THE TYPES OF SOME NEW CRUISERS.

THE Reina Regente, a Spanish armoured cruiser of about 5000 tons normal displacement, was recently launched at Clydebank. This vessel is what Sir N. Barnaby calls the "internally protected type," that is to say, she has a thick armoured turtle-shaped deck, extending from side to side and protecting the internal vital parts of the vessel. She is the largest of this type which has been built in this country, the only larger ships built anywhere being those constructed by the Italian Government in Italy; but as they are of about 12,000 tons displacement, and are intended for the line-of-battle, they are of a totally different class to this vessel. The Reina Regente is 330ft. long over all, and 50½ft. beam, and her fully equipped displacement is 5600 tons. Messrs. Thomson were selected by the Spanish Government to build this cruiser after the Spanish constructors had received competitive designs from all the leading European shipbuilders. The chief points of the design seem to have been the high speed guaranteed, 20½ knots, the powerful armament offered, four 21-ton, six 5in., and about twenty small guns; the large radius of action guaranteed, 13,000 knots, and the very minute and protective system of subdivision above the protective deck. We have been favoured with an inspection of the plans of this vessel, which we hope at a future date to publish, and have been struck by the extent of the subdivision in this ship. Between the protective and the main deck the space is divided into no less than eighty-three water-tight compartments, each of which, in addition to being made use of for carrying either coals or stores, is in direct communication with the main pumps of the ship.

The consideration of the value of this ship as a fighting machine opens up the whole controversy of the value of side armour, about which so much has already been said and written. In our own Navy we have the internally protected type, represented by the Thames, Forth, Mersey, and Severn, and several earlier vessels; but in the latest cruisers ordered for us the Admiralty have seen fit to depart from this type and to build seven vessels known as belted cruisers, in which a belt of compound 10in. armour is fitted for about two-thirds of the length of the water-line. The last of the five built by contract was launched this week on the Clyde. These vessels are 320ft. long over all, and 56ft. beam, of about 5000 tons displacement, having a speed of 18 to 18½ knots per hour, and it is therefore very interesting to see what variations are involved in this difference of principle in the two classes of vessels. Dealing first with the quality of the protection, we have in the Reina Regente a dome-shaped deck 4¾in. thick on the sloped part and 3¼in. thick on the flat part, extending from the water-line at the middle line of the ship to about 6ft. below at the side. In the belted cruiser we have a 2in. deck on the flat carried right out to the side of the vessel, and terminated by a belt of 10in. armour extending from 1½ft. above the water-line to 4ft. below. Hence, to penetrate vitally the Reina Regente it is necessary to get through the thin side of the ship, and through 4¾in. of steel plates standing at an angle of about 25 deg. to the water level; or to get through 3¼in. in the flat. In addition to this, the bunkers of coal, 8ft. to 10ft. thick, may have to be penetrated. In the belted cruisers 10in. of compound armour, backed by 6in. of wood, has to be penetrated direct, or 2in. of steel on the flat. In the latter case coal protection may be afforded by the side bunkers, but in the case of penetrating the armour this is not so. We think the protection from penetration is slightly in favour of the belted cruiser as far as the side armour or sloped deck respectively is concerned; but on the flat, which in our opinion is the most likely to be hit, the protection of the Reina Regente is 60 per cent. better. There is a further point in the question of the quality of protection of the internal vitals of the two ships. The belted cruisers have, on account of their greater beam, a much larger deck area liable to be hit, so that the chance of penetration is increased somewhat in proportion to the area exposed. It may be noted in passing that the distribution of protection at theends of the two vessels is very similar.

The question of the quality of the protection of the buoyancy and stability of the ship is one which has been so often gone over without a satisfactory solution that very little that is new can be said about it. But there is this to be remembered, that whatever the merits of a belt of side armour to preserve buoyancy and stability on account of its shot excluding power, it must cover an area which may reasonably be expected to be subject to being submerged and emerged by the motion of both the sea and the vessel. In the belted cruisers at their normal draught the armour extends 1½ft. above a still-water line, so that above this point the vessel's side is exactly the same as a cruiser of the internally protected type; and if water gets freely upon the armoured deck of the former vessel, it is quite as fatal to their stability as it is in the case of the latter, if not more so. Further, the belt of these vessels extends 4ft. below the water-line, and consequently in smooth water an angle of roll of 8 deg. brings the lower edge of the belt out of water. In the Reina Regente the protection does not begin to emerge until a roll of 13½ deg. is reached.

So far we have only been dealing with the normal load line, but when the two vessels have their bunkers full of coal, and not about half full, as is assumed, at the normal line, they will go down about 2ft. further in the water. The belt of the English cruiser then becomes submerged, and the protection to stability must depend in her case as much as in that of the Spanish cruiser upon the subdivision and the water-excluding power of the coals and stores in the spaces above the armoured deck. Hence it appears to us that in these two cases the protection of the buoyancy and stability depends very much upon the same thing ultimately, viz., the water excluding power of the coals and stores. But the belted cruiser has much more weight and cost spent upon her in order to fit the armour belt. But more than the question of cost and weight of belt is involved, for in fitting a belt the weights of the upper works are all lifted up, and in order to have the same original stability the belted ship must have more beam than the internally protected ship. This involves more weight, probably more horse-power to drive the ship, more cost, and more liability to be hit by plunging shots, and has the further disadvantage that the increased height of centre of gravity of the ship makes her condition more dangerous as soon as the side ceases to keep out water.

We may see the effects of some of these considerations in comparing these two designs. The speed of the Reina Regente is two to two and a-half knots more than that of the belted cruisers. She has four 21-ton guns against two of the latter, and her radius of action is probably 20 per cent. in excess. As to first cost, there can be no doubt which is the cheaper ship, for compound armour at £80 per ton very soon runs into thousands of pounds. These facts are for our readers' consideration, to enable them to judge of the merits of the two types of ships, and we hope in a future issue to give detailed plans of both types.

THE RAILWAY BILL.

THE new Railway and Canal Traffic Bill is a modified version of the Bill introduced last year by Mr. Mundella. In one respect, at least, it is an extended version, as it deals much more fully with canals. On the other hand, its scope is limited to goods traffic, whereas Mr. Mundella's Bill dealt with passengers' fares also. This limitation is probably intended to facilitate the passing of the Bill by diminishing the opposition of the railway companies, and by narrowing the scope of discussion. Possibly the change is prudent, and there is certainly an ample field of conflict in the ground covered by the Bill as it stands; but whether the public will be satisfied with what we presume is intended to be simply a postponement of the regulation of passengers' fares is another question. In several respects attempts appear to have been made to meet objections raised by railway companies and the public respectively to the provisions of the old Bill, while on some points the revisers have not made as good use of their opportunities as might have been expected. As Mr. Mundella's Bill was read a second time in the House of Commons without a division, there was, no doubt, a natural disinclination on the part of the present Government to depart very widely from its main features; but it is certainly remarkable to find in the new Bill two or three provisions in respect of which there was last year a perfect storm of denunciation, especially among bodies supposed to be in sympathy with the party at present in power. Possibly the Government may have had better reasons than are apparent for retaining portions of the Bill which most people expected to find expunged or materially altered. However this may be, we think it will generally be admitted that the new Bill is an improvement upon the old one, great as the difference of opinion in relation to some features of it may be.

As a matter of course, the Bill proposes to reconstitute and perpetuate the Railway Commission. In the proposals for constituting the new body, we come to one of the most important changes in the measure, as compared with that of last year. Mr. Mundella proposed to appoint three Commissioners, one to be a judge of a superior court, and the others "practical men of business." To this it was objected that the two "laymen" would become mere assessors to the judge; and although Mr. Mundella protested against that idea, his Bill clearly made the judge the sole arbitrator in all questions of law. In the new Bill the Chief Commissioner is to be "of experience in the law," but not necessarily a judge, and the two others laymen, one of whom must be experienced in railway business. However, as there is a great deal to be said in favour of the judicial element adding weight to the decisions of the Commissioners, the Government arrange for it in a somewhat cumbrous manner. It is proposed that, in addition to the regular Commissioners, there shall be three *ex-officio*, who would attend in cases where important points of law were involved. They are to be judges of the superior Courts of England, Scotland, and Ireland respectively, each to attend when necessary for his own country only. Thus the legal element in the proposed new Commission will be stronger than Mr. Mundella proposed to make it. This would not be a defect if, as might well have been arranged, there should be never more than a single appeal from a decision of the Commissioners, and that only on a question of law. As it is, a double appeal, first to a superior Court and then, under certain conditions, to the House of Lords, is retained in the Bill, though Mr. Mundella was prepared to expunge it last year. The *locus standi* given to public bodies and associations in making any complaint which the Commissioners can deal with is the same in the new Bill as in the old one. The provisions defining the jurisdiction of the Commissioners, too, remain the same on all important points, except that there is a new clause empowering them to require traffic facilities, notwithstanding agreements not confirmed by Act of Parliament, by the Board of Trade, or by the Commissioners. They are empowered to adjudicate on disputes concerning station accommodation, tolls and rates, and rating appeals, to award damages, to compel companies to make mutual arrangements for carrying into effect orders for traffic facilities, to apportion expenses between railway companies and applicants for works, such as bridges or subways, and to arrange differences between any company and the Postmaster-General. The Board of Trade is retained as provisional arbitrator between railway companies and the public, but with less summary powers than those accorded in Mr. Mundella's Bill. By the new as by the old Bill, every railway company is required to submit to the Board of Trade within twelve months of the commencement of the proposed Act, unless an extension of time be granted for a special reason, a revised classification of rates and charges and a revised schedule of maximum rates and charges proposed to be adopted in future by the company. Under the earlier measure the Board of Trade was required to communicate with the company and any objectors to the classification and schedule for the purposes of arranging the differences between them, and then to "settle the said schedule and classification in such manner as shall appear to the Board of Trade to be just and reasonable." The settlement, of course, would have been only provisional, as it had to be submitted to Parliament for ratification, and, if petitioned against, would have been referred to a Joint Committee of both Houses, before which any objectors would have been able to appear. Still the powers of the Board would have been very considerable, and the officials might have exercised them in an arbitrary manner. The railway companies, it will be remembered, strongly protested against the proposals, and it is probably with a view to conciliating them that alterations have been made. Lord Stanley of Preston, who has charge of the Bill, is more polite and ceremonious towards the railway companies than Mr. Mundella was. If he would attain the same object in the end, he has the grace to say "by your leave" in the first instance, and he gives obstructing companies more time to get out of his way. He distinctly directs the Board of Trade to make terms with a company if possible, and if no agreement can be arrived at there is to be a delay of a session before any Bill to enforce the arrangements imposed by the Board can be introduced. There is even a quite comical piece of politeness in this part of the Bill, which, after providing that the Board of Trade shall present to Parliament a scheme of its own, on failing to agree with any company, goes on to say that, in the session after the report has been sent in, "the railway company may apply to the Board of Trade to embody in a Provisional Order the classification and schedule which in the opinion of the Board of Trade ought to be adopted by the railway company." This considerateness is quite touching, although its effect is somewhat marred by the succeeding statement, to the effect that, in the event supposed, the Board of Trade shall, "and in any case may"—the iron hand here shows through the velvet glove—embody the scheme in a Provisional Order, to be followed by a Bill to confirm it. The Government can scarcely hope that the railway companies will be reconciled to the interference which they detest. The only inducement which can bring any of them to assent willingly to a rearrangement under the circumstances proposed, instead of standing by the conditions of their special Acts, is their desire to get terminal charges made legal without dispute. Nor are they alone in objecting to come under the control of the Board of Trade, for the more extreme of their opponents last year protested against that tribunal as not entitled to the confidence of agriculturists and traders. No one at present, however, has suggested a more fitting agency for making rearrangements with the companies. The Railway Commissioners were proposed, it is true; but it would clearly be improper for the Commissioners to frame the laws which they are to administer.

The clause relating to undue preference is the one which will excite most discussion, as was the case last year. The new clause is more explicit than the old one, though it is doubtful whether it would in practice have any greater effect. It names districts and foreign goods as well as traders and classes of traders, when laying down the rule that the burden of proving that a lower rate or different treatment does not amount to undue preference shall lie on the railway company. This amplification of the circumstances of possible undue preference will please agriculturists and traders, no doubt; but then they will be disgusted to find in the new Bill the identical subsection which excited among them such a storm of indignation when it appeared in Mr. Mundella's Bill. "In deciding whether a lower charge or difference of treatment does or does not amount to an undue preference," the sub-section declares, "the Court having jurisdiction in the matter, or the Commissioners, as the case may be, may, so far as they think reasonable, in addition to any other considerations affecting the case, take into consideration whether such lower charge or difference of treatment is necessary for the purpose of securing the traffic in respect of which it is made." If these words should be made law, they would clearly legalise preference rates on foreign goods under certain circumstances; and there is no point on which railway reformers are so determined and united as in declaring that nothing can justify a railway company in carrying foreign goods more cheaply than British goods of the same or a similar kind are carried. If low rates are essential to securing the foreign traffic, and do not pay a railway company, it is argued, the company receives no benefit, while home producers are injured. If the low rates do pay, the same rates on British goods sent in similar quantities and equal distances would also be remunerative. We have never seen a satisfactory answer to this argument, and even if there be one, our agriculturists and traders are determined not to be handicapped to the advantage of their foreign competitors, against whom they find it difficult under the most favourable circumstances to hold their own.

A new clause, requiring railway companies to exhibit at stations lists of rates, and to sell at a reasonable price lists of local and through rates and charges and traffic classification, will give much satisfaction to the public. The only other new features of the Bill are those relating to canals, in reference to which the measure is greatly amplified. The traffic regulations relating to railways are made applicable, as far as possible, to canals, and the Board of Trade is authorised to exercise arbitrary powers over the bye-laws and general arrangements. These new proposals will scarcely be submitted to by the railway companies without a hard fight against them, and they certainly appear to confer extraordinary power upon the Board of Trade. To prevent an increase in the control of railway companies over canals, by which competition is already to a great extent annihilated, there is a clause prohibiting the acquisition of any canal interest by any railway company, or individual connected with the company, without statutory authority. On the whole as we

said at the beginning of this article, the new Bill is an improvement upon the old one; but it still contains provisions of doubtful expediency, and there is certain to be a strong opposition to it, so that, bearing in mind the state of affairs in Parliament, we should say there is a very poor prospect of its being made law during the present session.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Argentine Republic — Raising coal. — Coal is said to have been discovered north-west to the town of San Juan, and the district is said to extend over 124 miles between the Cerros de Zonda to Huuco and Valli, Fértel, Pié de Palo, and Sierra de la Huerta. The national engineers are about to examine and report thereon.

Germany — Agricultural machinery at Altenberg. — An exhibition was held to collect and make known in Germany the industries and products of the little duchy of Saschsen Altenberg. It deserves attention as a sign of German enterprise in the remote districts, and as an indication of the way in which foreign productions may be brought under the notice of the rural population of Germany. In the agricultural department great interest was attracted by the machines, specimens in operation being shown by German houses from Leipsic and Magdeburg. Among the exhibitors from the latter city was an English firm, which has established a factory there. The machinery in general, though inferior in finish to American make, was of good workmanship and very serviceable, at the same time being much cheaper. The following are the names of the principal exhibitors of agricultural implements, with the prices, as far as they could be ascertained.—Fanning mills: Carl Altendorf, Goessnitz; Louis Barthel, Nobtz; Robert Barthel, Gnadschuetz; H. Lang, Mannheim. Feed and turnip cutters: Carl Altendorf, Goessnitz; feed cutters, £3 15s. to £5 4s.; turnip cutters, £2 2s. to £2 14s., H. Lang, Mannheim; feed cutters, £4 16s. to £7 6s., E. Nauendorf, Mouselwitz; feed cutters, £3 2s. to £4 16s., Schmidt and Spiegel Halle; mowing machines—imitation Woods, Carl Altendorf, Goessnitz, about £17 14s.; ploughs and harrows, M. Dittrich, Muelsen; M. Froehlic, Schoenberg; Gross and Co., Eutritsch, near Leipsic, Acme Pulveriser (imitated) £4 16s. to £5 4s.; drills, hand, £4 3s. to £7 18s.; drills, seeders, £10 8s. to £22 18s.; harrows, iron, one-horse, £1 17s. to £3 2s.; harrows, iron, two-horse, £3 15s. to £5 0s.; rollers, iron, £7 18s. to £10 16s.; rollers, wood, £6 5s. to £7 15s.; steel ploughs, £2 12s. to £6 5s.; steel ploughs, two furrows, £2 3s. to £2 6s.; steel ploughs, three furrows, £2 10s. to £2 16s. Thrashing machines, C. A. Klinger, Altstadt, £104 3s. to £116 13s.; E. Nauendorf, Mouselwitz, small machines, £50 to £62 10s.; Garrett, Smith, and Co., near Magdeburg, engines, 6-horse power, £196 17s. to £204 13s.; 8-horse power, £243 15s. to £250; 10-horse power, £283 6s. to £291 13s.; machines, £166 13s. to £208 6s.

