. per week. All this was borne with, until at length the zealous representative took upon himself to order the "buzzer" to be blown at a certain time before that considered proper and authorised by the foreman. The cup of tolerance was now too full for the patient manager. It overflowed, and the representative got his seven days' notice to leave, according to the rules of the works; and with him two other unsatisfactory workmen. Whereupon the remaining workmen, or rather a small proportion of them who pretended to represent all, assembled in conclave to consider the case. They did not, as they were bound, bring their grievance before the Board, whilst, in the meanwhile, they remained at work. On the contrary, they decided to remain out till the three discharged men were, as they called it, "reinstated again." Therefore Bowesfield Mills have been silent, and its chimney smokeless all the week. A workman, more sensible than the rest, occupied the chair at one meeting, and suggested that the legal seven days' notice should be given before ceasing work. A threat, however, from some of the audience that an aperture other than the door should otherwise be used to facilitate his egress promptly brought the chairman to reason, and led him hastily to withdraw his proposition. Another, which resulted in the action above indicated, was promptly passed. It is not thought likely the strike will endure long; impecuniosity will convince when all else fails.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Miners' Conference at Manchester, which closed on Saturday afternoon, has terminated, as was anticipated, in a resolution to ask for an advance of 10 per cent. There is much less aggressiveness in the tone of the delegates than during the 15 per cent. agitation. For example, a supplementary resolution has been passed to the effect that the conference, "being desirous of causing no bad feeling between the men and their employers," recommend that each district, either by meeting separate colliery owners or by deputation from the district or county associations, should ask the employers for the 10 per cent. advance agreed upon previously. The conference was adjourned until January 28th. It is not expected that the agitation will have any general result in Yorkshire, where it will be stubbornly resisted. The stores of coal which accumulated while a strike was impending are now pretty generally cleared out, and a touch of frosty weather would cause demand to become brisk. The high prices for house coal have been pretty generally maintained since the strike collapsed, and the house coal pits ought to be doing a profitable business at present. Small coal and manufacturing fuel of nearly all sorts keep at low quotations.

During 1883 the British Government has had completed and delivered the armour for the Warspite, Collingwood, and Edinburgh, and the new vessels for which the plates have been ordered are the Rodney, the Benbow, the Camperdown, and Howe. Italy has had the plates for the Italia, and the contract for the armour for the Lepanto, a sister ship to the Italia, is expected this month, as well as for two other large war ships, also for the Italian Government. For Russia, Messrs. John Brown and Co. have made the armour for the Dmitri Domskoy, and Messrs. Charles Cammell and Co. have entered into an arrangement with the Russian Government to put the works at Kolpino, near St. Petersburg, in working order to produce compound armour as it is made in Sheffield, one half of the requirements of the Russian Admiralty for the next ten years to be made in Kolpino, and one half in Sheffield. Brazil has placed her second ship, to be clothed with compound armour, with Messrs. Samuda Brothers. The new vessel is named Aquidaban, and is a sister ship to the Riachuelo, which was clothed with Sheffield armour some time ago.

A circular has been issued intimating that from and after January 1st, the name of the company which owns the Phœnix Bessemer Steel Works, the Ickles, Rotherham, will be altered from "Steel, Tozer, and Hampton, Limited," to "Steel, Peech, and Tozer, Limited. Mr. Wm. Peech, whose name is now introduced, has been a sleeping partner in the company since its establishment in 1875. Mr. Hampton is now with the Barrow Company, and his connection with the Ickles Company absolutely ceased, it appears, more than twelve months ago. The management of the business will be in no way affected by the change of name, but will remain in the same hands, and there will be no alteration whatever beyond that in the style of the firm. The Phœnix Bessemer proprietors have very wisely turned their attention to the production of special qualities of steel for Sheffield and district, the manufacture of rails, which was their chief article, having now given unmistakeable signs of leaving Sheffield. Their success in the new departure has been so marked that they intend to put down a new hammer for the manufacture of axles and forgings, as well as two rolling mills for spring steel and bars. The company hopes to have the rolling mills in operation in about a couple of months.

The annual meeting of the shareholders in the Acaster Rail Joint Co., Limited, was held on Monday at Sheffield. The company was formed in 1877 with a capital of £50,000 in £100 shares—of which £12,000 was called up—to work a joint, patented by Mr. A. J. Acaster, of the Princess Works, St. Mary's-road. In the report submitted to the meeting regret was expressed that the joint had not yet been got into actual use on any main line, but it was stated that an order had been received from the Great Northern Company for two miles of railway on which the rail joint is to be laid. The place selected is near Peterborough, where the heavy traffic will afford a severe test of its capabilities. The company believes that nothing can prevent, or much longer delay, the adoption of the joint by the railway companies, and the shareholders are counselled to wait patiently some time longer.

Electricity is being steadily though slowly developed. The well known cutlery works of Messrs. Joseph Rodgers and Sons, Limited, have now been lighted up by Messrs. Tasker, Sons, and Co., Sheffield. The light is being used at night by contractors to push on new buildings; a large drapery establishment and an extensive provision merchant have adopted it with satisfactory results. Messrs. Tasker, Sons, and Co., of Sheffield, who recently carried out extensive telephonic communications for her Majesty at Balmoral, are about to undertake similar work at Windsor.

"An Old Sheffielder," writing to a local paper from Nelson, New Zealand, points out that American axes, shovels, and haymaking tools are the only ones used there; but cutlery, saws, and sheep-shears are all of Sheffield make. The great fault, he says, of both American and Sheffield goods is their variable temper. This writer recommends Sheffield makers "to take a leaf out of Brother Jonathan's book in the way of finish, combining lightness with strength, and a general regard for the work the tool is required for." If with these points they could combine a uniform temper, "An Old Sheffielder" thinks they need never fear American or any other competition; but if they think these points too trifling to trouble about, they will find the Americans taking a large pro portion of trade in tools of all descriptions.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been comparatively little doing in the Scotch iron trade this week in consequence of the new year's holidays, which at most of the larger works extend over nearly the entire week. The iron market was closed from Monday forenoon till Wednesday, and the business since effected has been of a comparatively unimportant nature.

A very unfavourable impression has been produced in iron circles by the disclosure that the quantity of Scotch pig iron used in the manufacturing works at home had decreased 102,000 tons as compared with the figures of the preceding year. It was expected that there would be a large increase, instead of a decrease. The aggregate foreign shipments of Scotch pigs—449,977 tons—were distributed as follows:—United States, 126,720 tons; Germany, 71,285; Italy and Austria, 55,571; British America, 45,585; Holland, 42,360; East India, Australia, China, and Japan, 27,561; France, 24,230; Russia, 23,837; Denmark, Sweden and Norway, 10,619; Belgium, 9557; Spain, Portugal, Malta, and Gibraltar, 6672; South America, 3767; Turkey, Greece, and Egypt, 1020; Africa, 628; West Indies, 515; and Guernsey and Jersey, 50 tons. As compared with the preceding year, the shipments to the United States show a falling off to the extent of 20,000 tons; but this is more than made up by the increased exports to Austria and Italy. With reference to the outlook for the year upon which we have just entered, it cannot be said that it is encouraging. Unless prices should speedily improve it will be difficult for the ironmasters to keep from materially curtailing the production, and also reducing the wages of their employés. At the same time a low rate of value is more likely to attract business than a high one, and the year may perhaps turn out not such a bad one after all.

Business was done in the warrant market on Friday forenoon at 42s. 11d. to 43s. 1d. and 43s. cash, and 43s. 1d. to 43s. 2½d. and again 43s. 1d. one month, while the quotations in the afternoon were 42s. 11½d. to 42s. 11d. and 43s. cash, and 43s. 1d. to 43s. 0½d. and 43s. 1½d. one month. Business was done on Monday at 42s. 11½d. to 42s. 10½d. and 43s. cash, and 43s. 0½d. to 43s. 1½d. one month. The market was closed on New Year's Day. Business was done on Wednesday at 42s. 11d. and to 43s. cash. To-day—Thursday—at 42s. 11½d. to 43s. 1d. cash, and 43s. 1d. to 43s. 2d. one month.

In consequence of the unfavourable annual reports and depression in warrants, makers' iron has been dull at the following rates:—Gartsherrie, f.o.b., at Glasgow, per ton, No. 1, 50s. 6d.; No. 3, 48s. 6d.; Coltness, 55s. and 50s. 6d.; Langloan, 53s. 6d. and 50s. 6d.; Summerlee, 52s. 6d. and 48s. 6d.; Calder, 54s. and 47s. 6d.; Carnbroe, 51s. 6d. and 47s.; Clyde, 47s. 6d. and 45s. 6d.; Monkland, 44s. 3d. and 42s. 6d.; Quarter, 43s. 6d. and 42s.; Govan, at Broomielaw, 44s. and 42s. 3d.: Shotts, at Leith, 53s. and 51s. 9d.; Carron, at Grangemouth, 48s. (specially selected, 54s.), and 46s. 6d.; Kinneil, at Bo'ness, 46s. and 45s. 6d.: Glengarnock, at Ardrossan, 51s. 6d. and 45s.; Eglinton, 45s. 3d. and 42s. 9d.; Dalmellington, 47s. 6d. and 46s.

The production of malleable iron in 1883 has amounted to 427,000 tons, of which fully 400,000 tons was used at home, and the remaining 26,000 sent abroad, the exports to foreign countries being a good average of those of recent years. The amount of work on hand at present is large, but it is everywhere asserted that orders for the future are scarce.

The coal trade has, of course, been quiet during the week. Railway traffic in coals for inland use has been reduced to a minimum for the holidays. There has, nevertheless, been a fair shipment in the past week for the season, and orders for future delivery are not unsatisfactory.

Little work has been done this week at the collieries, and there is little or no mining news to record.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

It is complimentary to the good sense and improving character of the Welsh collier, that the only dispute of late in which he has been engaged—that of Caerphilly—the Sliding Scale Committee adjudge him to be in the right, and that the action of the weighers was against the clauses of the Mines Regulation Act. The dispute may now be expected to terminate.

The coal world is again full of enterprise, and the new year opens very hopefully. The Messrs. Crawshay's new coal taking has a hopeful look. Messrs. Cory, the enterprising coal shippers of Cardiff, have purchased the Gelli and Tynybedw Collieries, in the Rhondda Valley, and Mr. Davies, Ocean, concluded arrangements for a large tract, embracing a good extent of the Taff Valley and Ynysybwl. For the two collieries first named, purchased by Messrs. Cory Brothers, the price is understood to be £130,000. Possession will be given up in January.