Canal and harbour works, Frankfort-on-the-Main. — The River Main has been canalised from Frankfort to Mayence, where it enters the Rhine, a distance of twenty miles. Harbour works at Frankfort being partly finished, this town seems to have entered upon a new phase of its history in becoming a Rhine port and accessible to vessels of over 1000 tons. Vessels having no longer to unload their cargoes at Mayence into the small Main craft, Frankfort can enter into new business channels, and share in a trade from which it had in late years been excluded through its inability to use the great facilities of navigation by water. To restore the ancient property of Frankfort, Herr Cuna, Government architect and engineer, proposed to canalise the river from Frankfort to Mayence by five movable weirs, which would give the necessary depth of 8ft. 3in. up to Frankfort. The cost of this canalisation is about £275,000. After a great many delays the work was commenced in 1883. The cost of the canalisation having been provided, the town of Frankfort had to provide funds for the harbours and accommodation required by the trade likely to be attracted by the improvement of the river. Mr. W. H. Lindley, architect, had charge of the planning and erection of the works at a cost of near £325,000. The natural harbour formed by the river has been provided with a lock at the entrance, also deepened, and provides room for from fifty to sixty of the largest Rhine craft to unload into spacious docks, secure both against floods and ice drifts. The goods can be stored in five large warehouses, or can be forwarded by rail to the central depôt of the different lines now building in close vicinity. This central depôt will cost £1,500,000, and will be the finest structure of the kind in Europe. Customs formalities can be carried out on the spot; the Customs warehouse will be large enough to store large quantities of goods for short periods, so as to allow of these being parcelled out into smaller lots for transit in different directions. One of the beneficial effects which the Main canalisation is sure to produce is to reduce the price of coal. From the river Ruhr, and directly from the mineral beds, coal can now be shipped by water to Frankfort and then in smaller craft further up the Main. It was chiefly owing to the difference in rates of freight that Frankfort was unable to compete with the Rhine ports. Freights on shipments of goods from Bremen, Hamburg, Rotterdam, are higher than those to Cologne, Mannheim, Mayence, and other Rhine ports. The disadvantage being now overcome by the canalisation of the Main, Frankfort with its pecuniary resources will surely extend and increase its foreign trade in a large degree, and will in course of time become an import mart for cotton, foreign produce, grain, and petroleum. It is a circumstance that deserves to be noticed that in Germany, in the wake of the development of a large system of railways, public opinion reverts to the old waterways, and favours their utilisation by means of canalisation and improvement. Following the examples of Belgium and France, canals are either built or planned in many directions, and the rivers are getting better utilised.

Finland, British trade with.—Finland, which lies within easy reach of England, is almost entirely neglected. Very few English commercial travellers ever appear, and some of those who do are such bad linguists that they are at a great disadvantage in the struggle for orders. Most of the English firms trading with Finland are represented by German agents and travellers, who cannot be expected to have British interests at heart. A traveller in Finland need not necessarily speak Swedish, but a good knowledge of German is requisite. British traders should send their representatives to Finland in February if possible, but in no case later than the first week in March, or they will be anticipated by Germans, who are to be found in Finland in March. In spite of the absence of British energy and enterprise, the trade between England and Finland is steadily increasing. Although it is hardly advisable at present for Englishmen to establish themselves in Finland, any sound English house which opened a branch in Helsingfors, and adapted itself to the business ways and customs of the inhabitants, would in course of time succeed, for the capital of Finland is a rapidly increasing and very thriving town. Many Finnish merchants will willingly deal with English houses in preference to German, if the former will carry on business in the same style and afford the same facilities for payment that other nations do. British firms should be careful in choosing only good and trustworthy Finnish houses for their agents. The principal imports into Finland from Great Britain are cement, chemicals, coals, coke, earthenware, firebricks, hardware, iron and steel of all descriptions, such as bars, hoops, rails, roofing sheets, shipbuilding plates, tubes, and various kinds of machinery. There is special room for the development of the trade in building materials, cheap machinery, and hardware.

Russia: Trade of Azoff ports in 1886.—This report contains much of interest connected with agriculture, coal and iron mining, shipping, trade, &c. The imports into Rostoff and Taganrog declined in value from £461,770 in 1885 to £341,655 in 1886, a fall of 26 per cent. The exports of cereals, which are the largest part of the whole quantity, diminished in the same period nearly 45 per cent. When the crops in this region fail the purchasing power of the people fails also. Russian agricultural machinery is increasing rapidly, and owing to its cheapness must always find favour with the peasantry and small farmers. The fact must be no longer ignored that the days for importing foreign machinery are fast diminishing. If this market is lost, perhaps the next best thing is to bring British capital and energy to Russia, and thus secure a portion of the trade. There is much to be said against following such a course; but it is preferable to seeing foreigners occupying the position. The British must not be blind to the activity that prevails in other countries, and the perfection arrived at in the manufacture of many articles. For instance, American hay forks and horse rakes are made with teeth of a superior quality to those made in England; American latch locks are highly finished solid articles, and sold at half the price of English locks. Their hand, horse, and wind-power pumps are much superior to similar articles of English make. Grindstones from Nova Scotia find a sale here. Nothing is beneath the notice of the ubiquitous American or German, while English commercial travellers are rarely seen in these parts. In the case of ploughs, for years the leading English manufacturers would not make one so often pointed out as being the implement in demand for South Russia, because it seemed to them an inferior article. At last Messrs. Ransomes, Sims, and Head, consented; but improved it, thus completely ignoring the purchasers' tastes. Messrs. Howard then took the matter up, and their Anglo-Bulgarian plough meet more the requirements of the country; but its present price places it beyond the reach of the peasantry. Germany and Sweden here stepped in, studied purchasers' tastes, and in some instances imitated English patterns; and what with the increasing quantities made in Russia, England has completely lost the plough trade in this part of Russia. Other articles, such as cutlery, files, hardware, taps and dies, tools, are imported from Germany; scythes from Austria; shovels from America and Sweden.

The Russian Agricultural Exhibition will be held at Kharkoff this year, opening on September 20th (October 2nd), and closing on October 10th (22nd). There will be nine different divisions, but foreigners are only allowed to exhibit in divisions 1 and 6, cattle and live stock, agricultural implements and machinery, which are sub-divided into the following groups: —(1) Implements for cultivating the soil, ploughs, &c.; (2) corndrills, distributors, &c.; (3) implements used after the seed has come up, different kinds of harrows, &c.; (4) implements used in gathering and reaping crops; (5) implements for cleaning and thrashing grain; (6) apparatus and implements for preparing cattle food; (7) machinery for screening grain, buckwheat, and millet mills, oil presses, &c. Models of, or full-sized apparatus for drying grain; (8) all kinds of hand tools used in agriculture, scythes, sickles, &c.; (9) every kind of garden apparatus and tool for cleaning and drying fruit; (10) implements used in forestry; (11) motive power, locomotives, machinery driven by wind, &c.; (12) pumping apparatus and machinery, fire hoses, &c. The charges are 6s. 0d. for every 49 square feet of covered space, and 2s. for every 49 square feet of uncovered space. Exhibitors constructing their own stands, upon giving notice to the Council beforehand, will be allowed space free of charge. Exhibitors wishing to sell any article publicly or privately must state so on the invoice. One per cent. of the amount realised is to be paid to the Agricultural Society. The Executive Council may refuse to admit any article not conforming to the regulations. On the recommendation of juries, gold, silver, and bronze medals will be awarded, also diplomas for medals and certificates of honourable mention. Goods not taken away from the Exhibition within three days after its close will be sold for the benefit of the Agricultural Society. During the summer of 1887, prior to the opening of the Exhibition, trials will be made of different agricultural machinery, as mowers, sheaf binders, buckwheat and meal mills, and combined horse and steam thrashers up to 5-horse power inclusive. The trials of mowers will be held from the 3rd (15th) to 7th (19th) June; for sheaf binders, 20th June (2nd July) to 5th (17th) July; and thrashers and mills from the 15th (27th) August to the 20th August (2nd September). Persons wishing to enter their machines for trial must give notice to the Council of the Kharkoff Agricultural Society for mowers and sheaf binders not later than 20th May (1st June), and for thrashers and meal mills not later than 1st (13th) August. Competing machines must be delivered at the place appointed by the Executive Council a day before the trials commence. Machines not delivered in time will not be allowed to compete. The cost of delivering, removing, and setting up machines at the place appointed for trial must be borne by the competitors. Prior to the trials grass and wheat lands will be allotted to mowers and sheaf binders for preliminary trials, and competitors may utilise these tracts on the day before the trials come off. At the preliminary trial one shock of sheaves will be granted to the thrashers and 36 lb. of buckwheat and millet to the mills. Each mower will be tried over 8·1 acres of land on level and sloping ground and the sheaf binders on 10·8 acres both of spring and winter grain. Horse thrashers up to 4-horse power are to thrash ten shocks of sheaves of both spring and winter grain; steam thrashers of from 2½ to 5-horse power, twenty-five shocks of each of the above descriptions of grain. Bullocks, horses, and workmen will be provided gratis at the trials. The animals for working the machines will be drawn by lottery for both halves of the work to be done by them. The first prizes will be awarded to machines which have received not less than four and a half marks, second four, and the third for three and a half. In making the comparative valuation of all classes of machinery under trial the juries will make use of the five ball system: one specifies bad; two, fair; three, satisfactory; four, good; and five, excellent. During the summer there will be trials of certain machinery, viz., buckwheat and millet mills, combined horse and steam thrashers up to 5-horse power, mowers and sheaf binders. Persons desirous of becoming exhibitors must give a preliminary notice to the Council of the Kharkoff Agricultural Society, not later than the 1st (13th) May, 1887. The trials of mowers will be held from the 3rd (15th) June to the 7th (12th) June; for sheaf binders from 20th June (2nd July) to 5th (17th) July; and thrashers and mills from the 15th (27th) August to the 20th August (1st September). The detailed regulations form the subject of a separate report. The coal and iron industries for this province yearly attain greater attention. New companies are being formed which will commence operations this year. In spite of the alleged depression of trade, the output of coal from the Donetz Basin has greatly increased, though prices are still unremunerative. The colliery owners actively set before the Government the drawbacks their trade experiences. Amongst the concessions sought are an increase of the duty on foreign coal to about 7s. 4d. a ton, and out of half the sum raised from that source to subsidise the Russian coasting vessels at a rate per ton of coal transported by them. Great activity prevailed at the New Russia Company's Works during the past year in all departments. A large pit is being sunk close to the Hugheseo station on the well-known Alexandrofka seam, from which it is expected that coal will be shortly obtained. Another large pit is being sunk at the works on the Lieven seam, through which the celebrated Smolyanoff coking coal will be reached at a depth of 227 yards. The powerful pumping machinery for this pit is made by Messrs. Hathorn, Davey, and Co., of Leeds. The company are preparing by these additions to meet the great demand for coal expected upon the completion of the port of Marinpol—this port was begun last year. Colliery owners are pressing for the speedy completion of the works so as to ship their coal, which they seem confident will drive the English article from the Black Sea. The only effect of the present duty has been to tax the consumers to an amount far beyond that obtained from the duty imposed with the view of fostering Russian mining industries. The amount to be expended on the works this year is £136,000. The project of connecting the Sea of Azoff with the Black Sea by cutting a canal through the isthmus of Perekop is again under discussion, though the advantages trade in general may derive from the canal are doubtful; the coal trade may derive some benefit from it, the canal giving a shorter sea route from Marinpol to Odessa; but it is a question whether the dues and expenses of the transit will be so comparatively light as to enable the colliery owners to largely undersell English coal, which is now quoted at 16s. 4d. per ton c.i.f. The present high rate of exchange tells against the importation, but the freight is only 8s. 4d. per ton, whereas the average rate of coal for such a comparatively short distance as Taganrog is from 5s. 9d. to 6s. 10d.; and it must be borne in mind that the Russian colliers will have no return freight to Marinpol. It is said that some of the Russian coal is equal to the best Welsh, but the quality delivered does not bear out the statement, and it remains to be seen whether the friable Russian article can command the same price as Cardiff steam coal, or even Newcastle. Another consideration is that the canal traffic will cease for three months in winter, through the Sea of Azoff being unnavigable through ice. A new collier fleet will have to be brought into existence, and there are many other interests which will militate against the successful working of the scheme The blast furnaces have been under reconstruction, and are greatly increased in capacity. Two of the furnaces are in full operation, the average production of each being from 600 to 700 tons a week. A third furnace will be ready for blowing in early in the spring. Additional machinery has been erected to meet the increased capacity of the furnaces. The steelworks have been greatly augmented by the erection of additional Martin-Siemens melting furnaces, and a powerful new cogging mill, all of which will soon be in full operation. The merchant mills have been considerably enlarged to meet the demand for merchant iron, and new shops have been erected specially for the manufacture of rail fastenings, the excellent quality of the New Russia Company's material being much appreciated by the various railways in the country. The works are now provided throughout with electric light—a valuable improvement and a great convenience.

Quicksilver near Nikitofka station, on the Koursk-Kharkoff-Azoff Railway, is now being worked by a company. A pit 280ft. deep is being sunk provided with the necessary machinery for the production of quicksilver, and buildings and dwellings for the miners are in course of erection, all of which will shortly be completed. The ores are expected to yield 1 per cent. of metal. The samples which have been sent to the University of Kharkoff are pure, and in quality not inferior to foreign. The yearly importation of quicksilver has been about 50 tons, at an average price of £240 per ton, but now on account of its anticipated cheaper production it is thought the demand will increase. There are many projects on foot, some of which if realised will do much towards developing the trade of the country. The scheme for joining the river Volga with the Don has advanced a step, surveys and plans having been made. The advantages this waterway would confer on Rostoff and Taganrog are innumerable. The branch line from the Rostoff-Vladikavkaz Railway to Novorossisk was in July last opened as far as Ekaterinodar on the Konban, from whence large quantities of grain have been sent to Rostoff this autumn. When the line is completed to Novorossisk that place will become the outlet for the produce of the Konban country, greatly to the prejudice of the ports of Temriuk and Yeisk, especially the former, will then be frequented by small coasting vessels only. The construction of a harbour at Taganrog has been decided on at a cost of £82,500, and the work will be commenced in the summer. The trade results of the past year were unsatisfactory; commercial transactions on account of the failure of the harvest were limited. The tonnage of shipping of all countries fell off. The decrease in British shipping was 146,394 tons, or 42 per cent., compared with 1885. Great stress is laid upon the necessity of complying with the Russian Customs regulations in the minutest detail, as the slightest neglect, however inadvertent, is punished by heavy fines, and redress afterwards is nearly impossible. Several complaints have been made against British steamers for short delivery of cargo. The honesty of British shipmasters is not disputed, but greater attention is claimed on their part in discharging and lightering, and unless an improvement takes place preference will be given ultimately to other flags, the outturns of which are more satisfactory. In an appendix is given a list of the more important firms on the Sea of Azoff, so that manufacturers and merchants can bring their catalogues, price lists, &c., directly before those interested. All communications, printed or written, especially advertisements, should be either in German or Russian, English being comparatively useless.

South Kensington Museum.—Visitors during the week ending 5th March, 1887:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m.: Museum, 8492; mercantile marine, Indian section, and other collections, 3191. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 5 p.m.: Museum, 779; mercantile marine, Indian section, and other collections, 132. Total, 12,594. Average of corresponding week in former years, 15,936. Total from the opening of the Museum, 25,447,767.

TYPICAL MASONRY AND EARTHWORK DAMS OF THE WORLD.

(For description see page 189.)

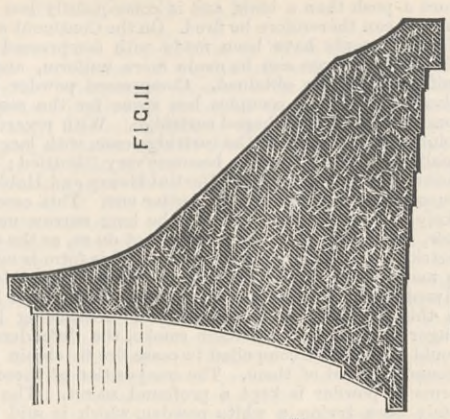


FIG. 11

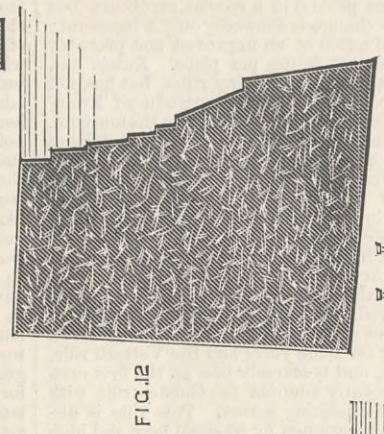


FIG. 12

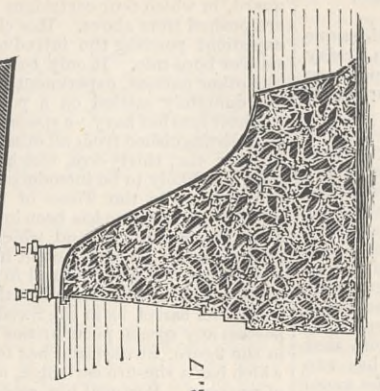


FIG. 17

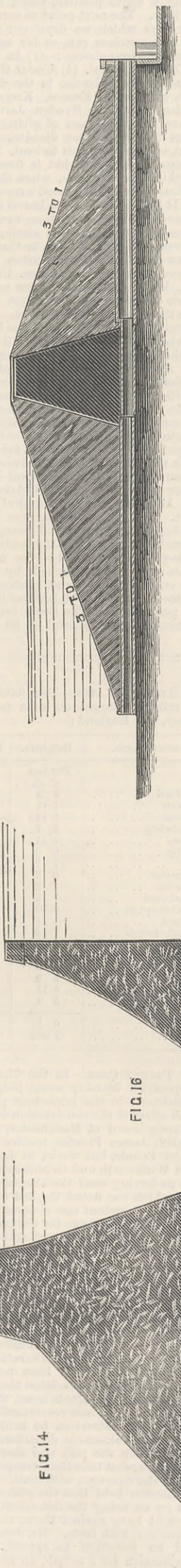


FIG. 5

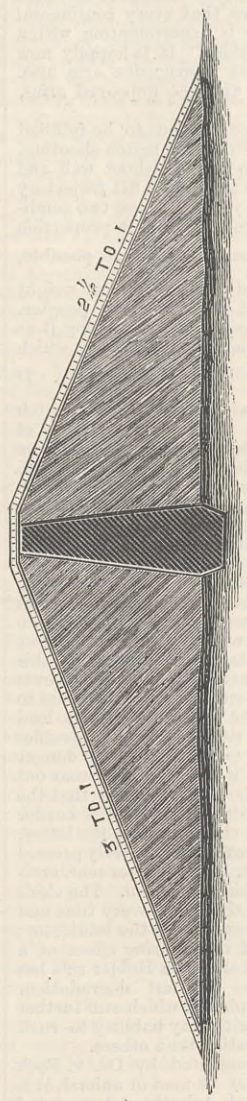


FIG. 7

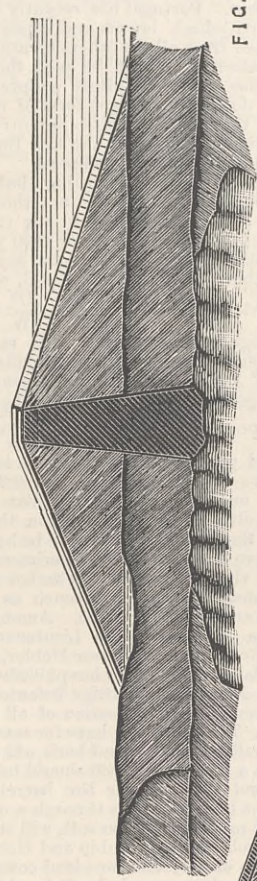


FIG. 6

FIG. 9

FIG. 14

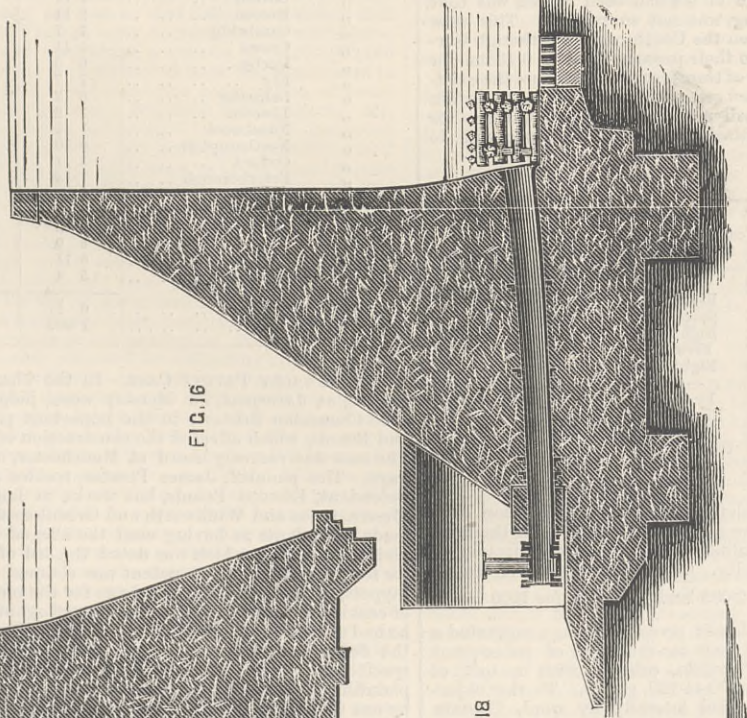


FIG. 16

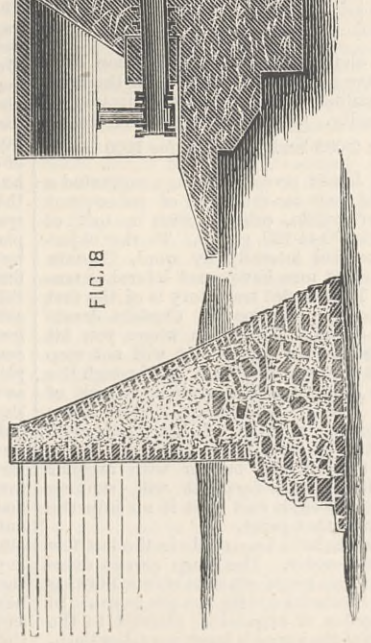


FIG. 18

MAGAZINE AND REPEATING ARMS.

Captain W. H. James, late R.E., read a paper on "Magazine and Repeating Arms" in the United Service Institution on Friday week. At the present time this subject is of the first importance to our army, and consequently, in the present state of Europe, of great importance to us as a nation.

Captain James began by raising the question of the value of a magazine or repeating arm. "With the Soper rifle forty-three well-directed shots have been fired in a minute." "What more," he asks, "can be desired in war?" This he answers as follows:—

"The advantage of a magazine arm is that it enables a sudden shower of bullets to be poured in at a moment when increased intensity of fire will decide the victory. The sudden intensity, this conversion of the shower of bullets into a blinding rain, is to be obtained from the magazine rifle alone. It is for this gain that we face the additional complication due to the repeating action, it is for this great quality that the nations of Europe are spending millions of money in the re-armament of their infantry, and that we too must follow their example. The magazine rifle has two advantages. Besides the one above mentioned, there is the moral support which it gives to the soldier, who feels that he has a reserve of power constantly at hand. No breech action, however rapid, can give the same rapidity so long as the magazine supply lasts. In a properly constructed magazine rifle the time taken to press the cartridge into the barrel is eliminated. Drawing back the action cocks throws out the old case, brings up a fresh cartridge; closing the breech pushes the cartridge home, which is therefore never touched by the man's hand, nor has he to take it from pouch to the breech. No single-loader can give that confidence which a man feels who has five or more shots at his instant command. A repeating rifle, therefore, is of advantage both on the offensive and defensive. Troops, whether acting on the one or the other, have to pass through that supreme moment when the combat trembles in the balance, and to both alike the special quality of the magazine arm is of the highest importance. Taking the case of two lines holding one another in close action, if one is suddenly enabled to quintuple its fire-rate, what," Captain James asks, "will be the fate of the other? At times when surprise is of moment, such as counter-attacks, it is also of the utmost value. To sentries, to small bodies of men acting by themselves, such as reconnoitring parties of cavalry, the use of a repeater is of the greatest assistance. Magazine arms were used with considerable effect both in the American Civil War and the Russo-Turkish. In the former it was said that one man armed with the Spencer was equal to five with the ordinary muzzle-loader. In the latter the Winchester did good service to the Turks, who not only armed their cavalry with it, but on occasions their infantry used it also for the close defence of works, as at Plevna. Fire should be by volleys alone, the frequency of which will depend on the range and object; but on the offensive the final rush should be prepared by the use of the magazine, which should be reloaded the moment the position is carried. On the defensive the magazine may be similarly employed, but possibly a little more often and earlier, *i.e.*, at longer ranges when it can be rapidly loaded; for instance, at the advancing troops during their rushes, when they are so much more visible and form so much better targets than when lying down to fire. The fire during these transitory moments should be intensified, because good results may be obtained from it. In fact, generally, either on the offensive or defensive the magazine is chiefly for the close combat, though occasionally it may be used at longer ranges; but it would rarely be employed for real long-range fire, for it would probably give rise to a great expenditure of ammunition without correspondingly adequate results. Against favourable targets, which from their nature are exposed only for a short time to fire, it may be made use of. For example, against masses of infantry, the staff of the enemy, cavalry or artillery unlimbering. But it will always remain chiefly reserved for the decisive stage, when its proper employment may decide the issue."

Captain James holds that repeaters will increase the expenditure of ammunition, but not to any large extent. He thinks, however, that the cartridge should be lightened to enable more rounds to be carried, especially because firing at long ranges, up to 1500 yards, has increased the demand on the ammunition. Captain James greatly doubts the feasibility of supplying ammunition to the fighting line in action, and he contemplates the men's kits being carried for them while each man carries 100 rounds on him; at least forty or fifty rounds per man are carried in a regimental supply.

Germany, soon after the war of 1870-71, adopted the Mauser rifle, and after various trials the Mauser magazine rifle succeeded it, which is now in the hands of five army corps, and will be supplied to the whole German Army before the summer. The dimensions of this and of the most important arms at present under trial are given in Table A, herewith.

The Mauser, like other magazine arms, is intended to be used, generally, as a single loader, with the magazine shut off. The latter is beneath the barrel and holds eight rounds, as well as one in the elevator and one in the barrel, thus providing the soldier with ten rounds at any critical moment.

Table A.

Name of rifle.	Weight.	Calibre.	Weight of bullet.	Powder charge.	Twist of rifling in calibres.	$\frac{D^2}{W}$	Muzzle velocity.	No. of cartridges in magazine.	
	lb. oz.	in.	grs.	grs.			feet.		
Mauser	10 2	0·433	386	77	1 in 50	3·4	1410*	Eight	* 1571 with new Rothweiler powder.
Kropatscheck	9 14½	0·433	386	80	1 „ 50	3·416	1430	Seven	
Lobell	—	0·307	—	—	—	—	—	Eight	
Mannlicher	9 8½	0·433	371	77	1 „ 68½	3·547	1437	Five	
Jarmann	10 1½	0·397	337	77	1 „ 55	3·222	1536	Eight	
Enfield-Martini	9 5	0·400	384	85	1 „ 37½	2·917	1570	—	† The Vetterli, the present arm, weighs 9 lb. 9 oz.
Vitali†	—	0·414	312	62	1 „ 63½	3·726	1430	Four	
Vetterli	10 8	0·414	312	55	1 „ 63½	2·932	1427	Eleven	
Hebler	9 14½	0·307	225	83	1 „ 15½	2·932	1942	—	Magazine and breech action same as Kropatscheck.
Guèdes	—	0·323	264	69½	1 „ 35	—	1673	Unknown	
Pieri	—	0·323	—	83	1 „ 36½	—	2057	Five	

Recently a charge of 89½ grains of compressed powder and a steel-covered lead bullet have been introduced. The thin steel-covering prevents fouling in the bore, and gives very perfect rifling. The balance of the Mauser rifle is bad and variable, being affected by the carriage of rounds all along under the barrel. France is likely to adopt the Lobell repeater, with a calibre of only 78 mm., or 0·307in., and a magazine beneath the barrel holding eight rounds. The French Navy has for some years been armed with the Kropatscheck repeater, somewhat resembling the Mauser.

"Austria has definitely adopted the Mannlicher rifle. This rifle presents several peculiarities worthy of notice. In the first place, the bolt is withdrawn by a straight backward motion, which renders it much quicker than one in which it is necessary to make a turn as in most bolt rifles, and hence it can be worked without taking it down from the shoulder. The cartridges are carried packed in tin frames containing five, which are placed in the case placed under the bolt chamber, and whence they automatically fall when empty. The cartridges are carried packed in these frames, two being wrapped round with paper, and thus issued to the soldier. The frames weigh 385 grains each, *i.e.*, roughly the weight of a bullet, and cost less than a halfpenny to manufacture. When these cases are placed in the rifle, *e.g.*, when arranged for magazine action, it cannot be fired as a single loader, although there is no reason why more than one round should be fired. The cartridge used is the same as that employed for the Werndl rifle, the weapon hitherto in use in the Austro-Hungarian Army. Experiments are, however, being made with an improved cartridge giving a higher initial velocity. In Italy experiments have been conducted for some years past, and it has been finally determined to alter the Vetterli rifle, which is an ordinary form of bolt-gun, in accordance with the system known as the Vitali. A magazine is fixed in a central position under the bolt chamber, in front of the trigger-guard, in which four cartridges packed in a special cardboard box are pushed from above. This change is avowedly only a temporary expedient pending the introduction of an improved and probably smaller bore rifle. It only costs 11 francs per piece. Russia has, like other nations, experimented with repeating rifles, but has not yet definitely settled on a pattern. She has introduced Evans' repeater into her navy—a specimen of which system is in the museum. It is distinguished from all others by the large number of cartridges it holds, viz., thirty-five, which are placed in the butt. It is, however, not likely to be introduced into the army. In the meantime, it is stated in the *Times* of the 19th February that a form of attachable magazine has been introduced for the Berden rifle, which holds two cartridges, and which can be fitted with a metal case containing six others, or eight in all, and that this apparatus, whatever it may be, can be fixed in less than ten minutes to the rifle. Sweden has for some time had the Jarmann rifle, with the magazine under the barrel, as in the Swedish regulation arm, but it does not possess any special peculiarities or advantages. Its action is shown in the figure. Switzerland has for some years had the Vetterli rifle, which has a rim-fire cartridge, and is scarcely now on the first rank of weapons. Portugal has recently adopted the Guèdes rifle with the Kropatscheck breech and repeating action. This rifle is distinguished from all the others mentioned by its small bore and high initial velocity. It will be seen therefore that every continental nation has either definitely adopted, or is experimenting with a view to deciding on some form of magazine." It is happily now decided to arm the British infantry with a magazine arm also. Trials will be made with the Lee Burton and Lee improved arms, but no arm is definitely adopted.

The lecturer then remarking that the conditions to be fulfilled by a good service rifle are not those of one for match-shooting, asked:—"What do we want our rifle to do? To shoot well and closely at ranges up to 1500 or 2000 yards; to have a flat trajectory within the decisive fighting zone, say 600 yards. These two conditions, other conditions being equal, require—(A) A high proportion of weight to area of bullet (*i.e.*, $\frac{D^2}{W}$ as near unity as possible, (B) A high muzzle velocity. The recoil depends upon the weight of the bullet, the weight of the rifle, and the amount of powder. To fulfil A without unduly increasing recoil and maintaining B as high as possible, it is necessary to have a long light bullet, in which the proportion $\frac{D^2}{W}$ is kept low, *i.e.*, a small bore is a necessity. If we could use 500 to 600 grains of lead, as is done in some match rifles, we could have a bore of 0·45in., but then the charge of powder necessary to obtain a flat trajectory would be so large and involve so heavy a weapon that the soldier could not use it; for the fire-arm must not be heavier than 9 to 9½ lb. These facts have induced many experiments in England and also abroad with a view to ascertain whether it was possible to design one which should combine as much as possible the qualities of the express and long-range rifle. Among others who have followed out this line of research are Lieutenant-Colonel Bode in Germany, Major Rubin and Professor Hebler, formerly an artillery officer in Switzerland. The latter has published a work called "Das Kleinste Kaliber oder das Zukünftige Infanteriegewehr," which the lecturer recommends to the attention of all who take an interest in this subject. The two latter have for some years carried on experiments with small-bore rifles, and both alike directed their endeavours to find out a projectile which should take the grooves well, not lead them, and yet not wear the barrel. With very long projectiles driven at high velocities through a quick twist, there is the danger that the projectile, if too soft, will strip; if too hard, will wear out the barrel. Messrs. Rubin and Hebler both determined that the best form of projectile was lead covered with a thin shell of harder metal; the former and also Colonel Bode chose copper; the latter, steel. In firing, the thin steel jacket is not cut, but merely pressed into the lead, which consists of 97 per cent. lead and 3 per cent. antimony, and is attached to the steel by a thin coat of tin. The clean close-fit surface of the steel polishes out the bore every time and removes fouling, and hence it is unnecessary to use the lubricator; and as the steel is so thin, it has not half the wearing effect of a really hard lead bullet; and, as a practical fact, a Hebler rifle has fired 1500 rounds without showing the slightest degradation. Latterly the steel shells have been nickel-plated, which still further improves the shooting and does away with any liability to rust. A steel-covered bullet has greater penetration than others.