Mr. Ebenezer Lewis, who was the proprietor of the Tynybedw Colliery, has taken a new coal-field near Pontypridd and the Taff Vale Railway, which is spreading out its arms and branches in a remarkable way of late, will forthwith construct a branch to the spot.

I am glad to announce a satisfactory ending of the dispute between the men at the Bute Docks and the Bute Dock management. Mr. W. T. Lewis received a deputation at Aberdare last week, when the questions at variance were amicably adjusted.

The stagnation of the holidays is scarcely yet brushed away, but we may hope by next week that output and export will have recovered vigour, and the totals from the ports reached their old averages. The holiday told conspicuously on Cardiff, where about 70,000 tons were shipped last week instead of the ordinary 150,000 tons, and other ports in proportion. The holiday has been one of a reckless character as regards the spending proclivities of the colliers. The large towns were overrun, and the savings scattered profusely. Seeing that the colliers in many districts can earn freely 45s. to 50s. per week, the waste of 50,000 colliers may be easily computed by men of the Wilfrid Lawson school, who devoted a week's earnings at least. I am not interested in that way, but should prefer that the colliers who have so easily founded the Relief Fund should rather strengthen and extend its influence than resort to idle wastefulness.

The year has ended with comparatively little loss of life, that at Gelli being about the heaviest. Considering the rashness of colliers, this is noteworthy; but coalowners, the more orderly of colliers, and magistrates have been rigid either in exposing or punishing the criminal. What colliers will do was shown near Mountain Ash this week. A haulier was summoned for leaving open two brattice doors and a door in the main heading. He was properly fined, but contended that he had enough to do to look after the horses and trams. Yet he passed through, leaving them open, saw, too, that there was no door boy to shut them, and that a speedy disarrangement of ventilation, with all its terrible consequences, must follow.

The total colliery explosions of 1883 were 21—12 fatal; deaths, 113. Of the 21 explosions, 17 occurred with a high or rising barometer.

The industries of Swansea are fairly active, and patent fuel is showing a steady increase. Tinplate remains about the same, but signs are somewhat promising.

Nothing can yet be stated with regard to Siemens' works. The steel trade generally is slack, and it is yet early to forecast the prospects for the year. The market remains low and dull, and the only encouraging sign is that afforded by Cyfarthfa in pressing on the transformation to a final issue. I shall note shortly the principal part of the costly machinery which has been obtained. Dowlais is eclipsing the huge stacks of the district, by erecting one of great height.

Sir George Elliot, on becoming owner of the Old Dock, Newport, gave a sumptuous banquet to captains and crews.

The Swansea Board has decided on building a new reservoir.

The Public Health.—The deaths registered during the week ending Saturday, December 29th, in 28 great towns of England and Wales, corresponded to an annual rate of 20·6 per 1000 of their aggregate population, which is estimated at 8,620,975 persons in the middle of this year. The six healthiest places were Bradford, Portsmouth, Salford, Halifax, Bristol, and Huddersfield.

The Institution of Civil Engineers.—The list of members of this association, corrected to date, contains the names of 20 Honorary Members, 1381 Members, 2264 Associates—of whom 1751 are professional associates—and 778 Students, being a total of 4443, and showing an increase during the past twelve months at the rate of 5½ per cent. The newly-elected Council have re-appointed Mr. H. L. Antrobus, the senior partner of Messrs. Coutts and Co., as treasurer; Mr. Charles Manby, F.R.S., honorary secretary; and Mr. James Forrest, the secretary.

London Bridge.—An unsettled problem, which, like a tune in a barrel organ, comes round periodically, is the character of the bridge by which the Thames is to be crossed below London Bridge. Proposals, official and otherwise, have been numerous during the year, but nothing is yet determined. There is little doubt, however, that a low-level opening bridge, such as that proposed by Sir Joseph Bazalgette will be ultimately adopted, as this plan secures the advantages of the low-level, avoids litigation and exorbitant compensation, while the few disadvantages attending the use of an opening bridge will be gone in a couple of years after the bridge is erected; for the bridge will hardly ever, or never, be opened.

The New Patent Act.—Unusual activity prevailed at the Patent-office on the 1st inst., when the new Patent Act came into operation. One enthusiastic inventor, hailing from north of the Tweed, took up his station outside the door soon after midnight; and his patience was rewarded by the honour of appearing as "No. 1" under the new law. Towards four o'clock he was joined by two others, and when the hour for opening had arrived a small crowd of about fifty eager applicants had assembled; but when they had been disposed of, business became slack. There was, however, a steady influx, and at four o'clock it was found that 266 applications had been recorded. This is by far the largest number ever received in one day. The 1st of October, 1852, when the Patent Law Amendment Act—the statute which has just expired—came into operation, was a busy day, 146 applications having been sent in. On the last day of last year one person, who wished to have the last patent under the 1852 Act, after waiting about some time, handed in a specification at the last minute, satisfied that he had secured the peculiar pleasure he sought. Half a minute to four o'clock, a small boy, from a dark corner in the office, sprung himself upon the astonished occupants, and handed in two specifications. The man who thought he had got the last was heard to mutter something about that artful little boy; but what it was he muttered does not seem to be a matter of importance to history, as similar remarks have been made before. Contrary to general expectation, the falling off in the work of the office during last year, consequent on the superior advantages offered by Mr. Chamberlain's Act, has not been very great. In 1882 the applications reached 6241, the largest number ever known, while in 1883 they amounted to 5993, or a decrease of 249. The diminution first manifested itself in the week ending September 22nd, just a month after the passing of the Act, when there was a deficiency of three, as compared with the corresponding period of 1882. From that time the number of applications fell off steadily, with the result above stated. A singular recrudescence occurred during the last few days of the old year, when a number of persons seem to have suddenly made up their minds to seek protection under the Act of 1852. The figures are as follows:—December 24th, 9; December 26th, 8; December 27th, 15; December 28th, 24; December 29th, 31; December 31st, 57. This is a very high average for the last week of the year, and with the single exception of October 1st, 1852, the number of applications received on the 31st ult. has never been exceeded. It would appear, then, that while a large body of persons waited to take advantage of the low fees under Mr. Chamberlain's Act, a respectable number of inventors thought it worth their while to pay £21 instead of £4, and obtain protection under the old statute. Although the fees are reduced, applications under the new Act will have to undergo the ordeal of examination, and further patents will not be granted for more than "one invention." It is true that the law of 1852 included a similar provision, but the law officers have always interpreted the clause with great latitude, and it is expected that a much stricter control will be exercised in future.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

26th December, 1883.

5859. Augers, &c., A. G. Brookes.—(*J. Swan, U.S.*)
5860. Hair-pins, A. G. Brookes.—(*H. G. Thompson, Milford, U.S.*)
5861. Sinking or Fixing Colours on Marble, &c., G. Hand-Smith, London.
5862. White Lead, G. Hand-Smith, London.
5863. Ships' Lights, W. R. Lake.—(*G. T. Parry, U.S.*)
5864. Working Steam, &c., Engines, W. R. Lake.—(*H. E. Depp, Sedalia, U.S.*)
5865. Dynamo-electric Machines, E. C. Warburton, Manchester, and L. J. Crossley, Halifax.
5866. Printing Presses, W. R. Lake.—(*T. S. Nowell, Boston, U.S.*)

27th December, 1883.

5867. Baskets, &c., H. Brunner.—(*C. Garneri, Paris.*)
5868. Chlorine, W. Weldon, Burstow.
5869. Musical Instruments, A. Dunlop, Glasgow.
5870. Automatic Drain-flushing Apparatus, W. Ross, Glasgow.
5871. Locomotives, J. W. Hartley, Stoke-on-Trent.
5872. Combing Machinery, W. R. Moss and W. H. Brown, Bolton.
5873. Obtaining Oil from Minerals, N. McF. Henderson, Linlithgow.
5874. Electrical Conductors, R. H. Brandon.—(*H. F. Campbell, Concord, U.S.*)
5875. Button Attaching Sewing Machine, R. H. Brandon.—(*J. Driscoll, Somerville, U.S.*)
5876. Cold Drawing Rods, Shafting, &c., R. H. Brandon.—(*C. C. Billings, Boston, U.S.*)
5877. Night Lights, S. Clarke, London.
5878. Safety Paper, J. Jameson, Newcastle.
5879. Driving Belts, &c., J. Paterson, Glasgow.
5880. Sewing Machines, A. Greenwood and S. Keats, Leeds.
5881. Producing Electric Currents, A. M. Clark.—(*H. M. Paine, Newark, U.S.*)

28th December, 1883.

5882. Preventing Watch Robberies, J. Badcock, London.
5883. Knitting Machinery, F. Keywood, Nottingham.
5884. Greenhouses, E. M. Wood, Natick, U.S.
5885. Indicating Time by Electricity, A. G. Brookes.—(*L. N. Downs, Boston, U.S.*)
5886. Treating Zinc Ores, F. C. Glaser.—(*G. von K. Erben and R. Wiester, Germany.*)
5887. Expansion Wrenches, &c., H. J. Haddan.—(*A. E. Lytle, Chicago, U.S.*)
5888. Rotary Engines, &c., W. Paddock, Birmingham.
5889. Hydraulic Lifts,.&c., J. Standfield, London.
5890. Torrefying Grain, &c., J. Fordred, London.
5891. German or Dried Yeast, J. Fordred, London.
5892. Sewing Machines, A. Greenwood, Leeds.
5893. Evaporating, &c., Liquids, J. Imray.—(*H. Egells, Berlin.*)
5894. Construction of Vessels exposed to Corrosive Action, J. Imray.—(*H. Egells, Berlin.*)
5895. Spring Mattresses, J. B. Rowcliffe, Glossop.
5896. Production of Photographic Negatives, A. Borland, Wilmslow.
5897. Creating Currents of Air or Gases, R. Lofthouse, Manchester.
5898. Projectiles, A. A. Cochrane, London.
5899. Arrangement of Tiles, &c., D. Clarke, Birmingham, and P. Shrapnel, London.
5900. Steam Engines, W. R. Lake.—(*T. W. Porter, Chelsea, U.S.*)
5901. Imparting Step-by-step Motion to Parts of Mechanism, O. W. F. Hill, London.
5902. Producing Patterns upon Velvets, D. Scott, Manchester.
5903. Obtaining Oil from Minerals, J. McCulloch and H. McVicar, Lanark, N.B.
5904. Producing Patterns upon Velvets, D. Scott, Manchester.
5905. Detonating Alarm, E. Edwards.—(*H. Gibout, Paris.*)

29th December, 1883.