An extensive series of experiments conducted by Dr. v. Beck show that in traversing the body, whether of man or animal, it is much less liable to deformation. Colonel Arbuthnot has stated that the reason why the calibre of 0·4 had been chosen was that with smaller bores the shooting was not so regular. This view does not agree with that held on the Continent, for although Germany and Austria have kept to their present bores of 0·433in. for reasons of economy and rapidity of transformation, because the existing barrels can be used for the new repeater, it is by no means certain that the former at any rate will not eventually adopt a smaller bore of 7 to 8 mm., while it is almost certain that France will do so, and in Austria economy alone prevented the adoption of a calibre of about 8 mm. To have a rifle which shall fulfil the most necessary quality in a good military arm, viz., flat trajectory, a small bore is an absolute necessity. The highest points of trajectories of bullets whose $\frac{D^2}{W}$ are 2·093 and 2·914 are for 1000 yards 28·7ft. and 35·64ft. Captain James seven years ago suggested a calibre of 0.38in., and would now in the light of subsequent experience hope to see one of 0·32in. calibre, with a ball of 336 grains, and a charge of from 90 to 100 grains. To the objection that light bullets are carried laterally by wind, Captain James answers that most targets of men have great lateral extension, but very little depth. Thus a flat trajectory is of the first importance. With regard to stopping power, Captain James observed: "Stopping a man depends largely on where you hit him. A kitchen poker which grazes an Arab's ribs will not stop him so well as a 50-grain bullet through his head, or through the lower half of his trunk." He referred to the medical records of the Franco-German War; Sir William M'Cormac's "Work Done under the Red Cross," Dr. Esmarch's work on "Military Surgery," and Dr. Beck's "Experiments with Small-bore Bullets." From these it appears that rapid moving long bullets with angular velocity enough to keep them point foremost will, striking half-way down the femur, go through and split it up into the hip-joint, involving amputation at that point.

As to the powder. Great strides have been made in the last few years in the manufacture of gunpowder. The sharp almost detonating action of the old form has given place to slower burning compositions, which give equal velocities with less pressures. In small bore rifles, where the number of expansions allowed to the charge owing to the great length of the barrel is large, very slow burning powders can be used. With such powders the recoil becomes more a push than a blow, and is consequently less felt. Greater charges can thererefore be fired. On the Continent a large number of experiments have been made with compressed powder, with which the charge can be made more uniform, and hence more uniform velocities obtained. Compressed powder has one great advantage, viz., it occupies less space for the same weight, and hence gives a better shaped cartridge. With regard to this latter point, viz., the form of the cartridge case, with large charges and small-bore bullets, the case becomes very "bottled;" this is clearly shown in the case of the Martini-Henry and Hebler cases. The truncated cone shape is a far better one. This case is much less likely to stick, as it has not got the long narrow neck, and moreover, when once it is started it cannot do so, as the surfaces of the cartridge and chamber come apart. This form is no more difficult to make than the bottle shape. Smokeless powder offers great advantages. A considerable amount of attention has been given to this question on the Continent. Advancing lines would no longer be indicated by their smoke, the defenders of a position would no more be compelled to cease fire to obtain a view of the ground in front of them. The composition of these experimental forms of powder is kept a profound secret. The French have lately been trying a white powder, which is said to have given astonishing velocities. The next point to consider is the magazine, *i.e.*, the reservoir from which we draw our stream of continuous fire. All forms of magazines can, so far as their position is concerned, be divided into four classes:—(1) In the butt. (2) Under the barrel. (3) Over the barrel. (4) Under the breech. No nation has the first named, except Russia, in the Evans repeater. The second has been adopted in France, Kropatscheck; Germany, Mauser; Switzerland, Vetterli; Sweden, Jarman; Portugal, Kropatscheck. It has the advantage of giving room for a number of cartridges, but the very great disadvantage, which it shares with first position, of being difficult to load. Moreover, the balance of the rifle is altered each time a shot is fired. The German rifle is very faulty in this respect, and is, when the magazine is filled, an extremely awkward and ill-balanced weapon, besides being very heavy, weighing 11 lb. Moreover the barrel is extremely awkward for the soldier, and in the case of those weapons which have the magazines on one side it is bad for aiming, especially when the sun is shining from the opposite side to that on which it is fixed. These three forms of rifle, viz., the Burton and the Lee Burton, and the Owen Jones, have such magazines. Underneath the breech is, on the whole, best. The rifle is more compact and far better balanced. Its sole disadvantage is the fact that it is difficult to arrange for more than about five cartridges. These rifles, viz., the Mannlicher, the Schulhoff, the Pieri, and the Lee, and the improved Lee, all have this form of magazine. All hold five cartridges except the Schulhoff, which will take ten arranged round a drum like a revolver. As regards the question of fixed or attachable magazines, the former are generally preferred as more certain to be available. Rifles with large magazines are apt to be heavy and awkward, and the magazines take some time to charge. A long-continued fire is quicker from a small and easily charged magazine. Lastly, as to action. The bolt has proved the best, especially when a straight pull only is necessary for firing, as the aim is less disturbed by such movement than by a twist.

In the discussion which followed General Bray, Colonel Hope, Mr. Lowe, Major Mackinlay, Colonel Arbuthnot, Colonel Hale, Colonel Fraser, Admiral Selwyn, Admiral Boys, and Admiral Colomb took part. The general feeling was in favour of a magazine arm with a fixed magazine, small bore, and consequent flat trajectory. Colonel Hale urged that the control over the magazines could only be kept in the hands of the commanding officer by having them removable and attached by word of command. Colonel Fraser, on the other hand, preferred fixed magazines. He objected to steel-coated bullets, because it appeared that they do not spread in penetration. The Boers' bullets in the Transvaal war, owing to spreading, proved fatal in 50 per cent. of cases of wounds.

Comparative Railway Rates.—The following table is a comparison of the railway charges on rails for equal distances in Belgium, Germany, and England:—

Distances for comparison.	Belgium.	Germany.	England.
	Per ton.	Per ton.	Per ton.
	s. d.	s. d.	s. d.
Ebbw Vale to Bedford	6 5	10 0	17 6
„ Boston	7 11	13 11	19 2
„ Brecon	2 11	2 6	6 8
„ Cambridge	7 7	15 2	16 8
„ Crewe	5 11	7 11	12 6
„ Derby	6 5	9 11	10 0
„ Ely	7 7	15 1	22 6
„ Leicester	6 7	10 10	15 10
„ Lincoln	7 2	13 6	17 6
„ Nantbrook	1 1	1 0	2 6
„ Northampton	6 10	11 11	15 0
„ Oxford	5 11	7 8	12 6
„ Peterborough	7 4	14 4	15 10
„ Rugby	6 7	10 6	13 4
„ Stafford	5 11	7 8	10 0
„ Thrapstone	7 2	13 1	15 0
„ Weadon	6 9	11 4	13 4
„ Wolverton	6 11	12 2	13 4
„ Worcester	5 4	5 6	6 8
Average of 19 distances	6 2¾	10 2½	13 5½
Ratios	1·000	1·634	2·162

The Burnley Patent Case.—In the Chancery Court of Lancashire, at Liverpool, on Monday week, judgment was given by Vice-Chancellor Bristowe in the important patent case of Procter and Bennis, which affected the construction of mechanical stokers. The case was recently heard at Manchester, and occupied several days. The plaintiff, James Procter, resides at Burnley, and the defendant, Edward Bennis, has works in London and elsewhere. Messrs. Cross and Winkworth and Greenhouse and Shaw were also made defendants as having used the alleged infringements of the plaintiff's patent, which was dated the 3rd of June, 1875, and was for fourteen years. The patent was claimed for a combination of tappets, springs, pushers, and doors for the mechanical distribution of coal in the furnace; and it was charged against the defendant that he had substantially infringed the patent. The Vice-Chancellor said the defendant's objections were three—first, that the plaintiff's specification was insufficient and misleading; secondly, that the plaintiff's invention was not new, having been anticipated, especially by one Church in 1829, and by the defendant himself in 1875; and finally, that in any case the defendant had not infringed the plaintiff's patent. His Honour held at once that the plaintiff's specification was sufficient; and after an exhaustive review of Church's invention and of the defendant's, and a careful consideration of the case, he also held that there had been no anticipation of the plaintiff's invention. He fully appreciated the argument, supported as it had been by reference to certain cases, that the plaintiff must show an infringement of the whole combination, and not of a part only; but after mature consideration he held that there had been by the defendant only a colourable departure from the plaintiff's invention. He had taken the pith and marrow of the plaintiff's invention, and therefore must take the consequences—an injunction, and an inquiry as to the damages, with costs. As to the co-defendants, the Vice-Chancellor held that the plaintiff, by his conduct in allowing them to go on using the defendant's machines, had lost any remedy he might have against them, and the action against them would be dismissed with costs. Mr. Jones, for the defendant, having intimated an intention to appeal, the Vice-Chancellor suspended the injunction for a month, an account to be taken in the meantime.

RESERVOIR DAMS.[1]

The construction of dams, in some form or other, may probably rank amongst the very earliest of engineering works. Works of this character are not infrequently referred to in the accounts of the earliest historians; but it is to be feared they are not always perfectly trustworthy. The subscribers to the Mudie of the period had to be considered; and their taste for the marvellous was probably not much inferior to that of our own day. When therefore Herodotus describes the reservoir of Moeris as formed for the control of the river floods of Nile-nourished Egypt, and of another constructed by Nebuchadnezzar at Sippara, of 140 miles in circumference, we must make allowances. But there is no question as to the existence in the East at the present day, and especially in India and Ceylon, of the remains of what may correctly be termed stupendous works; and the date of the construction of which, as regards India, is in many cases pre-historic. In Spain also the Moors, whose occupation of the peninsula terminated in the thirteenth century, have left reservoir dams of great magnitude, situated mostly in the south-eastern provinces of Murcia and Alicante, and many of which are still serviceable.

In India and Ceylon the greater number of the ancient dams or bunds are now in ruins, and this can occasion but little surprise, considering the meteorological condition of these countries. In Ceylon, for instance, the whole rainfall of the year occurs within a period of six to eight weeks, and often amounts to as much as 12in. in the twenty-four hours, and has been known, comparatively recently, to reach nearly 19in., the latter an amount only 2in. or 3in. less than the average rainfall of Lincolnshire for the whole year. In London it is only 25in., and in the wettest district in Great Britain, viz., Cumberland, averages not more than 70in. per annum. The rainfall in Bombay is from 80in. to 100in. per annum, and throughout India may be taken as from 50in. to 130in., varying, as is the general rule, in direct ratio with the altitude, and limited to a few weeks in the year. Notwithstanding this, there still exist in the Madras Presidency a not inconsiderable number of ancient bunds which serve their intended purpose at the present day as well as ever. Slight mistakes did occasionally occur, as they ever will till no more dams are wanted, as is proved by the remains of some works in Ceylon, where the failure was evidently due to error, possibly due to the instruments being out of adjustment, as their base is at a higher level than the bed of the stream at the point where water from the latter was to be diverted to afford the supply.

Among the most remarkable of these ancient works is the Horra-Bera tank, the bund of which is between three and four miles in length and from 50ft. to 70ft. in height, and although now in ruins would formerly impound a reservoir lake of from eight to ten miles long and three to four miles broad. There is also the Kala-Weva tank, with a bund of twelve miles in length, which would, if perfect, create a lake of forty miles in circumference. Both of these ruined works are situated in Ceylon. The third embankment of a similar character is that of the Cummum tank, situated in the Madras Presidency, and which although ranking amongst the earliest works of Hindoo history, is still in such a condition as to fulfil its original intention. The area of the reservoir is about fifteen square miles, the dam about 102ft. high, with a breadth at the crest of 76ft., and of the section shown in the diagram. The bywash is cut in the solid rock altogether clear of the dam; the outlet culverts, however, are carried under the bank. We will now consider generally the methods employed in determining the site, dimensions, and methods of construction of reservoir dams adapted to the varying circumstances and requirements of modern times, with a few references to some of the more important works constructed or in progress, which it will be endeavoured to make as concise and burdened with as few enumerations of dimensions as possible.

The amount of the supply of water required, and the purposes to which it is to be applied, whether for household, manufacturing, or irrigation uses, are amongst the first considerations affecting the choice of the site of the reservoir, and is governed by the amount of rainfall available, after deducting for evaporation and absorption, and the nature of the surface soil and vegetation. The next important point is to determine the position of the dam, having regard to the suitability of the ground for affording a good foundation, and the impoundment of the requisite body of water with the least outlay on embankment works.

It has been suggested that the floods of the valley of the Thames might be controlled by a system of storage reservoirs, and notice was especially drawn to this in consequence of the heavy floods of the winter of 1875. From evidence given before the Royal Commission on Water Supply, previous to that date it was stated that a rainfall of 1in. over the Thames basin above Kingston would give, omitting evaporation and absorption, a volume of 53,375,000,000 gallons. To prevent floods, a rainfall of at least 3in. would have to be provided against, which would mean the construction of reservoirs of a storage capacity of, say, 160,000,000,000 gallons. Mr. Bailey Denton, in his evidence before that Commission, estimated that reservoirs to store less than one-tenth that quantity would cost £1,360,000, and therefore a 3in. storage as above would require an outlay of, say, £15,000,000 sterling; and it will be seen that 3in. is by no means too great a rainfall to allow for, as in July of 1875, according to Mr. Symons, at Cirencester 3·11in. fell within twenty-four hours. Supposing serious attention were to be given to such a scheme, there would, without doubt, be very great difficulty in finding suitable situations, from an engineering and landowner's point of view, for the requisite dams and reservoir areas.

In Great Britain and many European countries rain gauges have been established at a greater or less number of stations for many years past, and data thereby afforded for estimating approximately the rainfall of any given district or catchment basin. The term "watershed" is one which it appears to me is frequently misapplied; as I understand it, watershed is equivalent to what in America is termed the "divide," and means the boundary of the catchment area or basin of any given stream, although I believe it is frequently made use of as meaning the catchment area itself. When saying that the rain gauges already established in most of the older civilised countries afford data for an approximate estimate only, it is meant that an increase in the number of points at which observations are made is necessary, previous to the design of a reservoir dam on the catchment area above, the waters of which are proposed to be impounded, and should be continuous for a series of five or six years, and these must be compared with the observations made with the old-established rain gauges of the adjacent district, say for a period of twenty years previously, and modified accordingly. This is absolutely necessary before an accurate estimate of the average and maximum and minimum rainfall can be arrived at, as the rainfall of each square mile of gathering ground may vary, the amount being affected by the altitude and the aspect as regards the rainy quarter.

But this information will be of but little service to the engineer without an investigation of the loss due to evaporation and absorption, varying with the season of the year and the more or less degree of saturation of the soil; the amount of absorption depending upon the character of the ground, dip of strata, &c., the hydrographic area being, as a rule, by no means equal to the typographic area of a given basin. From this cursory view of the preliminary investigations necessary can be realised what difficulties must attend the design of dams for reservoirs in newly settled or uncivilised countries where there are no data of this nature to go on, and where, if maps exist, they are probably of the roughest description and uncontoured; so that before any project can be even discussed seriously special surveys have to be made, the results of which may only go to prove the unsuitability of the site under consideration as regards area, &c. The loss due to evaporation, according to Mr. Hawksley, in this country, amounts to a mean of about 15in.; this and the absorption must vary with the geological conditions, and therefore to arrive at a satisfactory conclusion regarding the amount of rainfall actually available for storage, careful gaugings have to be made of the stream affected, and these should extend over a lengthened period, and be compounded with the rainfall. A certain loss of water, in times of excessive floods, must, in designing a dam, be ever expected, and under favourable conditions may be estimated at 10 per cent. of the total amount impounded.