5906. Raising Sunken Vessels, R. P. Wylie, London.
5907. Steam Boilers and their Furnaces, G. Stevenson, Airdrie.
5908. Grinding Swords, &c., A. Greenwood, Leeds.
5909. Measuring, &c., Physical Power, A. G. Meeze, Redhill.
5910. Starting, &c., Apparatus for Vehicles, H. M. Martin, Lrndon.
5911. Brakes, H. M. Martin, London.
5912. Guides for the Rope of Rope-traction, Railways, &c., H. M. Martin, London.
5913. Tubular Lanterns, T. Phillips, Orillia.
5914. Metallic Alloys, G. A. Dick, London.
5915. Putting Designs upon Glass, W. H. Warren, London.
5916. Utilising Power derived from the Tide, E. G. Brewer.—(*L. M. Giustina, Italy.*)
5917. Telephonic Apparatus, J. D. Husbands, London.
5918. Saddles for Bicycles, &c., J. A. Lamplugh, Birmingham.
5919. Rotary Blowers, &c., W. Allday, jun., and E. Allday, Birmingham.
5920. Volumetric and Decanting Apparatus, W. H. St. Ruth, Liverpool.
5921. Cutting and Dividing Sheets of Metal, W. T. Beesley, Sheffield.
5922. Steam Engines, J. and J. Saxon, Openshaw.
5923. Gas Engines, C. M. Sombart, Germany.
5924. Electric Arc Lights, C. M. Sombart.—(*Buss, Sombart, and Co., Germany.*)
5925. Spring Hinges, J. S. Stevens and C. G. Major, London.
5926. Dynamo-electric Machines, S. Z. de Ferranti, London.
5927. Incandescent Electric Lamps, S. Z. de Ferranti, London.
5928. Gas Engines, E. J. C. Welch and R. C. Rapier, London.
5929. Ships' Logs, J. Campbell, London.
5930. Centrifugal Governors, W. Hartnell, Leeds.
5931. Portable Ladder, W. R. Lake.—(*E. Canziani, Milan, Italy.*)
5932. Wheels, E. Sarjeant, Birmingham.
5933. Securing Dangerous Structures, W. E. Heath, London.
5934. Tills, J. L. Edwards, London.
5935. Repeating Fire-arms, W. R. Lake.—(*A. Larson and C. E. Winterros, Belgium.*)
4936. Coating Electrical Cables, R. Punshon and W. Nicolson, London.

31st December, 1883.

5937. Block Ice, W. W. Nightingale, Southport.
5938. Coating Metal Plates, E. Morewood, Llanelly.
5939. Electro-motor Engines, F. H. Danchell, Maidstone.
5940. Water-closets, &c., J. C. Mewburn.—(*J. E. Boyle and H. Huber, New York, U.S.*)
5941. Metallic Packing, S. Perkins, Manchester.
5942. Lawn-mowing Machines, G. E. Newton, London.
5943. Slide Valve, H. Howaldt, Kiel, Prussia.
5944. Combination Steam-engine, H. Howaldt, Kiel.
5945. Governors, W. Hartnell, Leeds, P. W. Willans, Thames Ditton, and R. E. B. Crompton, London.
5946. Wheels, R. Hadfield, Sheffield.
5947. Preparing Photographs, G. Rydill, London.
5948. Galvanic Batteries, O. E. Woodhouse, F. L. Rawson, and A. R. Upward, London.
5949. Ornamental Fabrics, F. Walton, Twickenham.
5950. Generating Steam, J. W. Gill, Birmingham.
5951. Gas Motor Engines, H. Campbell, Leeds.
3952. Furnaces, J. Dempster, Elland.
5953. Self-feeding Eyeletting Machine, C. Whitfield, Kettering.
5954. Treating Oils, W. Green, Thanet.
5955. Carbon Filaments, D. Zanni and A. Shippy London.
5956. Gas Engines, E. G. Wastfield, Liverpool.
5957. Forging Nails, B. P. Walker, Moseley, and C. B. Ketley, Birmingham.
5958. Obtaining Ether, &c., from Alkali Waste, C. F. Claus, London.
5959. Obtaining Sulphur from Sulphuretted Hydrogen, C. F. Claus, London.
5960. Treating Mixtures of Sulphuretted Hydrogen, C. F. Claus, London.
5961. Wheeled Vehicles, H. F. Lloyd, Liverpool.
5962. Making White Lead, H. J. Haddan.—(*F. Schmoll, Cologne.*)
5963. Refrigerators, C. M. Sombart.—(*B. Moebius, Chihuahua, Mexico.*)
5964. Telegraphic, &c., Apparatus, D. Sinclair and J. L. Corbett, Glasgow.
5965. Bleaching Leather, &c., G. W. von Nawrocki—(*G. Levinstein, Wiesbaden.*)
5966. Signals, F. W. Durham and J. D. Churchill, London.
5967. Barrel-forming Machines, P. M. Justice.—(*F. Myers, Hamburg.*)
5968. Teaching the Use of the Rifle, W. E. Heath, London.
5969. Bleaching Distillable Oils, R. Baynes, J. Fearnside, and W. P. Thompson, Liverpool.
5970. Compressing Crops, P. McIntyre, Trewydyr.
5971. Dressing Stone, &c., W. and T. Brindle, Upholland.
5972. Busts, F. McIlvenna, Manchester.
5972. Overhead Telegraph Wires, J. S. Lewis, Birkenhead.
5974. Artificial Bone, &c., C. B. Warner.—(*L. Mestaniz, New York, U.S.*)
5975. Treating Leather Straps, C. B. Warner.—(*L. Mestaniz, New York, U.S.*)
5976. Motive Power Engines, W. W. Tonkin, London.
5977. Regulating the Supply of Air to Furnaces, W. C. Gale, Lower Tooting.
5978. Incandescent Electric Lamps, J. W. Swan, Bromley.
5979. Coke Furnaces, A. J. Boult.—(*Schlesiche Kohlen und Koks Werke, Gottesberg.*)
5980. Railway Rolling Stock, F. J. Brougham.—(*Gesellschaft fur Verwerthung von Erfindungen im Eisenbahnwesen, Berlin.*)
5981. Printers' Quoins and Locking-up Apparatus, G. H. F. Featherstonehaugh, London.
5982. Generation, &c., of Electricity, J. S. Williams, New Jersey, U.S.
5983. Generating, &c., Electricity, J. S. Williams, New Jersey, U.S.
5984. Generating, &c., Electricity, J. S. Williams, New Jersey, U.S.
5985. Drawing Instrument, A. J. Boult.—(*G. R. Schulz, Germany.*)
5986. Electro-motors, E. Haller, London.
5987. Incandescent Electric Lamps, L. Goldbird and A. L. Fyfe, London.
5988. Baths, M. Dray and J. Bernard, London.
5989. Endless Cable Railways, E. P. Alexander.—(*C. W. Rasmusen, Chicago, U.S.*)
5990. Making Lace, F. E. A. Büsche, Westphalia.
5991. Ornamental Fabrics, J. Yuill, Glasgow.
5992. Lighting Gas by Electricity, C. Clarke, Manchester.
5993. Floating Structures, F. W. Brewster, London.

Inventions Protected for Six Months on Deposit of Complete Specifications.

5852. Loom Shuttles, C. H. Nichols, Boston, U.S.—*24th December*, 1883.
5858. Driving Mechanism, A. J. Boult, London.—A communication from J. C. Tennent, Glyndon, U.S.—*24th December*, 1883.
5863. Ships' Port and Starboard Lights, W. R. Lake, London.—A communication from G. T. Parry, Philadelphia, U.S.—*26th December*, 1883.
5864. Working Engines, W. R. Lake, London.—A communication from H. E. Depp, Sadalia, U.S.—*26th December*, 1883.
5884. Greenhouses, E. M. Wood, Natick, U.S.—*28th December*, 1883.
5899. Arranging Tiles, &c., D. Clarke, Birmingham, and P. Shrapnel, London.—*28th December*, 1883.

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

5435. Moving Cylinder Steam Hammers, A. C. Wylie, London.—*24th December*, 1880.
5436. Furnaces, A. C. Wylie and T. Lockerbie, London.—*24th December*, 1880.
5504. Sulphate of Ammonia, W. L. Wise, London.—*31st December*, 1880.
5456. Rotary Pumps, G. Waller, London.—*28th December*, 1880.
5457. Blow-pipe Revolving Furnace, B. J. B. Mills, London.—*28th December*, 1880.
254. Self-feeding, &c., Furnaces, L. W. Sutcliffe, Birmingham.—*20th January*, 1881.
5446. Ordnance, Sir W. G. Armstrong, Newcastle-upon-Tyne.—*28th December*, 1880.
5493. Flanging Plates, R. H. Tweddell, London, J. Platt and J. Fielding, Gloucester, and W. Boyd, Newcastle-upon-Tyne.—*30th December*, 1880.
5471. Gas Motor Engines, R. Hutchinson, London.—*29th December*, 1880.
5477. Saddle-bars, Sir T. Dancer and E. Chappell, Malmesbury.—*29th December*, 1880.
5479. Motive-power, G. Graddon, Forest Hill.—*29th December*, 1880.
5508. Feeding Fibrous Substances on to Scribbling, &c., Machines, W. Fox and J. Hall, Leeds.—*31st December*, 1880.

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

5029. "Dropper" for Retaining Wires, W. P. C. Bain, Edinburgh.—*29th December*, 1876.
5012. Steam Engines, G. and J. Weir, Glasgow.—*28th December*, 1876.
5013. Water-meters, T. Kennedy, Kilmarnock.—*28th December*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition*, *18th January*, 1884.)

4074. Motors, A. J. Boult, London.—A communication from P. E. G. Jacomy.—*22nd August*, 1883.
4098. Ropes for Driving, W. White, Bingley.—*24th August*, 1883.
4116. Bullets, W. F. Bayliss and C. Brown, Birmingham.—*25th August*, 1883.
4163. Signalling, J. Enright, London.—*28th August*, 1883.
4181. Propelling Vessels, A. L. Ségond, Paris.—*30th August*, 1883.
4186. Extracting Metals from Minerals, &c., J. Bell and G. J. Davis, London.—A communication partly from J. P. Kagenbusch.—*30th August*, 1883.
4262. Baling Cotton, C. J. Ash, London.—A communication from A. E. Cummins.—*5th September*, 1883.
4264. Separating Glycerine from Fatty Substances, C. Rumble and F. Sear, London.—*5th September*, 1883.

4268. EXCAVATORS, W. F. Batho, London.—*5th September*, 1883.
4341. LAMPS, J. Hinks, Birmingham.—*11th September*, 1833.
4357. STEAM ENGINES, M. J. Brewer, Cardiff.—*12th September*, 1883.
4455. GAS, &c., ENGINES, H. J. Haddan, London.—A com. from M. V. Schiltz.—*18th September*, 1883.
4625. SIGNALLING between VESSELS, H. Gardner, London.—A communication from G. M. Mowbray.—*28th September*, 1883.
4857. SURGICAL INSTRUMENTS, C. H. Butlin, Camborne.—*12th October*, 1883.
5174. MOVING the POINTS of PERMANENT WAY, E. C. Urry, London.—*31st October*, 1883.
5354. UMBRELLAS, &c., C. H. Butlin, Camborne.—*13th November*, 1883.
5468. RIVETTED JOINTS, J. A. Rowe, North Shields.—*20th November*, 1883.
5496. PURIFYING WATER, W. Anderson, London.—*23rd November*, 1883.
5518. SCULLS and OARS, J. O. Spong, London.—*26th November*, 1883.
5834. FIXING FLOORING, G. Howard, Cricklewood.—*21st December*, 1883.
5852. LOOM SHUTTLES, C. H. Nichols, Boston, U.S.—*24th December*, 1883.

(*Last day for filing opposition, 22nd January*, 1884.)

4126. BEATING EGGS, &c., H. J. Newport, London.—*27th August*, 1883.
4134. SORTING, &c., GRAIN, T. Stevens, Kingston-on-Thames.—*27th August*, 1883.
4144. PLASTIC COMPOUNDS, H. H. Lake, London.—A communication from the Bonsilate Company, Limited.—*28th August*, 1883.
4151. TREATING HOPS, J. H. Johnson, London.—A communication from L. Boulé.—*28th August*, 1883.
4155. TRICYCLES, G. Singer, Coventry.—*28th August*, 1883.
4173. MARKING, &c., LENGTHS, C. A. Weckbecker and L. Schwabe, Manchester.—*29th August*, 1883.
4202. WRINGING, &c., LACE, J. M. Cryer and W. O. Matteson, Bolton.—*31st August*, 1883.
4203. VESSELS for BOILING FATTY MATTERS, J. and D. Bell, Bolton.—*31st August*, 1883.
4230. SPINDLES USED in BRAIDING MACHINES, W. Ashton, Manchester.—*3rd September*, 1883.
4248. CRUCIBLES, &c., H. E. Newton, London.—Com. from T. Egleston.—*4th September*, 1883.
4285. KILNS, W. Lawrence, London.—*6th September*, 1883.
4286. STRAINERS, W. Lawrence, London.—*6th September*, 1883.
4317. RAILS and SLEEPERS, J. A. R. Main and J. Dick, Glasgow.—*8th September*, 1883.
4427. IGNITING, &c., CARTRIDGES by ELECTRICITY, T. P. Wood, Bristol.—*15th September*, 1883.
4432. PAPER PULP or PAPER, H. J. Haddan, London.—Com. from C. Coster.—*17th September*, 1883.
4450. COOKING RANGES, D. Dow, Falkirk.—*18th September*, 1883.
4454. WRENCHES, H. J. Haddan, London.—A communication from A. J. J. Machen.—*18th September*, 1883.
4617. GENERATING, &c., ELECTRIC CURRENTS, W. Thomson, Glasgow.—*28th September*, 1883.
5445. INTERNALLY-STOPPERED BOTTLES, D. Rylands, Staisfoot, near Barnsley.—*19th November*, 1883.
5549. LOOMS for WEAVING, R. Hall and C. Ellis, Bury.—*27th November*, 1883.
5593. OBTAINING INFUSIONS, &c., from COFFEE, W. N. Hutchinson, Bideford.—*1st December*, 1883.
5619. TELEGRAPH, &c., WIRES, A. J. Boult, London.—Com. from G. Gray.—*3rd December*, 1883.
5644. SOLID NON-DELIQUESCENT PHOSPHATE of LIME, C. D. Abel, London.—A communication from F. Barbe.—*4th December*, 1883.
5858. DRIVING MECHANISM, A. J. Boult, London.—Com. from J. C. Tennent.—*24th December*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 28th December*, 1883.)

2715. WEDGE-SHAPED BALLOONS G. Wellner, Brünn.—*31st May*, 1883.
3223. DYNAMO-ELECTRIC, &c., MACHINES, L. F. Lamkin, London.—*29th June*, 1883.
3236. PULLEYS, &c., T. Smith, London.—*29th June*, 1883.
3248. COMBING WOOL, &c., J. H. Whitehead, Leeds.—*30th June*, 1883.
3251. DRILLING ROCKS, T. R. Jordan, London.—*30th June*, 1883.
3279. COATING TIN, &c., C. Stuart, Fenny Stratford.—*3rd July*, 1883.
3281. MOULDS for CASTINGS, J. McLaren, Stenhousemuir.—*3rd July*, 1883.
3283. SAFETY-VALVES, A. Turnbull, Glasgow.—*3rd July*, 1883.
3286. SPINNING, &c., FIBROUS SUBSTANCES, J. H. Clapham, T. R. Whitehead, and T. W. Wheelwright, Bradford.—*3rd July*, 1883.
3292. MARINE DANGER SIGNALS, A. D. Porter, Boston, U.S.—*3rd July*, 1883.
3336. GAS MOTORS, H. Holden, Manchester.—*5th July*, 1883.
3343. ARTIFICIAL FERTILISERS, T. W. B. Mumford, London.—*5th July*, 1883.
3374. TIP WAGONS, A. G. Margetson and W. S. Hek, Bristol.—*7th July*, 1883.
3380. TELEGRAPHIC &c., APPARATUS, D. Sinclair, Glasgow.—*7th July*, 1883.
3456. SEWING, &c., MACHINES, W. E. Gedge, London.—*13th July*, 1883.
3458. PORTABLE PLATFORM for SHEEP, J. Hornby, Watton.—*13th July*, 1883.
3493. MACHINE or BATTERY GUNS, H. S. Maxim, London.—*16th July*, 1883.
3512. WATER-CLOSETS, E. and A. E. Gilbert, Dundee.—*17th July*, 1883.
3520. SUPPORTING the DRAWING ROLLS used in SPINNING MACHINERY, W. R. Lake, London.—*17th July*, 1883.
3563. BARRELS for HOLDING LIQUIDS, C. L. Eyre, London.—*19th July*, 1883.
3785. SETTING, &c., TYPE, W. R. Lake, London.—*2nd August*, 1883.
4043. EXPLOSIVE COMPOUNDS, J. C. de Castro, London. *21st August*, 1883.
4552. WATER-METERS, A. E. H. Johnson, Washington, U.S. *24th September*, 1883.
4772. STOPPERS for BOTTLES, J. S. Davison, Sunderland. *8th October*, 1883.
4787. ELECTRICAL SYNCHRONOUS TELEGRAPHIC, &c., SYSTEMS, S. Pitt, Sutton.—*9th October*, 1883.
4805. BEARINGS for JOURNALS, &c., W. R. Lake, London.—*9th October*, 1883.
4843. MAKING GAS, E. Brook, Wigan.—*11th October*, 1883.
4879. TREATING GOLD ORES, &c., H. R. Cassel, London.—*13th October*, 1883.
5001. TELEGRAPH INSULATORS, H. J. Allison, London.—*20th October*, 1883.

(*List of Letters Patent which passed the Great Seal on the 31st December*, 1883.)

3065. ORNAMENTAL METALLIC FELLOES, T. Fox, Sheffield.—*20th June*, 1883.
3275. ELECTRICAL RAILWAYS, W. A. Traill, Portrush.—*2nd July*, 1883.
3277. ELECTRICAL TRAMWAYS, W. A. Traill, Portrush.—*2nd July*, 1883.
3284. CONSTRUCTING VESSELS for DYEING, &c., J. Woodcock, Huddersfield, and J. Coulter, Batley.—*3rd July*, 1883.
3294. PACKINGS for STUFFING-BOXES, C. Schnerzel, Berlin.—*3rd July*, 1883.
3301. FURNACE FRONTS, W. Douglas, Blaydon-on-Tyne.—*3rd July*, 1883.
3309. WATER WASTE PREVENTER, A. Tylor, London.—*4th July*, 1883.
3311. FLUSHING APPARATUS, D. G. Cameron, London.—*4th July*, 1883.
3313. REGISTER for TILLS, J. Imray, London.—*4th July*, 1883.
3316. TURNING BOLTS, &c., W. R. Lake, London.—*4th July*, 1883.
3321. FERMENTING BEVERAGES, F. Wirth, Frankfort.—*4th July*, 1883.
3322. ROTARY ENGINES, G. W. von Nawrocki, Berlin.—*4th July*, 1883.
3332. PORTABLE COTS, G. H. Needham, London.—*5th July*, 1883.
3334. ROCK-PERFORATING MACHINES, M. Macdermott and W. Glover, London.—*5th July*, 1883.
3335. COLLECTING VAPOURS EVOLVED in the MAKING of INDIA-RUBBER GOODS, C. A. Burghardt, Manchester.—*5th July*, 1883.
3341. METAL CASKS, A. Dunn and A. Liddell, London.—*5th July*, 1883.
3348. LOOMS, R. L. Hattersley and J. Hill, Keighley.—*6th July*, 1883.
0357. FLUTING CYLINDRICAL SURFACES, W. Robertson, Johnstone.—*6th July*, 1883.
3365. STAYS, &c., A. Whitehorn, Bristol.—*6th July*, 1883.
3397. CLARIFYING LIQUORS, H. H. Lake, London.—*9th July*, 1883.
3411. BREECH-LOADING FIRE-ARMS, G. B. de Overbeck, London.—*10th July*, 1883.
3445. PLANTING POTATOES, W. Dewar, Dundee.—*13th July*, 1883.
3475. CONTROLLING ELECTRICITY, J. Hopkinson, London.—*13th July*, 1883.
3495. CHEMICAL DEPOSIT CURRENT METERS, D. Salomans, Tunbridge Wells.—*16th July*, 1883.
3500. HORSE-RAKES, J. Howard and E. T. Bousfield, Bedford.—*17th July*, 1883.
3508. DECORATING GLASS ARTICLES, C. D. Abel, London.—*17th July*, 1883.
3517. FODDER, H. J. Haddan, London.—*17th July*, 1883.
3545. REFRIGERATOR, J. H. Johnson, London.—*18th July*, 1883.
3601. PURIFYING AIR, F. Windhausen, Berlin.—*23rd July*, 1883.
3608. TURNBUCKLES, A. W. L. Reddie, London.—*23rd July*, 1883.
3666. SHIPS, W. P. Thompson, Liverpool.—*26th July*, 1883.
3726. ORGANS, T. C. Lewis, London.—*30th July*, 1883.
4121. BRUSHES, J. Thompson, London.—*25th August*, 1883.
4234. STAMPING PLATES, R. Baillie, London.—*3rd September*, 1883.
4294. BARRELS of FIRE-ARMS, P. A. Bayle, Paris.—*6th September*, 1883.
4296. STEAM BOILERS, P. A. Bayle, Paris.—*6th September*, 1883.
4732. TRANSPORTING, &c., SENSITISED PHOTOGRAPHIC PLATES, J. E. Atkinson, Greenwich.—*4th October*, 1883.
4788. TELEGRAPHY, S. Pitt, Sutton.—*9th October*, 1883.
4943. COUPLING for SHAFTING, P. Brotherhood, London.—*17th October*, 1883.
4960. GAUGE GLASSES, A. M. Clark, London.—*17th October*, 1883.
4971. CUTTING FIBROUS MATERIALS, W. R. Lake, London.—*18th October*, 1883.