As regards the choice of position for the dam of a reservoir, supposing that it is intended to impound the water by throwing an obstruction across a valley, it may be premised that to impound the largest quantity of water with the minimum outlay the most favourable conditions are present where a more or less broad valley, flanked by steep hills, suddenly narrows at its lower end, forming a gorge which can be obstructed by a comparatively short dam. The accompanying condition is that the nature of the soil, *i.e.*, the character, strata, and lie of the rock clay, &c., as the case may be, is favourable to assuring a good foundation. In Great Britain, as a rule, dams for reservoirs have been constructed of earthwork with a puddle core, as deemed by the majority of English engineers as more suitable for this purpose than masonry. Earthwork, in some instances combined with masonry, was also a form usual in the ancient works of the East already referred to; but it would appear from the experience of recent years that masonry dams are likely to become as common as those of earthwork, especially in districts favourable to the construction of the former, where the natural ground is of a rocky character and good stone easily obtained.

As to the stability of structures of masonry for this purpose as compared with earthwork, experience would seem to leave the question an open one. Either method is liable to failure, and there certainly are as many cases on record of the destruction of masonry dams as there are of those constructed of earthwork, as instanced in Algeria within the past few years. As regards masonry dams, the question of success does not seem so much to depend upon their design as far as the mere determination of the suitable profile or cross section is concerned, as that has been very exhaustively investigated and fairly agreed upon from a mathematical point of view, but to be principally due to the correctness of the estimate of the floods to be dealt with, and a sufficient provision of bye-wash allowed for the most extreme cases; and lastly, perhaps the most important of all, the securing a thoroughly good foundation and a careful execution of the work throughout.

These remarks equally apply to earthwork dams, as regards sufficient provision of byewash, careful execution of work, and security of foundation, but their area of cross section, supposing them to be water-tight, on account of the flatness of their slopes and consequent breadth of base, is, of course, far in excess of that merely required for stability; but in these latter the method adopted for the water supply discharge is of the very greatest importance, and will be again referred to.

Before commencing the excavation for the foundations of a dam, it is most essential that the character of the soil or rock should be examined carefully by sinking a succession of small shafts, not mere borings, along the site, so that the depth to which the trench will have to be carried and the amount of ground water likely to be encountered can be reliably ascertained, as this portion of the work cannot be otherwise estimated, and as it may bear a very large proportion of the total expense of construction, and in certain cases may demonstrate that the site is altogether unsuitable for the proposed purpose.

The depth to which puddle trenches have been carried for the purpose of penetrating water-bearing strata, and reaching impenetrable ground, in some cases has been as much as 160ft. below the natural surface of the ground, and the expense of timbering, pumping, and excavation in such an instance can be easily imagined. This may be realised by referring to Fig. 4, giving a cross-section of the Yarrow dam, in which the bottom of the trench is there only 85ft. below the ground surface. In the Dale Dyke dam, Fig. 2, the bottom of the trench was about 50ft. below the ground surface.

There is one other point which should be mentioned in connection with the form of the base of the puddle trench, that instead of cutting the bottom of the trench at the sides of the valley in steps, that it should be merely sloped, so that the puddle, in setting, tends to slide down each inclined plane towards the bottom of the valley, thereby becoming further compressed; whereas, should the natural ground be cut in steps, the puddle in setting tends to bulge at the side of each riser, as it may be termed, and so cause fissures. It will be noticed that the slopes of these earthwork dams vary from 7 to 1 to 2 to 1.

The depths to which some puddle trenches are carried has been objected to by some engineers, and among them Sir Robt. Rawlinson, as excessive and unnecessary, and, in the opinion of the latter, the same end might be obtained by going down to a depth, say, of 30ft. only, and putting in a thick bed of concrete, and also carrying up the concrete at the back of the puddle trench, with a well for collecting water, and a pipe leading the same off through the back of the dam to the down stream side. An arrangement of this kind is shown in the Yarrow dam, Fig. 4.

The thickness of the puddle wall varies considerably in the different examples given in the diagrams before you, a fair average being the Row bank of the Paisley Waterworks, Fig. 6; and although in instances of dams made early in this century, such as the Glencorse dam—Fig. 5—of the Edinburgh Waterworks, the puddle was of very considerable thickness, and it would appear rightly so. This practice does not seem to have been followed in many cases, as, for instance, again referring to the Dale Dyke dam, Fig. 2, where the thickness of the top was only 4ft., with a batter of 1 in 16 downwards, giving a thickness of 16ft. at the base. For a dam 95ft. in height this is very light, compared with that of the Vehui dam at Bombay, of which the engineer was Mr. Conybeare Fig. 7—where the puddle wall is 10ft. wide at the top, with a batter downwards of 1 in 8, the Baun reservoir—Fig. 8—of Mr. Bateman's design, where the puddle is 8ft. broad at the top, and other instances. The same dimension was adopted for the puddle wall of the Harelaw reservoir at Paisley, by Mr. Alexander Leslie, an engineer of considerable experience in dam construction.

There appears to be a question as to what the composition of puddle should be, some advocating a considerable admixture of gravel with clay. There is no doubt that clay intended for puddle should be exposed to the weather for as long previous to use as possible, and subject to the action of the air at any rate, of sunshine if there be any, or of frost. When deposited in the trench it should be spread in layers of not more than 6in. in thickness, cut transversely in both directions, thoroughly watered, and worked by stamping.

The position of the puddle wall is, as a rule, in the centre of the bank and vertical, but laying a thickness of puddle upon the inner or up-stream slope, say 3ft. thick, protected by a layer of gravel and pitching, has been advocated as preventing any portion of the dam from becoming saturated. There are, however, evident objections to this method, as the puddle being comparatively unprotected, would be more liable to damage by vermin, such as water-rats, &c.; and in case of the earthwork dam at the back, settling, as would certainly be the case, unless its construction extended over a very lengthened period, the puddle would be almost certain to become fissured and leaky; in addition, the comparative amounts of puddle used in this manner, as compared with the vertical wall, would be so much increased. With the puddle wall in the position usually adopted, unequal settlement of the bank on either side is less liable to affect the puddle, being vertical.

It would be interesting to refer to the embankment of the Bann, or Lough Island Reavy reservoir, Fig. 8, designed by Mr. Bateman, now nearly fifty years ago, where a layer of peat was adopted both on the slope, 15in. thick, and in front or on the up-stream side of the puddle wall, 3ft. thick. The object was, that should the puddle become fissured and leaky, the drought so created would carry with it particles of peat which would choke up the cracks and so reduce the leakage that the alluvial matter would gradually settle over it and close it up. On the same diagram will be noticed curved lines, which are intended to delineate the way in which the earthwork of the embankment was made up. The layers were 3ft. in thickness, laid in the curved layers as indicated.

It is a moot question whether in making an earthwork embankment dependence, as far as staunchness is concerned, should be placed upon the puddle wall alone, or upon the embankments on either side, and especially upon the up-stream side in addition. Supposing the former idea prevails, then it can be of little moment as to how or of what material the bank on either side is made up—whether of earth or stone—placed in thin layers or tipped in banks of 3ft. or 4ft. high; but the opinion of the majority of engineers seems to be in favour of making the banks act not merely as buttresses to the puddle wall, and throwing the whole onus, as it may be termed, of staunchness upon that, but also sharing the responsibility and lessening the chances of rupture thereby. But to insure this, the material must be of the very best description for the purpose. Stones, if allowed at all—and in the author's opinion they should not be—should be small, few, and far between. Let those that are sifted out be thrown into the tail of the down-stream slope, they will do no harm there, but the layers of earth must not approach 3ft. in thickness, nor 1ft.—the maximum should be 6in.—and this applies also to the puddle. Let the soil be brought on by, say, one-horse carts, spread in 6in. layers, and well watered. The traffic of the carts will consolidate it, and in places where carts cannot traverse it should be punned. In the Parvy reservoir dam a roller was employed for this purpose. It comprised a small lorry body holding about a yard and a-half of stone, with two axles, on each of which was keyed a row of five or six wheels.

At the Oued Meurad dam in Algeria, 95ft. high, constructed about twenty-three years ago, the earthwork layers were deposited normal to the outer slope, and as the bank was carried up the water was admitted and allowed to rise to near the temporary crest, and as soon as the bank had settled, the earthwork continued another grade, and the same process repeated.

(*To be continued.*)

[1] Paper, with slight abbreviation, read by Mr. David Gravell, Assoc. M. Inst. C.E., before the Society of Civil and Mechanical Engineers. The paper brings together in a convenient form the sections and salient facts concerning many dams. It was illustrated by numerous diagrams from which our engravings have been prepared, some of which are given on page 187.

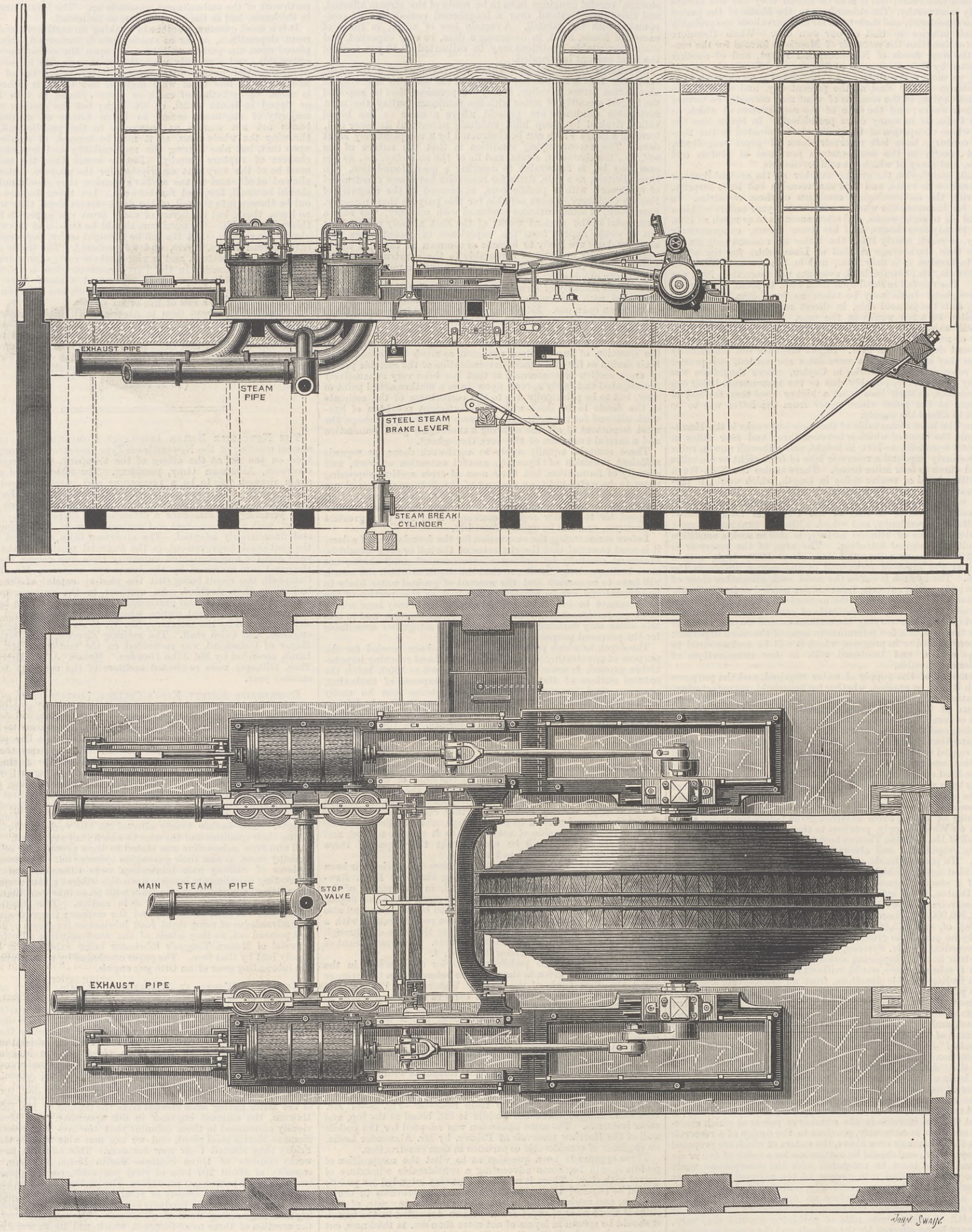
The Newcastle Boiler Insurance Company.—The eighth annual meeting of the Newcastle-on-Tyne Insurance Company was held on the 1st at the offices of the Company, Grey-street, the chairman, Alderman Gray, presiding. The statement of affairs again showed this to be a prosperous and carefully conducted undertaking. There are about 4000 boilers throughout England and Scotland insured in the company, the directors of which were able yesterday to announce a dividend of 10 per cent. Their report, with a balance-sheet and engineers' report, were submitted and unanimously adopted.—The chairman fully explained as to the continued improvement in the financial position of the company and the unprecedented immunity from any claims, showing the great care exercised by the company's engineer, Mr. W. E. Campbell, the result being that the paid-up capital of the comhad more than doubled. An accident to the engineer evoked expressions of regret, and gratification that he would soon be able to resume his important duties, which had, in the interval, been well performed by the secretary, Mr. W. B. Jackson, the assistant engineer, and extra staff. The retiring director, Mr. Davidson, Mayor of Gateshead, was re-elected on the motion of Mr. John Lamb, seconded by Mr. John Howden. Messrs. J. A. Batty and Thos. Gillespie were re-elected auditors of the company for the ensuing year.

Engineering Society, King's College, London.—At a general meeting held on March 1st, Mr. P. T. Gask read a paper on "Lubricants and Lubricating Appliances." The author began by a few general remarks upon the growing importance of the question of lubrication, and the decrease of expenditure consequent upon the adoption of an efficient method. The requirements of a good lubricant were then given, and apparatus for finding the "body," the "flashing" point, and the liability to "gum" of can oil being described. Great stress was laid upon the use of an easily oxidised lubricant, as many large and disastrous fires have resulted from this cause. A remedy is found by mixing mineral with animal and vegetable oils, as the former is entirely freed from that danger. The author briefly alluded to the various lubricants, giving their qualities and the uses to which they are suited. John Bell and Sons' asbestoline was stated to have proved very efficient in many cases, as also their gas engine cylinder oil. The two rival systems of railway axle lubrication were discussed and some interesting experiments bearing upon this subject given—a greater force being required to start a train with oil as lubricant than with grease, but less force to keep it in motion. The question of lubricators was then discussed, and the ordinary forms described. The advantages of using sight feed lubricators for steam cylinders was pointed out, as they admit of the most accurate adjustment, a model of Messrs. Tangye's lubricator being exhibited, it being kindly lent by that firm. The paper concluded by a description of the lubricating gear of an Otto gas engine.

New Steel Works at Middlesbrough.—On Friday, at the invitation of Messrs. Dorman, Long, and Co., of the Britannia and West Marsh Ironworks, Middlesbrough, a large party, including the members of the leading firms of the Cleveland district, visited the Britannia Works for the purpose of witnessing the first tapping of a portion of the extensive steel furnaces which the firm have recently added to their large plant on the Marshes at Middlesbrough. Both the leading partners, Mr. Dorman and Mr. De Long, were present and received their visitors, whom they courteously conducted over the splendidly laid out plant, which embraces all the newest appliances for iron and steel making, most of the latter having been erected from the designs of Mr. Richard Howson, the eminent engineer in this speciality. We have previously announced in these columns that the firm was erecting a Siemens-Martin steel plant, and we are now able to state that on Friday they started their new furnaces. This addition to their works consists of three Siemens-Martin 18-ton furnaces, of a capacity of about 200 tons of steel per week, each supplied by seven Wilson's patent gas producers. The process, as is well known, allows of any desired quality of steel to be made from hematite ores, thus rendering the products especially suitable for shipbuilding and engineering work of all classes. The firm are busy with the erection of three more furnaces, which will be at work in the course of a few weeks, and which will enable them to have an output of about 1200 tons per week. This is very important to the Cleveland district, as it will render it independent of outside supply. The party, in viewing the works, noticed the particularly light but exceedingly strong roof of the steel department, the columns of which, instead of being of cast iron, as is usual, are made of rolled joists of the firm's well-known manufacture. While these are of very neat and light appearance, they are much stronger than are ordinary cast iron columns. It is the intention of the firm to continue the manufacture of girders, of which they have obtained a speciality in steel. It is thought that steel girders will be very beneficial both to the engineering and building trades, allowing, as it will, lighter sections to be used, with increased strength and consequent actual saving in first cost. The visitors were afterwards shown the plant for the rivetting together of rolled joists which make various combinations of girders suitable for architectural and engineering purposes where extremely heavy weights have to be carried. The party were next escorted over the department for the finishing complete—kneeing and cambering—bulb tees for deck beams. The firm will continue to roll iron in their West Marsh Works, where they have two mills.

WINDING ENGINES AND STEEL DRUM, LADY WINDSOR PIT, BLACK ROCK COLLIERY, YNYSYBWL.

MESSRS. DAGLISH AND CO., ST. HELENS, ENGINEERS.



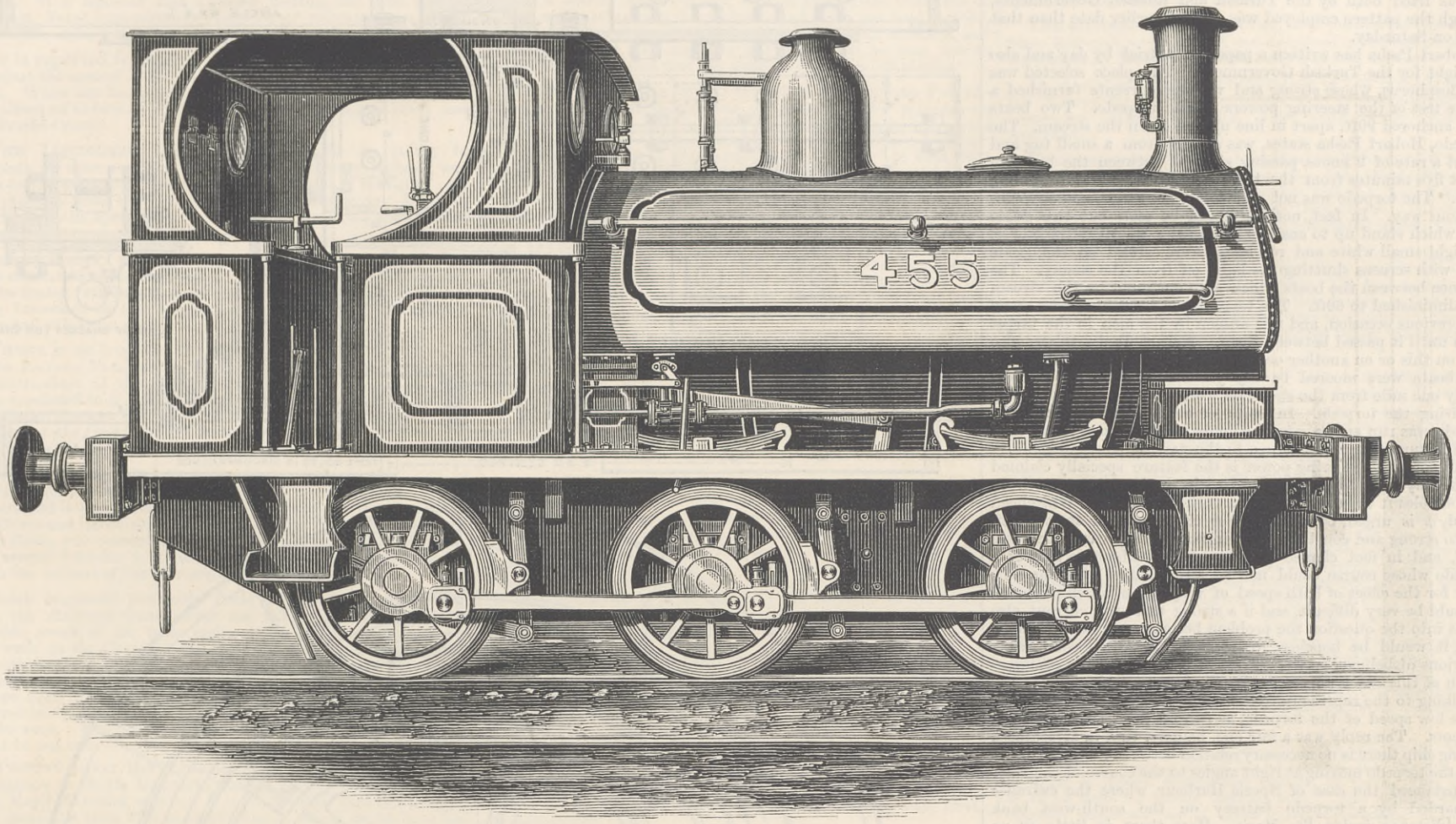
WINDING ENGINES AND WINDING DRUM.

On the 12th of October last year was started the permanent winding engine at the Lady Windsor Pit, Ynysybwl. The Lady Windsor Colliery is situate in the Clydach Valley—a mile below Old Ynysybwl—in the direction of Pontypridd. Mr. Beith, M.E. (Beith Brothers), started sinking on the 16th June, 1884. In sixteen months and four days from that time he reached the lowest seam. There are three coals which it is contemplated to work almost immediately. The No. 1 coal, at a depth of 541 yards, is 6ft. 8in. thick; the No. 2 coal, at a depth of 559 yards, is 7ft. 6in. thick; and the No. 3 coal, at a depth of 601 yards, is 9ft. 10in. thick. The whole series is of the finest quality smokeless steam coal. The shaft has been sunk to a total depth of 630 yards. The Schiele fan for ventilating the colliery is guaranteed by the makers to deliver 300,000 cubic feet of air. The sinking was, it is said, an unexampled feat in the history of the Welsh coalfield. The downcast—the winding—pit is 19ft. in the clear of the brickwork, and the upcast is 17ft. The permanent winding machinery was erected during the sinking.

We illustrate the winding engines constructed by Messrs. Daglish and Co., St. Helen's. The steam cylinders of these engines are 42in. diameter, and the piston has a stroke of 7ft. The piston rods are of steel, carried through both ends of the cylinder, and are 6½in. diameter at the front end and 5½in. diameter at the back end. There are two valve boxes to each cylinder, each valve box containing two gun-metal equilibrium valves; the steam valve has an area of 95in., and the exhaust valve an area of 113in. The valve spindles are of steel, 1⅜in. diameter. These valves are worked by excentrics on the drum shaft, with an improved arrangement of the reversing link motion. The arrangement for opening and closing the valves is the patent of Mr. Geo. Heaton Daglish, and is an adaptation of the motion of the slide valve to that of the lifting valve. The radius rod of the link motion is connected by suitable levers to a long sliding bar working in frames on the top of the valve boxes directly over the valves. On this bar is fixed a cast steel cam for each valve, working through a lifting box screwed to each valve spindle, and which has a cast steel roller under which the cam works. These cams are fixed on the bar in such a position as to lift the steam and exhaust valves of each box alternately, and being loose on the bar and secured by a bolt, are capable of the nicest adjustment, and are made of such a form as to lift the valve rapidly, and will also close the valve in its return stroke, should there be any tendency to stick. The sliding bar is carried on antifriction rollers so as to make the reversing motion as easy as possible to the engine-man. This arrangement of valve gear has now been at work for ten years on other engines made by the firm, and has given great satisfaction both in the speed attained by the engines, the easy

CONTRACTOR'S LOCOMOTIVE.

MESSRS. PECKETT AND SONS, BRISTOL, ENGINEERS.

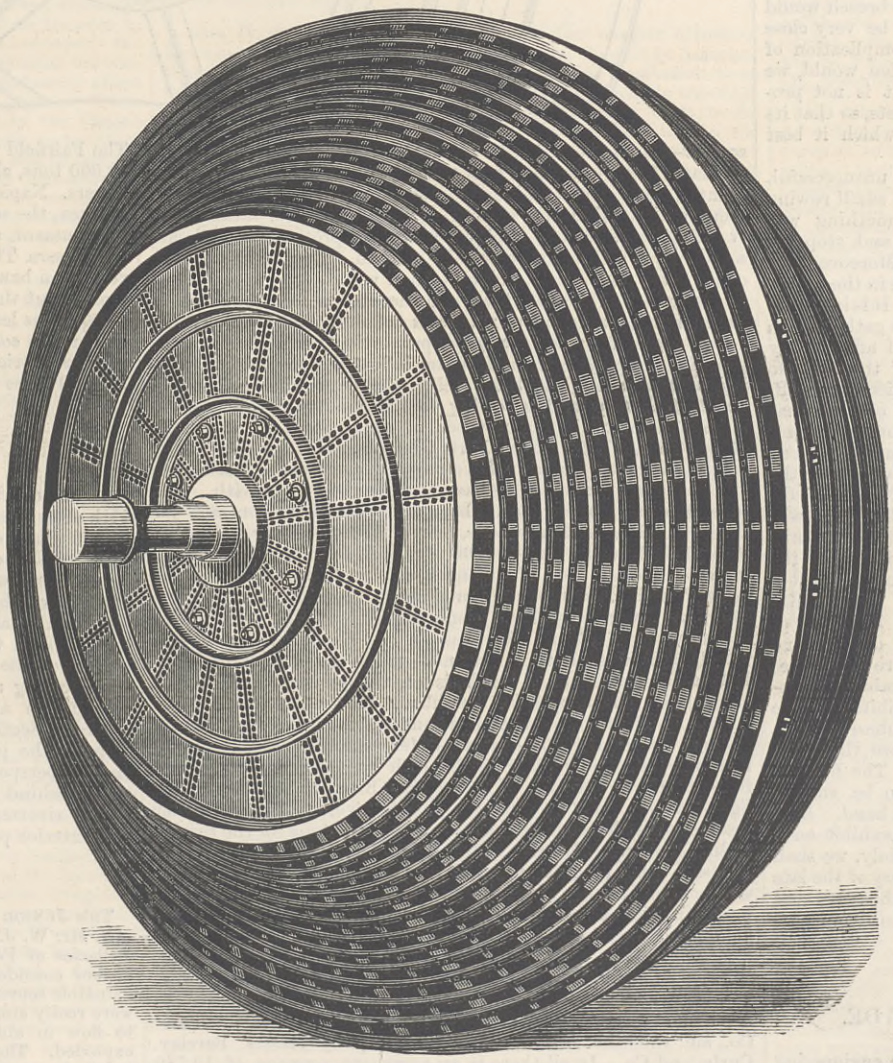


handling by the engine-man, and by the almost total absence of wear. The crossheads, connecting rods, and cranks, are all of the best hammered scrap iron. The crank pins are steel, 9in. diameter, and 12in. long. The foundation plates are 18in. deep, and 1½in. thick. The slide blocks are 28in. long, and 9in. wide, with adjustable slippers on the bottom side. The bearings of the drum shaft are 18in. diameter and 30in. long.

The winding drum illustrated on the next page is made entirely of Siemens-Martin steel, with the exception of the two main bosses of cast iron, which fit on the drum shaft; and is constructed under the method patented by Mr. Geo. Heaton Daglish. It is made on the spiral conical principle, and is 18ft. diameter at the base of the cone, and 33ft. diameter at the top of the cone. The spiral grooves on the face of the cone are made of a specially-rolled section of steel to suit the rope. The cone is formed of strong frames of T-section, without any plates, and well tied and braced together. The face of the cone is curved in such a way as to allow the grooves to be fixed at uniform pitch, and, at the same time, to give ample tangential clearance to each succeeding coil. Distance pieces are rivetted between each coil on every frame, so as to reduce the strain of the load on the rivets of the coil. The gross load starting from the bottom of the shaft is twelve and a-half tons.

At present there are six boilers placed in position, but five only are used. When the colliery is in full work it is expected that as many as twelve boilers will be required. The fan, it should be added, is 14ft. 6in. diameter. It is worked by a single 26in. cylinder engine, with a 4ft. stroke. Arrangements have been made in the construction of the engine-house for duplicating the engine power if necessary. The engine-house itself is spacious and lofty, and though it seems to be lightly constructed, is yet so firm and solid that the vibrations of the immense drum are scarcely felt.

The large arches at the pit bottom, opposite four roadways, are 22ft. 6in. in the clear, and about 16ft. high. Humble's detaching hooks are used for winding. They are safeguards against over-winding. The cages for carrying the coal up to the surface are spacious enough to take two trams of the size used by the Ocean Company, so that four tons of coal are raised at each lift. The main outlet for the coal will, of course, be the downcast shaft, at which the winding engine is, but coal can be worked through the upcast shaft, some little distance off. This has been a main outlet hitherto, but for the future it will be chiefly used as a ventilation shaft. The coal will be sent to the ports *viâ* Aberdare Junction. About a mile of double sidings is to be laid down by the company. The first sod of the colliery was cut by Mr. Morgan Joseph. It is computed that at least £150,000 have been spent on the colliery. Mr. William Jenkins, Ystradfechan, will be the chief manager; Mr. W. Bevan, assistant manager; and Mr. John Talbot, surveyor. Mr. Jacob Rees, Treorky, was the architect, and Mr. George Wilkins was the contractor for the masonry.



WINDING DRUM, BLACK ROCK COLLIERY.

CONTRACTOR'S LOCOMOTIVE.

We give above an engraving of a tank locomotive engine, designed and constructed by Messrs. Peckett and Sons, of the Atlas Engine Works, Bristol, which has been specially designed for the use of contractors, and is also well adapted for collieries, ironworks, and many other purposes, and is neat and strong. This locomotive, as will be seen from the illustration, is of the saddle tank type, and is fitted with inside cylinders of special hard cylinder metal, 12in. diameter and 18in. stroke. This engine is of the usual 4ft. 8½in. gauge, with six wheels coupled, 3ft. diameter, with a short wheel base of 10ft., the tires of the driving wheels being turned thin to facilitate its passage round sharp curves. The axles are of the best Bessemer steel, 5in. diameter, and the journals are 5in. diameter and 6in. long. The wheel tires are of the best Bessemer steel, 2¼in. thick on the tread, and 5in. wide. The framing consists of two solid wrought iron plates, ¾in. thick, 2ft. 8in. deep, and 18ft. 8in. long, running from end to end of the engine, well stayed together with cross stays. The boiler barrel is made of the best Siemens-Martin mild steel plates, ⅜in. thick, 10ft. 9½in. long, and 2ft. 10in. diameter, the longitudinal seams being all double rivetted, and the shell well stayed with strong gusset stays. The outer shell of the fire-box is also made of the best Siemens-Martin mild steel plates ⅜in. and $\frac{7}{16}$in. thick. The fire-box crown is stayed direct to the shell, the stay bolts, which pass through the shell plate, taking hold of the stirrups fixed to the fire-box crown, so that the upward expansion of the fire-box when raising steam is freely permitted. The internal fire-box is made of selected copper plates, the crown, sides, and fire-door plate, being ⅜in. thick, and the tube plate $\frac{11}{16}$in. The tubes are of solid drawn seamless brass, 75 in number, and are 1¾in. diameter. The heating surface is of ample capacity. The boiler is constructed for a working pressure of 140 lb. per square inch, and is fed by two Giffard's No. 5 injectors, which are amply sufficient for the purpose. The tank is placed on the boiler barrel, and will contain 600 gallons of water, and is securely fastened to the frames and smoke-box. The piston-rods are of steel, 2in. diameter, and the connecting and coupling rods are of the best forged scrap iron, and are fitted with heavy gun-metal brasses. The coupling pins are of steel, 3in. diameter, and 2½in. long.

This engine is fitted with a powerful screw brake acting on all the wheels by means of cast iron brake blocks. There is also an adequate sanding arrangement on each side of the engine worked by levers from the foot-plate. A coal bunker is placed on the foot-plate with a capacity of 20 cwt. There is also a weather board and awning over the foot-plate, as shown in the illustration; and the engine is supplied throughout with the usual fittings, the feed, jet, and warming pipes being of solid drawn copper. The weights are evenly balanced, the engine is well painted and finished, and weighs, empty, 15 tons 16 cwt., and about 20½ tons when in working order.

THE LAY TORPEDO.

On Saturday last, March 4th, a trial of the Lay torpedo took place off Brightlingsea, which was attended by officers of the Royal Navy and Royal Artillery and Engineers and others interested in the question. The Lay torpedo is the invention of Colonel, or Mr. Lay—we do not know which designation he prefers. The inventor employed a spar torpedo with considerable success in the American war, and has now given his attention to the question for many years and made a great number of experiments. The torpedo with which we are now concerned is a locomotive one, impelled by carbonic acid gas and steered by electricity. The speed can be arranged before it starts within certain limits. After it is once started it cannot be altered. Thus, it can be set to run for 300 yards at a rate of 25 knots an hour, or, on the other hand, for seven miles at the rate of five miles an hour. These are the extremes. The torpedo which was tried on Saturday was arranged to run two miles and 400ft., cable of this length being wound up in its interior. This torpedo was 23ft. long, it weighed 1¼ tons. It was cylindrical in form, except that its head was of the usual sharp conical shape. The propeller was in the head; it had a rudder astern and a single keel. In the fore part it is capable of carrying a charge of 150 lb. of explosive. The cylindrical form is adopted to enable the wire to be coiled conveniently without risk of fouling. This, of course, entails some sacrifice in motion, seeing that the tapered stern, common to fish and fish torpedoes, has been established from the time of Sir Isaac Newton as the one that offers least resistance, and it also moves with least disturbance through the water. The speed to be attained was 15 knots.