List of Specifications published during the week ending December 29th, 1883.

1827, 2d.; 1840, 6d.; 1913, 10d.; 1918, 8d.; 2028, 3s. 2d.; 2033, 6d.; 2055, 4d.; 2193, 1s. 6d.; 2312, 6d.; 2316, 2d.; 2318, 2d.; 2319, 6d.; 2331, 2d.; 2334, 4d.; 2335, 6d.; 2336, 6d.; 2337, 6d.; 2338, 6d.; 2339, 6d.; 2346, 2d.; 2347, 6d.; 2348, 2d.; 2352, 4d.; 2354, 1s.; 2355, 2d.; 2361, 6d.; 2365, 2d.; 2366, 2d.; 2374, 6d.; 2380, 6d.; 2388, 2d.; 2392, 2d.; 2401, 6d.; 2402, 2d.; 2403, 2d.; 2404, 2d.; 2415, 6d.; 2424, 6d.; 2425, 2d.; 2426, 2d.; 2442, 6d.; 2447, 6d.; 2449, 6d.; 2468, 4d.; 2566, 4d.; 3658, 2d.; 4008, 8d.

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

ABSTRACTS OF SPECIFICATIONS.

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

1827. THRASHING MACHINES, *J Coulson, Stamford.—11th April*, 1883. *2d.*

The object is to work the shakers of thrashing machines by four outside cranks or excentrics, and thereby use a plain straight shaft inside the machine, and also to actuate the shoes from the same cranks or excentrics.

1840. LUBRICATING APPARATUS FOR STEAM ENGINE CYLINDERS, &c., *T. Holland, New York.—11th April*, 1883. *6d.*

This relates to improvements on patent No. 3888, A.D. 1882, in which oil is introduced into a cup connected to a water chamber, and is forced therefrom by steam acting upon the water in the chamber and passes into a gauge glass or tube connected at its lower end with the engine cylinder, and it consists in using only one oil cup and one water chamber for supplying oil to two cylinders.

1913. DRIVING GEAR, *F. Jenkin, Edinburgh.—14th April*, 1883. *10d.*

The object is to diminish the loss by friction in transmitting power by gearing. In one form a small smooth roller works between two smooth rollers, the three being pressed together by the internal surface of a ring or wheel.

1918. APPARATUS TO BE EMPLOYED IN HARMONISING MELODIES, &c., *B. S. Maitland, London.—16th April*, 1883. *8d.*

This relates to apparatus for harmonising melodies, modulating, analysing, and effecting other operations in connection with the science of harmony, such as finding any given chord in any key, giving the attendant keys to any tone, transposing music, or giving intervals.

2028. APPARATUS AND PROCESSES FOR GENERATING REGULATING, AND MEASURING ELECTRIC CURRENTS, *Sir W. Thomson, Glasgow.—21st April*, 1883. *3s. 2d.*

The armature consists of radial bars of copper arranged about a vertical or horizontal axis insulated from each other throughout their length and connected at their outer ends by a copper band. The inner ends are each connected to an insulated commutator strip. The sectional area of each radial bar is maintained constant by increasing them in width correspondingly to their decrease in thickness as they approach the axis of the armature. The insulated commutator bars form a hollow cylinder surrounding the vertical shaft, and are held in place by a spring ring secured in turn by a heavy gun-metal ring screwed down on it; this ring serves also to counteract the effects of centrifugal force on the radial bars. The two semicircular field magnets are supported vertically by a framework in such a position as to allow of the passage of the armature between their movable pole pieces. Special means for lubricating are described and illustrated. The driving belt is kept tight by supporting the generator on wheels or on rocking curves placed on inclined surfaces. The invention further relates to a potential regulator consisting of a shallow drum mounted on a vertical axis and partly filled with oil. A pair of toothed wheels gearing together are mounted on a frame which permits of their falling to either side of the position of rest, and so gearing with the surface of the oil. The motion of the wheels is communicated through shafts and pulleys, the motion of the frame being effected by any suitable electric or electro-magnetic appliances. When the regulator is used to control an electric light installation on the incandescent system the extinction of the lights is effected by automatic gradual insertions of resistances. In a current integrator a one-wheel carriage is used in combination with a horizontal disc which is kept rotating uniformly. In a modified integrator a gyrostatic system is employed, which is also applicable as a speed indicator. To measure the current two coils of thick copper rod have a needle suspended centrally between them, the stability of the needle in its zero position being regulated by an electro-magnet. Various other forms of integrators and meters are described and illustrated.

2033. APPARATUS FOR DELIVERING PREPAID GOODS, *J. G. Sandeman and P. Everett, London.—21st April*, 1883. *6d.*

The main object is to automatically deliver post-cards and stamped envelopes with a blank enclosure to persons depositing, say, a penny or twopence in a slit or slits prepared for the reception of such coin. The coin in entering falls on a lever and allows one of a pile of cards or envelopes to be delivered outside the case enclosing the apparatus.

2055. METALLIC OXIDES, *H. A. Bonneville, Paris.—23rd April*, 1883.—(*A communication from L. C. E. Faucheux, France.*) *4d.*

This consists in the manufacture of metallic bases and oxides, and the utilisation of the sulphuric acid produced. Any kind of sulphide or sulphure is treated with steam.

2115. INSULATORS OR APPARATUS FOR CARRYING OVERHEAD ELECTRIC TELEGRAPH OR OTHER WIRES, *J. S. Lewis, Birkenhead.—25th April*, 1883. *6d.*

In a terminal insulator a central vertical rounded bearing is used for the line wire, the shackle being attached by a horizontal bearing. In a drop insulator a hooked tongue-piece is so arranged as to tighten the line wire by a screwing motion.

2147. GENERATION, STORAGE, REGULATION, DISTRIBUTION, AND UTILISATION OF ELECTRICITY AND APPARATUS THEREFOR, &c., *J. S. Williams, Riverton, N.J., U.S.—27th April*, 1883. *4s. 6d.*

It would be impossible with the space at our disposal to give a satisfactory abridgment of this specification, which contains 116 pages of description and eight sheets of drawings.

2193. RAILWAY BRAKE APPARATUS, *B. J. B. Mills, London.—1st May*, 1883.—(*A communication rom D. Torrey, New York, U.S.*) *1s. 6d.*

Relates to means for transmitting stress from the draw-bar to the brake mechanism, the parts being so arranged that there can be no transmission of the stress except when the established movement of the car is to be arrested. The brakes may be actuated by hand, electro-magnetic, or air-pressure appliances.

2200. APPARATUS FOR INDICATING THE DIVERGENCE OF MAGNETISED NEEDLES, *G. C. Cooke, Sutton, Surrey.—1st May*, 1883. *6d.*

This consists in combining with a main magnetic needle a number of subsidiary magnets lying in a zone of opposite induced divergence and outside the area of mutual astatic influence, so arranged that they shall be affected by a divergence opposite to that of the main needle, a comparison of the two divergencies indicating the true terrestrial magnetic meridian.

2268. APPARATUS FOR MEASURING THE STRENGTH OF ELECTRIC CURRENTS, *F. V. Anderson, London.—4th May*, 1883. *6d.*

A magnetised needle is deflected by electro-magnets in opposition to a spring, and moves over a graduated dial.

2280. DYNAMO-ELECTRIC MACHINES AND ELECTRO-MOTORS, *Sir C. T. Bright, London.—4th May*, 1883. *6d.*

The coils of the armature and field magnets are both stationary, the latter being wound on fixed hollow cores through which an iron or steel shaft, divided by a non-magnetic partition between the coils, passes. The divided ends of the shaft are segmentally formed, and so shaped that the outer ends of the segments revolve in the same plane. The outer ends of the shaft are carried in gun-metal plummer blocks. The armature is formed of a circular series of insulated coils arranged in close proximity to the outer parts of the segments, which are shaped to correspond with the armature. This may consist of a number of electro-magnets or be of the ring type. Or a soft iron ring may be used, having radially fixed on its interior a number of rectangular coils, the cores of which, in cross section, are similar to a double-headed girder. In the commutator the ends of the armature coils are connected to divided insulated metallic plates cylindrically mounted. Corresponding with, and adjacent to these are other insulated non-divided cylinders connected to the positive and negative poles of the generator. Circular metallic brushes revolving on their own axis make contact between the two cylinders.

2281. METHOD OF AND APPARATUS FOR DEPOLARISING ELECTROLYTIC BATHS IN THE REFINING AND DEPOSITION OF METALS, *A. M. Clark, London.—4th May*, 1883.—(*A communication from C. de Changy, Levallois Perret (Seine) France.*) *6d.*

The "depolariser' consists of an armature and two electro-magnets, one of high and the other of low resistance. The bath circuit is broken until the "machine charges itself" sufficiently to overcome the high resistance magnet, and thus complete the circuit. The static charge of the bath is discharged by the armature vibrating between make-and-break contact points.

2302. SADDLE BARS, *J. W. Clarke, Guisborough.—7th May*, 1883. *6d.*

This relates to the construction of parts whereby the stirrup leather is firmly held whilst the rider retains his seat, but is instantly liberated from the front, back, and over or across the back of a horse in the event of the latter falling or of the rider being thrown.

2305. MANUFACTURE OF WALL COVERINGS, *S. Fisher, Herne Hill.—7th May*, 1883. *2d.*

This relates to a wall covering made of textile fabric and finished in oil colours, in lieu of paper hangings.

2306. SAFETY VALVES FOR STEAM BOILERS, *H. J. Haddan, London.—7th May*, 1883.—(*A communication from E. Delsart, Auzin, France.*)—(*Not proceeded with.*) *2d.*

This relates to the general construction of safety apparatus.

2307. SELF-ACTING APPARATUS FOR REGULATING THE FEED OR SUPPLY OF WATER INTO STEAM BOILERS, &c., *W. White, Hackney.—7th May*, 1883. *6d.*

The object is the regulation of the feed or supply of water into steam boilers by a self-regulating apparatus, so as always to keep the water in the boiler at one level so long as injection pump acts.

2308. APPARATUS FOR HEATING OR COOLING LIQUIDS, CONDENSING STEAM, &c., *J. Price, jun., Liverpool.—7th May*, 1883. *6d.*

This relates to improvements on patent No. 452, of 1879, and is designed to simplify the cost of making the apparatus, to ensure of the ends of the tubes forming the chambers making tight joints with their end plates and covers, and to facilitate the taking apart of the apparatus for the purpose of cleansing same or renewing parts thereof.

2310. FASTENINGS FOR GLOVES, BRACES, &c., *G. P. Lemprière, Balsall Heath.—7th May*, 1883.—(*Not proceeded with.*) *2d.*

This relates to a hook-and-eye arrangement.

2309. APPARATUS FOR SCRAPING OR CLEANING THE BOTTOMS OF SHIPS, &c., *J. Fishwick, Barnstaple.—7th May*, 1883. *6d.*

This relates to apparatus for scraping or cleaning bottoms of ships or vessels, in which a buoyant and preferably flat mass, provided with transverse scraping edges, points, or bars, is dragged to and fro longitudinally against the under surface of the hull between guide chains, or between the bow or stem and a guide chain.

2311. APPARATUS FOR CONTROLLING AND REGULATING THE FLOW OR PASSAGE OF GAS, &c., *G. P. Lemprière, Balsall Heath.—7th May*, 1883. *6d.*

The object is to regulate and control—preferably at a distance—the flow of gas and other fluids to gas and fluid meters and services, whereby only a determinate or fixed amount of gas or other fluid is allowed to pass from the principal main or supply pipe to the meter or service.

2312. ILLUMINATING GAS, &c., *H. C. Bull, Brooklyn, U.S.—7th May*, 1883. *6d.*

The essential features are the use of coal pulverised to an impalpable powder and depulverised, mixed and charged with tar, and treated in an upright retort in which the coal lies undisturbed during the process, and is resolved into a solid mass of coke. A pulveriser is employed for reducing the coal, a conveyor for elevating and desulphurising the coal, a mixer for mixing it with tar, and a travelling closed charging hopper for conveying the coal to the vertical retorts.

2313. WARMING THE CARRIAGES OF RAIL AND TRAMWAYS, &c., *T. Perkins, Hitchin.—7th May*, 1883.—(*Not proceeded with.*) *2d.*

This relates to means for warming railway carriages by steam supplied from the locomotive.

2316. PACKING AND PRESERVING SENSITIVE PLATES, *B. J. B. Mills, London.—7th May*, 1883.—(*A communication from A. Lumière, Lyons.*)—(*Not proceeded with.*) *2d.*

The plates are placed in grooves formed by the corrugated sides of a metallic box, which is fitted with a tight fitting cover, so that the plates are protected from the light.

2318. CONSUMING SMOKE AND ECONOMISING FUEL IN STEAM BOILER AND OTHER FURNACES, &c., *H. C. Paterson, Glasgow.—8th May*, 1883.—(*Not proceeded with.*) *2d.*

This consists in making the ashpit of furnaces so that it can be drawn out for the purpose of regulating the admission of air.

2319. SPINNERS AND FLYERS OF SPINNING FRAMES, *D. Skeoch, Stewarton, N.B.—8th May*, 1883. *6d.*

The object is to ensure the flyers of spindles or spinning frames at all times remaining true or concentric with the axis of the spindles on or with which they rotate, and it consists in forming the spindle with a continuous conical surface extending from the base of the screw downwards over and out to the full diameter of the collar, so that no ledge or projection or flat seat is left, and also so that as the conical hole in the flyer wears it has a conical surface of larger diameter on the spindle to rest or bear upon.

2320. SUBMARINE TORPEDO BOAT, *J. Davies, Farnborough.—8th May*, 1883.—(*A communication from P. B. Walker and H. G. Riggs, Sydney.*) *6d*

The object is to construct torpedo boats capable of travelling under water with passengers or crew, and of continuing under water at any necessary depth, and carrying, fixing, and firing torpedoes while under water.

2321. MANUFACTURE OF ARTIFICIAL STONE FOR VARIOUS PURPOSES AND MATERIAL APPLICABLE AS A SUBSTITUTE FOR EMERY, *B. Hess, Bayreath.—8th May*, 1883. *4d.*

The artificial stone consists of serpentine (or kindred minerals), soapstone, feldspar, mica, quartz, and fire-clay, or some of these, variously combined according to the purpose for which the stone is intended. These substances are pulverised, mixed, and moistened, and after having been pressed into the required forms are burned at a white heat.

2323. MANUFACTURE OF COLOURED PHOTOGRAPHIC PICTURES, *J. Adams, jun., Liverpool.—8th May*, 1883.—(*Not proceeded with.*) *2d.*

This relates to improvements in the whole process.

2325. PEDAL HARP WITH DOUBLE ACTION, *H. J. Haddan, London.—8th May*, 1883.—(*A communication from E. Meyer and Co., Germany.*) *6d.*

This relates to a mechanical arrangement for the shortening of the strings.

2326. PROCESSES FOR PURIFYING GLYCERINE, *H. J. Haddan, London.—8th May*, 1883.—(*A communication from C. Moldenhauer and Dr. C. Heinzerling, Frankfort-on-the-Main.*) *4d.*

The process has for its object to completely purify glycerine from common salt, soda, and volatile organic acids, while the substances thus eliminated are at the same time recovered as bye-products.

2327. APPARATUS FOR HOLDING AND FACILITATING THE DELIVERY OF TOILET PAPER, *M. Hart, London.—8th May*, 1883.—(*Not proceeded with.*) *2d.*

This relates to means for holding and unrolling the paper.

2328. POLES FOR LAWN TENNIS NETS, *S. C. Davidson, Belfast.—8th May*, 1883. *2d.*

This relates to means for making fast the net rope to the poles when it is drawn up to its correct height between them.

2329. STAND FOR HOLDING TENNIS RACKETS AND BALLS, *S. C. Davidson, Belfast.—8th May*, 1883.—(*Provisional protection not allowed.*) *2d.*

This relates to the general construction of the stand.

2330. MAGNETO-ELECTRIC AND DYNAMO-ELECTRIC MACHINES AND MOTORS, *A. Clark, Glasgow.—8th May*, 1883.—(*Not proceeded with.*) *2d.*

The armature cores are made of S shape in cross section, so as to present a large extent of surface on which the coils are wound. The field magnets are elliptical, and fitted together around the armature with their like poles adjacent, the internal surfaces tapering inwards towards the poles, and receding from the axis at the part between the poles.

2331. MICHROPHONES OR TELEPHONES, *E. G. Brewer, London.—8th May*, 1883.—(*A communication from R. Weber, Neuchatel, Switzerland.*)—(*Not proceeded with.*) *2d.*

In a michrophone a number of plates connected to one another as in electric batteries are made to vibrate. In the circuit of a telephone a tuning-fork set in vibration causes, by the changes of contact, fluctuations in the telephone.

2332. SHEDS FOR THE PROTECTION OF RICKS, *T. Colby, Pantyderi, Blaenffos.—8th May*, 1883. *6d.*

This consists in arranging the roof sections to rise by rotating about their supports.

2333. APPARATUS FOR EVAPORATING SALTS, BRINES, &c., *W. T. Whiteman, London.—8th May*, 1883.—(*A communication from H. Frasch, Cleveland, U.S.*) *6d.*

This refers more particularly to the manufacture of salt from the brine of natural wells or springs, although it is in part applicable to the evaporation of other brines and the recovery of salt therefrom, to the recovery of other crystallisable substances from their solutions, and to the evaporation of liquids generally.

2334. PROCESS FOR THE MANUFACTURE OF VEGETABLE OILS, *C. F. Stollmeyer, London.—8th May*, 1883. *4d.*

The seeds or other oleaginous vegetable substances are placed in a closed vessel with water, and heated until a pressure of 75 lb. per square inch is attained, which is maintained for twelve hours. The pulp produced is run off and allowed to settle, the oil being then collected from the top. The solid matter is then pressed to remove the remaining oil.

2335. APPARATUS FOR LIGHTING BY GAS, *D. W. Sugg, Westminster.—8th May*, 1883. *6d.*

The object is to produce a gas flame in which the portion of highest illuminating power shall be at the bottom. The apparatus employed will be above the flame which burns downwards in a sealed globe surrounding the burner and fitted to a cylindrical pendent holder, the products of combustion being carried off by a chimney standing up through the holder. The burner is preferably of the Argand form, and is secured in an inverted position in an annular space in a hollow cylindrical casting. Within the burner the chimney is fitted. Above the holder, and between the chimney and the burner, air enters to support combustion.

2336. LOCKS OR FASTENINGS FOR RAILWAY CARRIAGE AND OTHER DOORS, *H. Parkin and C. J. Reynolds, London.—8th May*, 1883. 6*d*.

This relates to the construction of latch locks with springs so applied as to retain the latch in either the locked or unlocked position, and with two inclines upon the striking plate, one to raise and the other to press the latch downwards.

2337. ELECTRIC LAMPS OR LIGHTING APPARATUS, *A. Shedlock, New York, U.S.—8th May*, 1883. 6*d*.

Relates to an arc lamp in which the feed is controlled by a clamp, consisting of a spiral spring having its coils closely wound and its free ends projecting at right angles to its axis. The movement of a plate, suspended by three links so as to move helically, operated by an electro-magnet, actuates the spring. The invention further relates to the style of globe and method of securing it to the lamp, and to means for raising and lowering the lamp.

2338. ELECTRIC TRAMWAYS AND VEHICLES TO BE USED THEREON, *H. H. Lake, London.—8th May*, 1883.—(*A communication from C. Baston, Lisbon.*) 6*d*.

The conductors are placed in a trench provided with a cover having a small longitudinal slit to permit the passage of the sliding contact pieces. The arrangements are also applicable to traction with special wheels for steep inclines, in which case special vehicles are employed.

2339. DYNAMO-ELECTRIC MACHINES, *H. H. Lake, London.—8th May*, 1883.—(*A communication from C. H. Palmer and A. M. Loryea, New York, U.S.*) 6*d*.

The polar projections of the field magnet surround the armature, and are bolted together at the neutral parts. At the junction of the parts, or in projecting brackets, spherical bush bearings for the shaft are formed. The coils are wound and connected in the ordinary manner. The armature is built up of a number of flat iron rings insulated from each other by washers of paper-board and felt; the rods for holding the rings together pass through tubes of insulating material. The commutator is composed of two series of plates arranged to break joint.