The motive power, that is the carbonic acid gas, is applied by means of the ingenious spherical engine, of Messrs. Heenan and Froude, of Manchester. The torpedo is intended to be worked either from a fixed base or from a small boat, which might take it out to any required spot before starting it. The main object of the Lay torpedo at present is coast defence. With this view it was tried both by the Turkish and Russian Governments, though the pattern employed was one of earlier date than that tried on Saturday.

Hobart Pasha has written a paper on a trial by day and also by night for the Turkish Government. The place selected was the Bosphorus, whose strong and varying currents furnished a severe test of the steering powers of the torpedo. Two boats were anchored 90ft. apart in line up and down the stream. The torpedo, Hobart Pasha states, was started from a small tug and ran at a rate of 9 knots, passing straight between the boats in about five minutes from the time of starting without wasting cable. The torpedo was not considered to be visible in any conspicuous way. In fact, nothing could be seen but two guide rods which stand up to enable the operator to direct its course. At night small white and red lamps were carried on the guide rods, with screens shutting the light off from the enemy. The distance between the boats which were anchored in the stream was diminished to 60ft. The torpedo ran between them as on the previous occasion, and was unseen by the men in the target boats until it passed between them. Hobart Pasha relates also that on this or on another occasion, it is not quite clear which, two boats were moored twenty yards apart at a spot chosen nearly one mile from the shore, on which was placed the battery for firing the torpedo. In spite of complicated currents the torpedo was run at the rate of 9 knots between these boats, then made to turn round and return to the starting point on shore.

This complete steering power is the feature specially claimed for the Lay torpedo as compared with the Brennan or others. This enables it to be employed for work for which the Whitehead would, it is urged, be useless. For example, in a stream subject to strong and constantly varying currents it would be guess work, and in fact chance work to a great extent, to project a torpedo whose course could not be altered after starting. To allow for the effect of both speed of torpedo and of ships armed it would be very difficult, and if a strong unknown current also comes into the question the problem becomes one which, practically, it would be hopeless to attempt. Hobart Pasha was a notorious disbeliever in the powers of torpedoes. His commendation of this one is therefore the more remarkable.

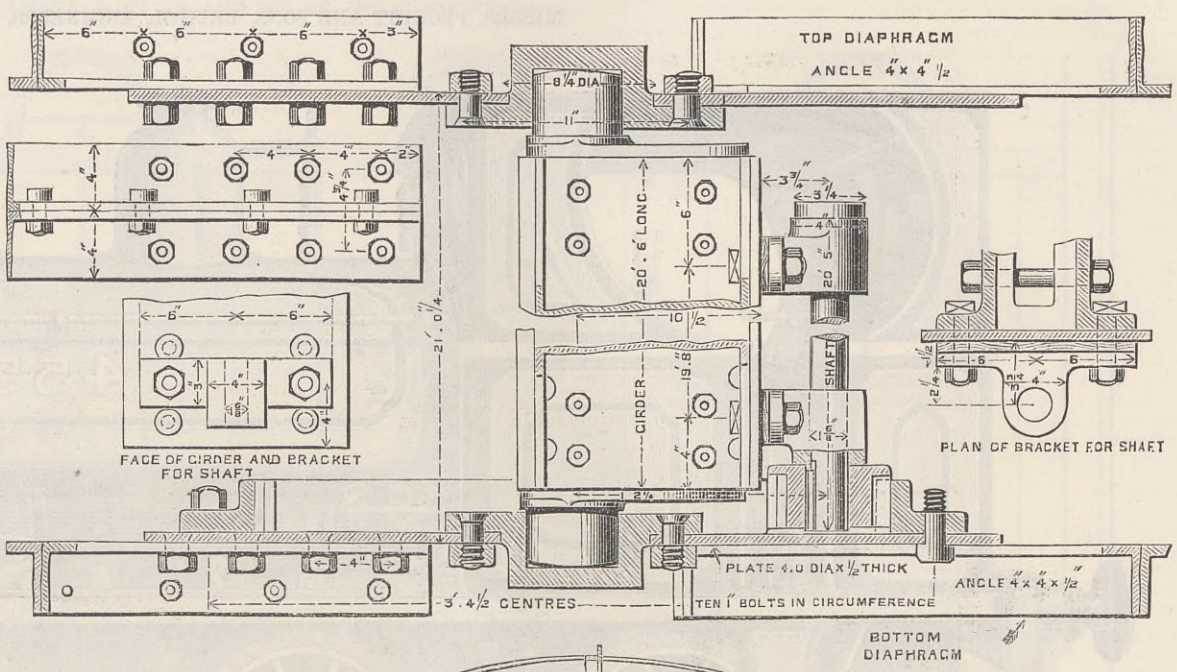
Talking to the representatives of Messrs. Balfour we objected to the low speed of the torpedo, as run on this occasion, that is 15 knots. The reply was a fair one, namely, that in attacking a moving ship there is no necessary relation between the speed of the ship, the torpedo moving at right angles to the course of the ship. We instanced the case of Spezia Harbour, where the entrance is guarded by a torpedo battery on the south-west bank some distance inside St. Maria. Here there is little or no current, and the case is comparatively a simple one, and it is possible that torpedoes might be actually kept as suggested lying in the water ready, and started at vessels as they came nearly opposite to them. This, we think, is perhaps the most formidable way in which they could be used. As to vessels lying at anchor, it is probable that they would not be caught in such a position without fenders, crinolines, or netting guards of some kind. It is urged that although the first torpedo might be exploded by the netting, a second one following would find its way through the breach made by the first. This we do not believe. Immediately after the first explosion the breech would cease to be visible, and the second would have to be very close on the heels of the first to get through, and complication of steering wire and the *débris* of the first explosion would, we think, make the chance of success very small. It is not proposed at present to carry the Lay torpedo with fleets, so that its most promising function at present, and that in which it best acquits itself, is the guarding of channels.

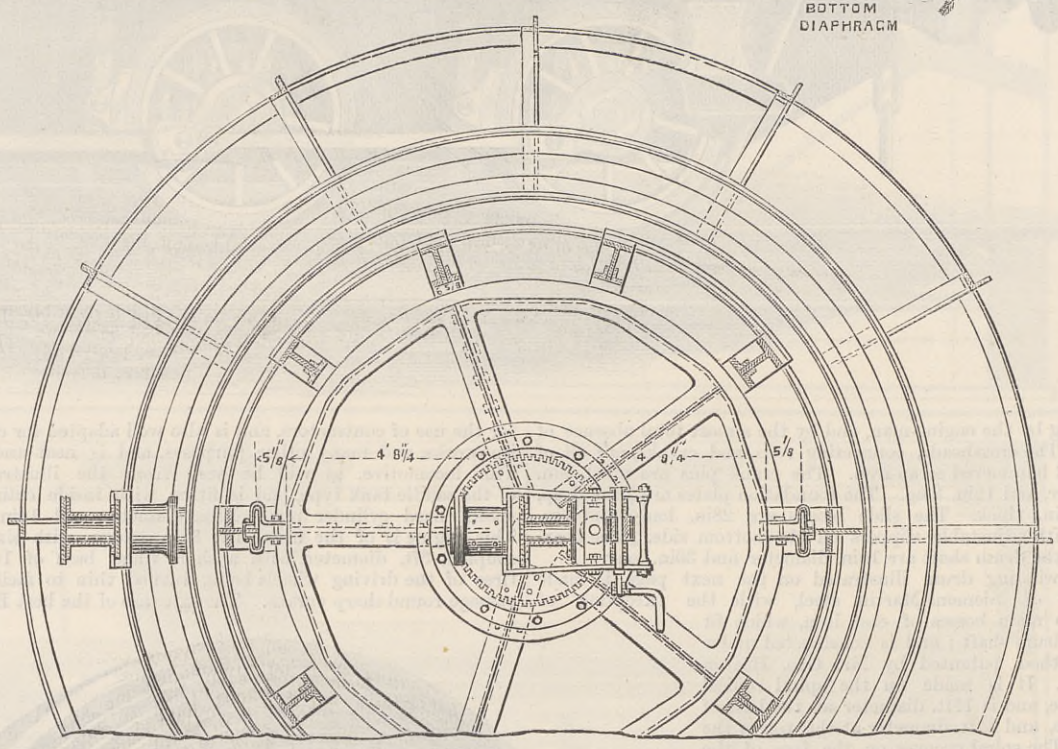
The trial on Saturday was unfortunately unsuccessful. Colonel Lay started the torpedo, working it from a small rowing boat, but immediately it was apparent that something was wrong. The torpedo moved for a short distance and stopped, and nothing more could be done at the moment. Moreover, the torpedo was not running properly. It was too high in the water, and far too visible, and it had a list over to one side. It is intended to be only a few inches below the water, and we gather from the description that the depth is in a measure affected by the speed. This may account for the visibility of this torpedo perhaps. As it was it did no sort of justice to itself. We understood a distinguished naval officer to observe that on service he would hang a captain who allowed himself to be struck by such a thing. The explanation offered of the misfortune is that, owing to wrong information, the attempt was made at low tide, when the water is full of weeds, and that the screw and wire had become entangled in weeds, and a short circuit was set up. Awkward management or mistakes of this kind must be distinguished from faults in the design of the torpedo itself. It was so unfortunate that a number of spectators should be invited to see an unsuccessful attempt made by Colonel Lay himself, that there is danger of over-rating the significance of it. No one would depend on a single torpedo, and it seems improbable had there been more that all would have failed, even under unfavourable circumstance. We hope to witness a more successful exhibition of the Lay torpedo shortly. In the meantime we say, unhesitatingly, that the behaviour must be very different in more than one respect from that of last Saturday's torpedo. The torpedo must be very much less visible, and it ought to be started promptly at a given signal, and shown to be well in hand. If at this stage of development Colonel Lay does not exhibit on a show day something that acts promptly and certainly, we shall be inclined to think that he is beset with the infirmity of the late Mr. Babbage, who could not be got to perfect one thing because he was constantly tempted by greater future possibilities which some new unworked design presented to his view.

THE CLYDE SHIPBUILDING TRADE.

The state of the Clyde shipbuilding and marine engineering industries has recently been undergoing a gradual improvement, berths which have been long vacant again becoming occupied, and yards which have been closed again resuming operations. Speaking generally, the new work secured, or on hand, more than makes up for the rate of output. During the past four months, vessels aggregating about 45,000 tons have been launched, while the orders booked for vessels of all kinds during the same period represent nearly 81,000 tons. The output for the month just closed is remarkably small, consisting of six vessels of 6799 tons; as much as 5000 tons of which are made up by the contribution of Messrs. J. and G. Thompson in the new Spanish armoured cruiser Reina Regenté launched by them. Only on two occasions within the past decade has the monthly output been so low—in October, 1886, when the total was 6634, and in January, 1884, with 6672 tons. What may thus appear from one point of view a lamentable state of matters, is in another and more philosophical way of looking at it, matter for satisfaction. It is in slow and steady production that the prospects of ultimate solid revival will be more surely realised. During the month of February just closed, orders for new vessels have been booked to the extent of 18,000 tons, and there are a few inquiries in the market of which more may soon definitely be heard. Of the vessels secured, by far the larger proportion are steamers, thus providing employment for the sister industry of marine engineering, which for long has been feeling the depression even more keenly than shipbuilding, owing to the number of sailing ships built and to the larger number of competitors in the field. Messrs Russell and Co. of Port Glasgow, noted for their large output of sailing tonnage, have recently commenced work upon two steamers, the first they have as a firm had to do with. The same firm are understood to have also secured the contract for three additional sailing vessels, one of 1700 tons for a Glasgow firm, and the other two of 1600 tons each for a firm in London. Messrs Caird and Co., of Greenock, are busily occupied with the large P. and O. steamers ordered some time ago, and Messrs. Scott and Company have commenced to build a first-class steam yacht of about 100 tons for a Highland gentleman. At Dumbarton matters are not much improved of late; but a fair amount of work is on the stocks, especially as compared with its opposite neighbour Port Glasgow. Messrs. Birrell and Stenhouse have been commissioned to build an iron sailing vessel of 1700 tons, an order which enables them to resume operations in their yard, which has been entirely closed for some time. Messrs. W. Denny and Bros., in addition to the light-draught work on hand for Indian river traffic and other heavier work, have secured a steamer of 1300 tons for the British India Company. Messrs. McMillan and Son have three steamers of about 2500 tons for a Greek firm on hand, and a passenger steamer for Canada, which they have just launched. At Clydebank the launch of the cruiser Reina Regenté reduces the amount of work on the stocks considerably, and will result in the dismissal of a large number of operatives unless, as is expected, some new work for the Spanish Government is forthcoming. Two contracts have been secured for the Whiteinch district; one a steel screw steamer of 3000 tons, by Messrs. C. Connell and Co., and the other a 2000-ton sailing ship by Messrs. Barclay, Curle, and Co. In all there is an aggregate tonnage of 13,780 tons on hand at Whiteinch, as compared with 6280 tons at the beginning of the year. Messrs. D. and W. Henderson and Co., of Partick, have secured the contract to build for the Allan Line a steamer of 3000 tons for transatlantic service. Several other important Clyde firms tendered for this vessel—a full specification of which was furnished by the owners to all who tendered—and it is understood Messrs. Henderson's price was a very low one. In the yard of Messrs. A. and J. Inglis, Pointhouse, a steamer of 5000 tons is being laid down on the "spec" principle, mainly with the view of affording employment to the men out of work. Messrs. Alex. Stephen and Sons, Govan, have recently booked an order for a steamer of 2000 tons, making the number of vessels on hand six, and the tonnage about 15,000. The Fairfield Company has five vessels on hand representing 13,000 tons, all of which are in the later stages of construction. Messrs. Napier and Sons will launch on the 10th inst. the Galatea, the second belted cruiser built by them for the British Government, and are beginning work on a steamer of 3500 tons for Messrs. Thompson and Co., of Aberdeen. The tonnage of vessels on hand throughout the Govan yards amounts to 37,000 tons, about the same as at the beginning of the year, and some 12,000 tons less than at the corresponding period in 1886. Altogether it is computed that the vessels on hand throughout the various districts number about seventy-five, and aggregate some 120,000 gross tons.

THE FORTH BRIDGE.—PIVOTTED GIRDER AND CAGE.





THE FORTH BRIDGE.

In the engravings published in The Engineer of the 4th and 11th of last month, illustrating the North Queensferry steel pier now in course of erection, the cages in and by which the rivetting together of the plates of the vertical and the inclined 12ft. tubes is performed were shown in several places. We now, through the courtesy of the engineers, give a perspective view, with a plan and some details of one of these rivetting cages. From these it will be seen that attached to the strong ring at the top and bottom of the cage is a vertical girder which carries one part of the rivetting apparatus, while the other part of the rivetting machine is attached to the similar pivotted girder in the centre. Sections of the outer and inner vertical girders are seen in the plan above, with details for their attachments. In our perspective view the outer rivetting girder happens to lie behind two angle-verticals of the cage, but the position of the rivetter is shown. The whole cage, including its inner and exterior parts, is raised from within as the work proceeds.

The Junior Engineering Society.—On Friday evening, 25th ult., Mr. W. J. Tennant read a paper before this Society on "The Fallacies of Perpetual Motion." Defining perpetual motion, the author considered it should be more precisely termed "the inexhaustible source of power," this being what perpetual motion men were really aiming at, specifications of these absurdities continuing to flow in almost daily, proving the idea to be by no means exploded. The consideration of principles opposing was next touched upon. It was impossible to conceive a machine which should be capable of giving out perpetually an excess of energy above that energy which was utilised to give it motion. Reference was made to Bernardi's thermomotive wheel as an illustration of a direct heat engine, after which an investigation was made of some examples of so-called perpetual motion machines, the obvious causes of failure in them being pointed out. Models of several were exhibited. Spence's spinning bar and the culminating exposure of the fraud in the discovery of secreted mechanism beneath the containing case were described, the author concluding by demonstrating the impossibility of the existence of an inexhaustible source of power, since the creation of energy by any human agency would involve the suspension of the laws of Nature. An interesting discussion followed the reading of the paper, after which a cordial vote of thanks was accorded the author.

RAILWAY MATTERS.

THE directors of the Great Northern Railway have elected Mr. Reginald Wigram, of the firm of Messrs. John Fowler and Company, engineers, Leeds, to a seat at the Board.