2342. APPARATUS FOR CUTTING DOUBLE WOVEN PILED FABRICS, *R. Hitchcock, New York.—8th May*, 1883.—(*Not proceeded with.*) 2*d*.

This relates to apparatus for cutting double woven piled fabrics, so as to divide the web into two layers each presenting a pile.

2344. APPARATUS FOR SIGNALLING MECHANICALLY IN VESSELS OR IN MINES, &c., *R. Chipperfield, Clerkenwell.—8th May*, 1883. 6*d*.

This consists in connecting the signalling handle and the receiving index of each instrument to the intermediate gear which connects the two instruments by shifting bevel gear or clutches, or their equivalents, so arranged that the act of engaging the handle of either instrument disengages the index of that instrument, and that the act of stopping the handle of a signal disengages it and re-engages the index, a single set of intermediate connecting gear being thus utilised both for sending a signal and for communicating its repetition.

2345. REPEATING FIRE-ARMS, AND CARTRIDGE MAGAZINES THEREFOR, *C. D. Abel, London.—8th May*, 1883.—(*A communication from F. Mannlicher, Vienna.*) 6*d*.

This relates, First, to improvements on patent No. 3774, A.D. 1882, and consists in dispensing with the hinged feeder and curving the front end of the magazine upward, so that as the cartridges are pushed forward by a rear spring they rise gradually to a horizontal position, and are pushed by the breech bolt into the breech chamber; and, Secondly, to detachable cartridge magazines in the shape of a parallelogram of narrow rectangular cross section, and arranged to project either upwards or downwards from the side of the breech chamber.

2346. APPARATUS FOR GIVING AN ALARM AND IGNITING A LAMP AT ANY DESIRED TIME, *E. Edwards, London. 8th May*, 1883.—(*A communication from A. Richard Morey, France.*)—(*Not proceeded with.*) 2*d*.

This relates to apparatus connected with any ordinary alarum clock, in such manner that at any time previously determined, an alarm is given by the sound of which a sleeper is awakened, and at the same time a lamp is ignited.

2347. REMOVABLE PROTECTING COVER FOR ACCOUNT BOOKS, &c., *H. J. Fitch, London.—8th May*, 1883. 6*d*.

This relates to a removable protecting cover constructed of two sides or boards hinged to a back and having inner flaps hinged to them, the sides or boards and the inner flaps being adapted to receive the permanent sides or boards of the book between them and combined with suitable locking devices.

2348. REAPING MACHINES, *M. Jenkinson, Grantham.—9th May*, 1883.—(*Not proceeded with.*) 2*d*.

This relates to improvements in or additions to reaping machines to facilitate the tying or binding of the sheaves.

2349. DECOMPOSING AND TRANSFORMING FATS OR FATTY SUBSTANCES INTO FATTY ACIDS AND GLYCERINE, *A. Marix, Paris.—9th May*, 1883. 8*d*.

This relates to improvements on patent No. 2559, A.D. 1882. It consists in the use of a neutral substance acting purely as a mechanical agent for opening up the molecules and breaking through the albuminous film surrounding the same. An apparatus is described and a vacuum is employed for facilitating the operation, for facilitating the separation of the stearine or stearic acid from the oleine and glycerine, for purifying and filtering the glycerine, and for evaporating the water from the glycerine.

2352. MANUFACTURE OF ARTIFICIAL STONE AND CEMENT, *E. S. Shepherd, London, and J. L. Aspinwall, Mantle Vale.—9th May*, 1883. 4*d*.

This relates to the utilisation of slate in the manufacture of artificial stone and cement.

2354. A NEW APPLICATION OF MOLTEN METALS, &c., *O. Trossin, London.—9th May*, 1883. 1*s*.

The object is to employ gas or steam as a moving power by means of fluid metal.

2355. APPARATUS TO BE APPLIED TO THE OUTSIDE SEATS OF TRAMWAY CARS AND FOR OTHER SIMILAR PURPOSES, *H. C. Clanahan, Manchester.—9th May*, 1883.—(*Not proceeded with.*) 2*d*.

The object is to provide a waterproof covering which can at any time be drawn up over the seat when the latter is damp.

2357. RAILROAD AND OTHER LOCOMOTIVES, *M. Benson, London.—9th May*, 1883.—(*A communication from C. Rothrock, Pennsylvania.*) 8*d*.

The locomotive has a twin boiler composed of two parallel sections with smoke flues, and communicating at their front ends with a fire-box. A passage is left between the two sections for the engineer and the store fuel, and at the sides of the passage are water tanks, which may also form the floor of the passage and extend across the latter above the line of the boiler in rear of the engine-room, so as to form a roof and tanks of large capacity.

2365. BEARINGS FOR BICYCLE PEDALS, MILLING MACHINERY, &c., *J. E. Price, Wrexham.—9th May*, 1883.—(*Not proceeded with.*) 2*d*.

This relates to the employment of a cap to prevent the entry of dust to the bearing.

2361. CONSTRUCTION OF DRY OR GRAVING DOCKS AND GRIDIRONS, &c., *J. Walsh, Cardiff.—9th May*, 1883. 6*d*.

This relates to constructing dry or graving docks with side walls having overhanging portions or "dolphins," whereby vessels may be supported without shoring; increased accommodation is afforded, and access to the bottoms and sides of the vessels for inspection and repair is facilitated.

2366. EASELS, *A. Tuck, London.—9th May*, 1883.—(*Not proceeded with.*) 2*d*.

The easel is made of cardboard, papier maché, or other pliable substances.

2369. INCANDESCENT ELECTRIC LAMPS, *J. Warner, London.—9th May*, 1883.—(*Not proceeded with.*) 2*d*.

The tubular part of the lamp is closed by a vulcanite plug, a tight joint being made by a rubber ring partly contained in a recess formed in the tubular neck.

2374. CONSTRUCTION OF GARDEN FRAMES, *W. Wright and T. Holmes, Birmingham.—10th May*, 1883. 6*d*.

This relates, First, to the mode of attaching the sashes to the frames; Secondly, to improvements in the glazing bars; and Thirdly, to an improved ventilator.

2376. PREVENTING THE CORROSION OF WATER PIPES, &c., *J. B. Hannay, Glasgow.—10th May*, 1883. 4*d*.

This consists in preventing the corrosion of water pipes by causing an electric current to pass through the metal of the pipe in such a manner as to render the metal relatively electro-negative. The pipe is connected to the negative pole of a battery or dynamo machine, the positive pole of which is connected to a carbon electrode placed in the water inside the pipe. The outside of the pipe is protected by a shunt or separate conductor from the positive pole connected to a piece of carbon embedded in the earth near the pipe.

2377. APPARATUS TO BE APPLIED TO MILL STONES AND ROLLER MILLS, *G. Davies, Manchester.—10th May*, 1883.—(*A communication from J. S. Stark, Constantinople.*) 6*d*.

The object is to prevent millstones and roller mills from running empty by giving an automatic alarm, and it consists in the use of a bell or gong put in action by a battery, the contact between the pole being made by means of an armature of platinum or other suitable metal. The grain, as it is fed into the mill, falls upon a disc placed in the hopper and connected with a spring or weighted contact device, so that when the supply of grain ceases the circuit is closed and the alarm sounded.

2380. MACHINES FOR CRUSHING, BREAKING, OR GRINDING STONE, &c., *S. Mason, Leicester.—10th May*, 1883. 6*d*.

Upon a shaft, preferably vertical, is a conical crusher head surrounded by a cylindrical jamb, which may, however, be tapered if required; both head and jamb are fluted in any required manner or direction.

2388. SIGHTING APPARATUS FOR ENSURING ACCURACY OF AIM, *H. P. Miller, London.—10th May*, 1883.—(*Not proceeded with.*) 2*d*.

This relates to an opaque fixed plate fitted in a suitable frame and having therein an aperture through which aim is taken. A revolving disc is pivotted to such fixed plate, which is perforated with a series of sight holes.

2392. HOLDERS FOR CIGARS AND CIGARETTES, *J. L. Hancock, London.—10th May*, 1883.—(*Not proceeded with.*) 2*d*.

This relates to an appliance for firmly securing the cigar or cigarette in the holder.

2394. DISTILLING APPARATUS, *A. Marix, Paris.—11th May*, 1883. 6*d*.

This relates to improvements in distilling apparatus, and consists in the construction and arrangement of the parts so as to obtain, first, a rapid circulation of the matter under treatment through pipes, so that the fluid is discharged in more or less finely divided spray on to a sieve, whereby it is further subdivided while being acted upon by superheated steam, and under the employment of a continuous vacuum. Secondly, a thorough agitation of the matter whilst being acted upon by superheated steam, and whereby a continuous vacuum is employed so that a rapid distillation is achieved at a low temperature, and so that mineral oils, chemicals, and other substances can be distilled rapidly, economically, and at a lower temperature than hitherto; and, thirdly, a rapid distillation of volatile fluids at a low temperature, thus retaining the natural flavour, whilst the lower temperature and continuous vacuum enable pure distilled liquid to be produced, leaving the fusel oil or other less volatile matter behind.

2398. MOULDING OR CASTING RAILWAY CARRIAGE AND TRUCK WHEELS, &c., *E. de Pass, London.—11th May*, 1883.—(*A communication from J. D. Delille, Paris.*) 6*d*.

The mould is formed by building up on a horizontal plate, first, a portion of the hub and a portion of the lugs to receive the iron spokes which may be cast in if desired; and secondly, the other parts which, when fixed to a sand box or frame, and rammed with sand, and the parts forming the metal pattern withdrawn from the mould, present the required shape of wheel mould in sand, the outside of which is chilled by means of a suitably constructed chilling piece.

2401. CARTRIDGE HOLDERS OR MAGAZINES FOR USE WITH BREECH-LOADING FIRE-ARMS, *T. Nordenfelt, London.—11th May*, 1883. 6*d*.

The cartridge holder or magazine is formed with two side plates held at such a distance apart, that a row of cartridges may be placed between them with the heads of all the cartridges lying in the same direction and one directly above the other.

2402. WHEELS FOR VEHICLES, *J. C. Merryweather, Greenwich.—11th May*, 1883.—(*Not proceeded with.*) 2*d*.

The object is to prevent the wheels of vehicles "skidding" when crossing tramway lines or other irregularities or obstructions in the road.

2403. MANUFACTURE OF LACE BLINDS, *W. Dow and T. Frame, Glasgow.—11th May*, 1883.—(*Not proceeded with.*) 2*d*.

This refers to the manner of manufacturing and finishing lace fabrics, as and for Holland blinds.

2404. HOLDER FOR SUSPENDING LAWN TENNIS BATS FROM THE WAIST, *W. G. Attree, London.—11th May*, 1883.—(*Not proceeded with.*) 2*d*.

This relates to metal clips attached to the handles and attached to a cord or girdle.

2408. ORGANS AND SIMILAR WIND INSTRUMENTS, *A. Gern, Notting Hill.—11th May*, 1883. 6*d*.

This relates to means of working the stops and valve of wind instruments, and of providing, when required, wind at different degrees of pressure for different stops. The bellows is loaded, so that when being distended it contains air at atmospheric pressure, and when it collapses it contains air at a higher pressure.

2414. LAMPS FOR BURNING OIL, &c., *J. Matthews, London.—12th May*, 1883. 6*d*.

This consists in constructing lamps, so that a column of the oil to the burner or subsidiary reservoir is supported by the combined weight of a weighted piston and a column of oil in a lower reservoir, the last column being maintained always at the same height by a self-acting supply from an upper reservoir, by which means the oil in the burner or subsidiary reservoir attached thereto is also always maintained at the same level.

2415. APPARATUS FOR DISINFECTING RAGS, &c., *J. Illingworth, Batley.—12th May*, 1883. 6*d*.

This relates to the use and employment of a rotary cage working within a heated chamber supplied with a disinfectant.

2424. CONSTRUCTION OF TEAPOTS, &c., *J. Ridge, Sheffield.—12th May*, 1883. 6*d*.

The teapot is constructed with a fixed perforated false bottom within a short distance from the bottom of the pot or vessel, and preferably strengthened by ribs on the underside. The opening to the spout is made between the perforated and the solid bottom.

2425. WATER-CLOSETS, *T. Parkinson, jun., Blackburn.—12th May*, 1883.—(*Not proceeded with.*) 2*d*.

This relates to apparatus for flushing water-closets.

2426. PICKERS EMPLOYED IN WEAVING, *R. Lister, Keighley.—12th May*, 1883.—(*Not proceeded with.*) 2*d*.

This consists in constructing pickers employed in weaving of hide known in the trade as "sizing," and with metal picker spindle slides secured in the openings formed in the pickers, and firmly secured to the side projections of the pickers.

2442. PLATES FOR SECONDARY BATTERIES, *W. Hochhausen, New York, U.S.—15th May*, 1883. 6*d*.

To obtain an intimate admixture of the lead and its oxide in the construction of electrodes, red lead or litharge is stirred into molten lead while in a semi-liquid condition. The supports may consist of lead plates channelled transversely on both sides with V-shaped grooves, in which red lead, or the oxide of lead mixed with lead, is placed.

2447. HYDRAULIC PUMPING APPARATUS, *J. Moore, San Francisco.—15th May*, 1883. 6*d*.

This relates partly to the combination of two pump barrels placed in the same line, with a compound tubular plunger, with a foot or suction valve in the first or lower barrel and with a check valve in the plunger, the part of the plunger working in the lower barrel being of double the effective area of the part working in the second or upper barrel, to which last the ascension or discharge pipe is connected.

2449. MACHINERY OR APPARATUS FOR RINGING BELLS, *E. Edwards, London.—15th May*, 1882.—(*A communication from R. Latowski, Silesia.*) 6*d*.

This relates to the general construction of apparatus which is actuated by steam, air, or gas.

2467. GUMMING APPARATUS, *C. Pieper, Berlin.—17th May*, 1883.—(*A communication from J. E. Parmentier, Prussia.*) 6*d*.

This consists of a receptacle with elastic walls, and adapted to be tightly closed, and provided with one or more small orifices, by which, when a pressure is brought to bear on the walls, the adhesive liquid contained in the receptacle will issue, and may then be spread out by the apparatus itself on the surface to be gummed.

2468. WOOL WASHING APPARATUS, *J. Imray, London.—17th May*, 1883.—(*A communication from La Société Boca-Wulvérijck frères, Paris.*) 4*d*.

This relates to means of opening and subdividing the masses of wool while they are advancing in the bath, so that the separate fibres become more rapidly and completely cleansed.

2471. EVER-POINTED PENCIL CASES, &c., *W. Wiley, Birmingham.—17th May*, 1883. 6*d*.

By pressing on the top of the holder the part carrying the writing material can fall by its own weight, and when the pressure is removed is held firmly in the position it then occupies. By inverting the holder the writing material will, when pressure is applied to the top of the holder, fall inside the outer case.

2494. MULTIPLE CYLINDER ENGINES, *P. Brotherhood, London.—18th May*, 1883. 6*d*.

This relates to multiple cylinder engines of the kind in which two or more cylinders radiate from a central cavity in which a single crank revolves, connecting-rods for the pistons of the cylinders being linked directly to the crank.

4254. MACHINERY FOR ORNAMENTING METALLIC TUBES, &c., *J. Earle and G. Bourne, Birmingham.—4th September*, 1883.—(*Complete.*) 6*d*.

This relates to the employment of dies as stampers.

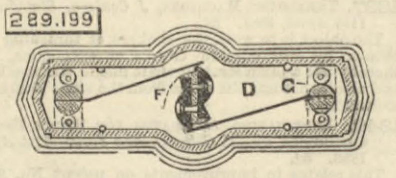
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

289,199. ELECTRIC CIRCUIT BREAKER, *Edward Weston, Newark, N.J.—Filed November 25th*, 1882.

Claim.—(1) The combination, with contact springs, of a revolving metal plate, and insulating pieces of irregular conformation secured to the sides of the plate in line with the axis of rotation, whereby the continuity of the circuit formed between the springs through the plate can be broken only by the instantaneous reaction of the springs on leaving the exposed edges of the metal plate, as set forth. (2) The combination, with contact springs, of a revolving metal plate having flat sides and flanged and rounded edges of insulating plates or pieces of irregular conformation, secured to the flat sides of the metal plate, as and for the purpose set forth. (3) The combination of standards G and spring plates D D, with a metal plate

289.199

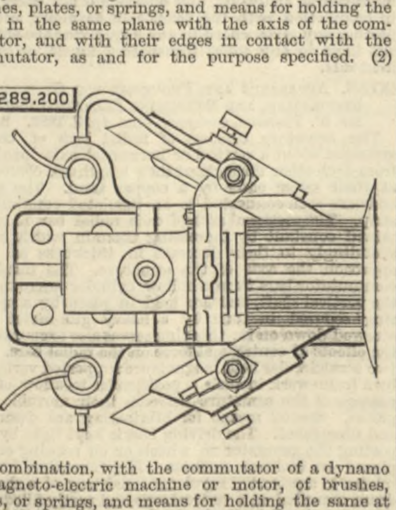


F, having flanged and rounded edges, and forming part of a spindle B, and plates or pieces of insulating material, shaped substantially as described, and secured to the opposite sides of the plate F, for the purpose set forth. (4) In a switch or circuit breaker in which the contact surfaces are held together by the compression and separated by the reaction of springs, the combination of two fixed and two movable contact surfaces and means for bringing the same into and out of engagement, these parts being so constructed that the separation of the contact surfaces shall be effected simultaneously and instantly, as and for the purpose set forth.

289,200. DYNAMO AND MAGNETO-ELECTRIC MACHINE, *Edward Weston, Newark, N.J.—Filed July 2nd*, 1883.

Claim.—(1) The combination, with the commutator of a dynamo or magneto-electric machine or motor, of brushes, plates, or springs, and means for holding the same in the same plane with the axis of the commutator, and with their edges in contact with the commutator, as and for the purpose specified. (2)

289.200

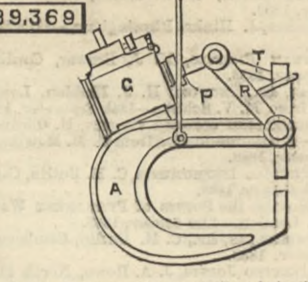


The combination, with the commutator of a dynamo or magneto-electric machine or motor, of brushes, plates, or springs, and means for holding the same at an angle to the axis of the commutator and in the same plane with the axis.

289,369. RIVETTING MACHINE, *John F. Allen, Brooklyn.—N.Y.—Filed February 13th*, 1883.

Claim.—In a rivetting machine, the combination of the jaw-frame A, pressure cylinder G, piston rod P, rods R R and T, of different lengths, with plunger E

289,369



and dies D^1 D, all arranged to operate substantially in the manner and for the purpose described.

289,456. INCANDESCENT ELECTRIC LAMP, *Robert H. Sheehy, New York, N.Y.—Filed December 15th*, 1882.

Claim.—(1) The combination, substantially as hereinbefore set forth, of a curved tube of glass or other transparent material and an illuminating conductor or filament of carbon traversing the axial line of said tube. (2) The combination, substantially as hereinbefore set forth, of a tube of glass or other transparent material, having a curved projection when viewed in any direction, and a filament of carbon or other illuminating conductor traversing the axial line of said tube. (3) The combination, substantially as

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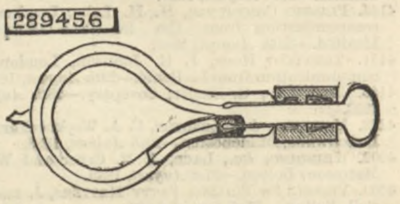

hereinbefore set forth, of a tube of glass or other transparent material, a filament of carbon or other conducting material traversing said tube axially, and a common neck to which both ends of said tube are welded. (4) The combination, substantially as hereinbefore set forth, of a tube, a filament of carbon within said tube, a common neck to which both ends of said tube are welded, a system of electrodes carried by said neck, and a handle whereby said neck may be revolved.

289,590. ELECTRIC LIGHTING APPARATUS, *Nelson S. White, Canton, Mass.—Filed August 16th*, 1883.

Claim.—The combination of the transparent vacuum bulb and inclosed filament of an incandescent lighting apparatus with the wire gauze envelope C, substan-

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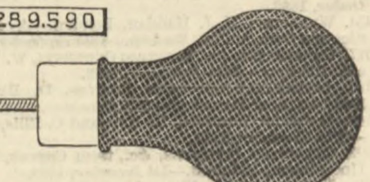

tially conforming to the transparent vacuum bulb, and disposed around the incandescent filament at a point beyond the radiating point of a temperature of ignition substantially as described.

CONTENTS.

THE ENGINEER, January 4th, 1884.

THE DRAINAGE OF BRENTFORD.—The new works for the drainage and disposal of the sewage of the county town of Middlesex have just been completed, at a cost of about £30,000. They have been designed by Messrs. Gotto and Beasley, of Westminster.