GREAT faith in the value of railways is shown in South Africa. It is reported that a public meeting has been held at Estcourt, Natal, approving the extension of railways, even at the imposition of fresh taxation.

IT is reported from New York that Mr. Jay Gould has acquired the control over the St. Louis and San Francisco Railroad. When this line is annexed to the Missouri Pacific system it will afford an unbroken route between the Mississippi River and the Pacific Ocean.

THE Lieutenant-Governor of Bengal is going to Purneah to open a section of the Assam and Behar Railway, and then to Rhawulpore to open the new waterworks in that city. He will probably make over his office to Sir Steuart Bayley, K.C.S.I., C.I.E., early in April.

THE discussion on Mr. W. P. Marshall's paper on "Railway Brakes," read on Wednesday at the Society of Arts, has been adjourned to Monday evening next, 14th inst. The secretary of the Society will be happy to send a card of admission to anybody interested in this subject on application. Sir Frederick Bramwell will again preside.

THERE is no truth in the statement published last week in the *Railway News*, that "Mr. T. W. Worsdell, chief locomotive superintendent at the North-Eastern works, at Gateshead, has been appointed to a similarly important position on the London and North-Western line. Mr. Worsdell will be succeeded by Mr. Holden, of the Great Eastern Railway, who served his apprenticeship under the North-Eastern Railway at Gateshead."

SOME Colonial tenders seem to permit of considerable profit or considerable paring. *The Colonies and India* says:—"The Queensland Government, upon a reconsideration of the tenders for the Cairns and Herberton Railway, has decided to accept that of Mr. John Robb, who consented to reduce his tender by about £25,000. The amended tender is under £300,000, and about £200,000 less than the highest of the four originally sent in."

SOME engineer probably feels relieved, or ought to, says the *Railroad Gazette*, over the miraculous escape from a terrible wreck of the train under which a 60ft. iron bridge fell last week on the Cleveland and Pittsburg Railroad, because of a defective bridge foundation. All the conditions were present for a disaster as fatal as, and more discreditable than Ashtabula, except high speed and a very heavy train. No one was even injured badly, but the accident was one of the most notable ones of the week. Fire broke out instantly, which, as no one was hurt, could be put out.

WRITING upon the collision which occurred on the 4th of January at Shotts Ironworks sidings on the Caledonian Railway, Major Marindin says:—"It is thus evident that this collision of a passenger train with an empty wagon, which might have had most disastrous results, arose from a collision between two engines on an ironworks' branch, and a second collision between one of them and some empty wagons on a siding, and that the servants of the Caledonian Railway Company are in no way responsible for it. The continuous brake with which the train was fitted does not appear to have had time to do much to avert the collision, but, being automatic, it remained on, although the leading brake pipe on the engine was broken by the collision, and probably, by its action on the carriages, had some effect in keeping them upon the rails, and lessening the shock of the collision."

REFERRING to the statement that it is proposed to make over an important section of the Punjab Railway system to the management of the East India Railway, and to transfer to the East Indian the line from Ghaziabad to Saharunpur, the *Indian Engineer* says:—"This measure will entirely alter the condition of railway traffic in the province. It will materially affect the convenience of the travelling public. It will seriously interfere, so far as we can see, with the development of the Punjab generally. The object of the proposal is apparently to facilitate railway traffic between the Punjab and Calcutta, and to tap, for the benefit of the Bengal port, districts which have hitherto sent their surplus produce to Karachi. In other words, the commercial prosperity of the East Indian Railway is to be promoted at the expense of the line that connects the Punjab with its natural seaport in Sind."

IN mentioning that the first through express from Adelaide to Melbourne reached the latter town on January 20th, the *Colonies and India* says:—"Through railway communication between Adelaide and Melbourne is an event not to be lightly passed over. This was initiated on January 19th, when the first express train was despatched in the presence of some 400 persons on a journey that will be for ever memorable as a red-letter day in the history of the two colonies. The distance between Adelaide and Melbourne as the rail goes is 500 miles, and it can be accomplished in nineteen hours. This is a revolution which cannot fail to affect for good the whole of the colonies on that continent. The railway is splendidly laid throughout, and the carriages, especially the first class, are fitted up most luxuriously. The English mails will in future be landed at Adelaide, and passed on to the other colonies over this line—an operation which will save many hours in their delivery." It is somewhat illustrative of the matter of course way in which engineering works are now accepted that a new road 500 miles in length should be opened almost without comment.

THE non-automatic vacuum brake has now become not only untrustworthy in case of need, but has itself been the cause of accident. In reporting on the collision which occurred on the 21st December last at the Citadel Station, Carlisle, when the London and North-Western down limited mail train from London to the North, instead of stopping at its usual place on the down main line, passed rapidly through the station, and was still moving at a speed of about twelve miles an hour when, at a point about 300 yards north of the usual stopping place, its engine came into collision with a Midland Company's engine, Major-General Hutchinson says:—"This collision between the down limited mail train and an unattached engine was mainly due to the failure of the vacuum brake, with which all the fourteen vehicles composing the train were fitted. On examination of the vacuum brake arrangements of the mail train soon after the collision it was found that the brake pipes between the engine and tender were completely blocked with a plug of ice, extending for about a foot on each side of the junction of the pipes. The occurrence of this collision gives rise to the question whether some improvement cannot be introduced into the tell-tale arrangement for brakes, by which it may be at once made manifest to the driver whether or not the brake pipe is clear, instead of a vacuum being indicated which may not exist. The advantage of the automatic brake arrangement advocated by the Board of Trade over that now in use on the London and North-Western Railway is also made manifest; for had the automatic arrangement applied to the whole of the mail train instead of only to the three brake vans, and had it been applicable by either one of the three guards, the train might easily have been stopped at the proper place when the driver, finding that the vacuum brake would not work, gave the brake whistles. To meet the difficulty of the formation of ice in the brake pipes, the London and North-Western Company have issued special instructions to be attended to during frosty weather, which instructions, if properly carried out, will no doubt suffice." The life of drivers and guards on the London and North-Western will soon be one continuous study of special brake instructions.

NOTES AND MEMORANDA.

IT is said that at the south heading of the New York Croton Aqueduct Tunnel, from the 22nd to the 29th of January, last, 90ft. were driven in very hard gneiss and quartz in twelve shifts.

"WE learn," says *Nature*, "from Italy that the idea of boring a tunnel between the peninsula and Sicily has been revived. The estimated cost is said to be seventy-one millions of francs, and the time required for completing the work would be from four to six years. It is stated that the depth of the sea is 160 metres."

ACCORDING to the official report of the German Patent-office, just published, the number of applications for patents rose from 5949 in 1878 to 9991 in 1886; but whilst in the former period only 25 per cent. of the applications were disallowed as not patentable, they increased in the latter to 60 per cent. In 1886, 4008 patents were sealed, whilst 5983 were disallowed.

AN American paper says:—"Dr. Kauffmann has been experimenting for the Russian Government in solidifying petroleum for use as fuel. As reported, his process is to heat the oil and then add from 1 to 3 per cent. of common soap and boil again for half an hour. The soap dissolves and then turns the liquid into a putty-like mass which is as hard as stiff tallow when cold. The product is difficult to light, burns slowly without smoke but great heat, and leaves about 2 per cent. of a black, hard residuum."

THE number of telegraph offices in Germany has nearly doubled during the last four years, during which period 4415 new ones have been opened, the total number of 5014 in 1880 having been increased to 9529 in 1884. The total length of telegraph lines has increased from 121,520 miles to 150,040 miles during the same period, an addition of 28,520 miles. The telephonic service, which was introduced into Germany four years ago, now counts 58 central offices, 7311 subscribers, and a network of upwards of 10,000 miles.

A GREAT many attempts have been made in New Zealand to produce from local materials a really good hydraulic cement, of the character of Portland cement. The *Colonies and India* says:—"Success seems to have at last attended these efforts, as Messrs. Wilson and Co., of Mahurangi, near Auckland, are now turning out an article which has stood tests to which it has been subjected in competition with the imported article. Reference may be made to a series of experiments by the Inspector to the Lyttelton Harbour Board, in which the Auckland cement only broke at a stress of 588 lb to the square inch."

IN an official report recently made to the Commissioners of the State Reservation at Niagara, Superintendent Welsh says that examinations show the average recession along the contour of the Niagara Horseshoe Fall since 1842 to have been 2·4ft. per year. At the point where the acute angle is formed the recession from 1842 to 1875 was over 100ft., and from 1875 to 1886 more than 200ft. The wearing away of the American Fall since 1842 has been but slight. The heights of the falls above the level of the water were determined by the engineers of the United States Geological Survey on August 17th, 1886, as follows:—American Fall, 167ft.; Horseshoe Fall, 159ft.

CHEMISTRY has revealed much that enables us to agree that there is more in a ton of coal than is obvious. Besides gas, a ton of gas coal will yield 1500 lb. of coke, 20 gals. of ammonia water, and 140 lb. of coal tar. Destructive distillation of the coal tar gives 69·6 lb. of pitch, 17 lb. of creosote, 14 lb. of heavy oils, 9·5 lb. of naphtha yellow, 6·3 lb. of naphthaline, 4·75 lb. of naphthol, 2·25 lb. of alizarin, 2·4 lb. of solvent naphtha, 1·5 lb. of phenol, 1·2 lb. of aurine, 1·1 lb. of aniline, 0·77 lb. of toludine, 0·46 lb. of anthracine, and 0·9 lb. of toluene. From the last-named substance is obtained the new product known as saccharine, which is 230 times as sweet as the best cane sugar.

MR. H. A. WHEELER notes that in the copper mines of Keweenaw on Lake Superior, now among the deepest in America, that usually a descent of 50ft. to 55ft. vertical is equivalent to an increase of temperature of 1 deg. Fah., with exceptions to this rule. At the Superior mines the average gradient is about 100ft. to the degree. This is exceptionally low, but the variations among the different mines is very striking, ranging from 76·5ft. to 122ft. per degree. The rock in the mine gives no explanation, as the widest divergence is in rock of the same character. He thinks the proximity to the lake seems to offer the true solution of the puzzle, as the mines nearest the shore have the lowest gradients. All of the mines are near the lake with its water at 38·8 Fah., and the Osceola mine, five miles away, shows the highest gradient of 76·5ft.

MR. BURCHARD, American Consul in Honduras, reports that the pita plant, which has never been cultivated, grows spontaneously and in apparently inexhaustible quantities by the margin of every river and lagoon, and, indeed, anywhere below the altitude of 2000ft. It can be had for the cost of cutting. The fibre is susceptible of a thousand uses. The people of Honduras convert it into thread for sewing boots and shoes, and into nets, fish lines, and cordage. The finest hammocks and most costly are also made of it. The small quantities which have been sent to this market have been manufactured into handkerchiefs, laces, ribbons, false hair, and wigs. The difficulty is to decorticate the plant without rotting or otherwise injuring the fibre. The *New York Herald* says, "The man who can do that will be able to take fortune at the flood." We may ask, will not the machinery used now for Rhea fibre treatment suit the requirements?

AT a recent meeting of the Physical Society, Mr. James Swinburne read a note on "Professor Carey Foster's Method of Measuring the Mutual Induction of Two Coils." The author described an apparatus devised last summer for measuring mutual induction by a null method, thus dispensing with a ballistic galvanometer. The induction in the secondary coil is balanced by an opposite effect produced by a variable known fraction of the primary current passing through one wire of a double wound coil of known mutual induction, the other wire of which is joined in series with the secondary coil and galvanometer. In a preliminary trial, using an ordinary reflecting galvanometer, it was found that instead of no deflection being observed, two kicks in opposite directions occurred when there was iron in the circuit. A new galvanometer with heavy needle is now being constructed to overcome this difficulty. A null method of finding the ohm by means of a differentially wound heavy needle galvanometer is suggested in the latter part of the note.

THE last volume of the "Transactions" of the American Society of Mechanical Engineers, recently issued, contains a discussion on the best method of drilling holes in plate glass. Mr. Ashworth referred to the remarkable efficacy of the sand blast steam jet in drilling holes through glass, and Mr. Towne stated that that was, undoubtedly, the best method where the work is to be done in large quantities and can be sent out to be done. But for doing the work in small quantities in one's own establishment, he instanced the method employed in the works of the Yale and Towne Manufacturing Company for drilling holes seven-sixteenths of an inch in diameter through glass one-eighth of an inch thick. The best tool for the work was found to be a brass tube $\frac{1}{100}$in. thick, the cutting agent being emery, No. 5 H, and the lubricant simply water, which they had found as efficient as oil or turpentine, and much less troublesome. Thus the workman was able to drill thirty to forty holes per hour, the drill being run at 2000 revolutions per minute, and the drilling of forty holes through the one-eighth inch glass using up about one inch of the tube. Mr. Towne added that it was important to keep the emery well washed and cleaned, that is, with the dust removed from it which results from the abrasion of the glass.

MISCELLANEA.

IT is stated that an important and extensive discovery of asbestos has been made in the Umsinga division, South Africa.

A SAMPLE of coal from a seam near the Tongaat River, on the coast of South Africa, has been received at Natal. The specimens are said to be excellent.

THE six-horse engines, boiler, and pumps for the Indian State Railways, as illustrated and described in our last impression, were made by Messrs. Hayward Tyler and Co., Luton.

IT is stated that the utilisation of the flood waters of the Murray for irrigation purposes is to form the subject of an agreement between Victoria, New South Wales, and South Australia.

THE contract of Messrs. Johnston and Shaw, at £204,786, for the construction of the second section of the Watt's River Aqueduct, has been accepted in connection with the Yan Yean water supply of the Adelaide Public Works Department. The section is twenty-one miles long, and must be completed within two years and three months.

IT seems that the electric lighting in the House of Commons is dependent upon one boiler. The feed to this choked, or something of the sort happened last Friday, so there was no electric light. There was, however, time to substitute other lights in the rooms where the electric light is used before the incandescent lamps were extinguished.

THE directors of the Bristol Water Company have just accepted a tender for the construction of four large filter beds at Barrow. Mr. Oliver is the contractor, and has in hand the reservoir works now in course of construction near the site of the filter beds. Three of these beds will be constantly in use while the fourth is being cleaned. This work, including the mains and other subsidiary works, will cost nearly £30,000.

MESSRS. ALEX. WILSON AND CO., of the Vauxhall Ironworks, Wandsworth-road, have just completed a triple expansion surface-condensing launch engine for the Admiralty, which up to the present time is the smallest in the service. It is fitted in one of the service launches at Devonport Dockyard, the high-pressure cylinder being only 6in. diameter, and the indicated horse-power attained on the trial being 72 I.H.P.

MR. A. E. GARWOOD, Mem. Inst. C.E., who was formerly with Messrs. Winans Bros. during the construction of railways in Russia, subsequently engineer-in-chief, locomotive and carriage department, Losova and Sebastopol Railway, and more recently in a similar position on the Egyptian Government Railways, has joined the firm of McConnell and Lowthian, of Great George-street, Westminster, as a partner.

ONE of the largest grab-dredgers made by Messrs. Priestman Brothers is about to be sent to the Panama Canal, by order of Messrs. Fontan and Tedesco, of Paris. This dredger is to be used for lifting blasted rock. The Canal Company's engineer inspected one of these machines working at the new entrance of the Royal Albert Dock lifting the blasted concrete of the wall which was blown up last year, as described in our pages. The trial was so far satisfactory that he recommended the directors of the company to adopt this system on the Panama Canal.

ON Wednesday, March 9th, Messrs. Edward Withy and Co., Hartlepool, launched a steel screw steamer from their yard. The dimensions of the vessel are 275ft. by 37ft. 2in. by 20ft. 7in., and she will carry a very large deadweight cargo. Her bridge, quarter, main, and topgallant forecastle decks are of steel and iron, the chart-house, galley, engine-room, cabin skylight, bulwarks, rails, &c., are of iron. She has also four watertight bulkheads, and is fitted with Withy and Sivewright's patent double bottom for water ballast, all fore and aft. The steamer will be fitted with triple expansion engines by Messrs. Blair and Co., Stockton-on-Tees.

IN accordance with arrangements made with the Admiralty, the Cunard steamer Etruria will be altered and rendered fit to take her guns as a cruiser previous to resuming her sailings next Saturday week to New York from Liverpool. The Cunard Company will thus supply two crack vessels for the new service—the Etruria and the Umbria. The Etruria, which arrived at Queenstown a few days ago after an extraordinary run of six days and five hours from New York, has, counting outward and homeward voyages, accomplished 6250 miles in 325 hours, or upwards of 19 knots per hour. The Umbria now requires only her guns to be an efficient cruiser.

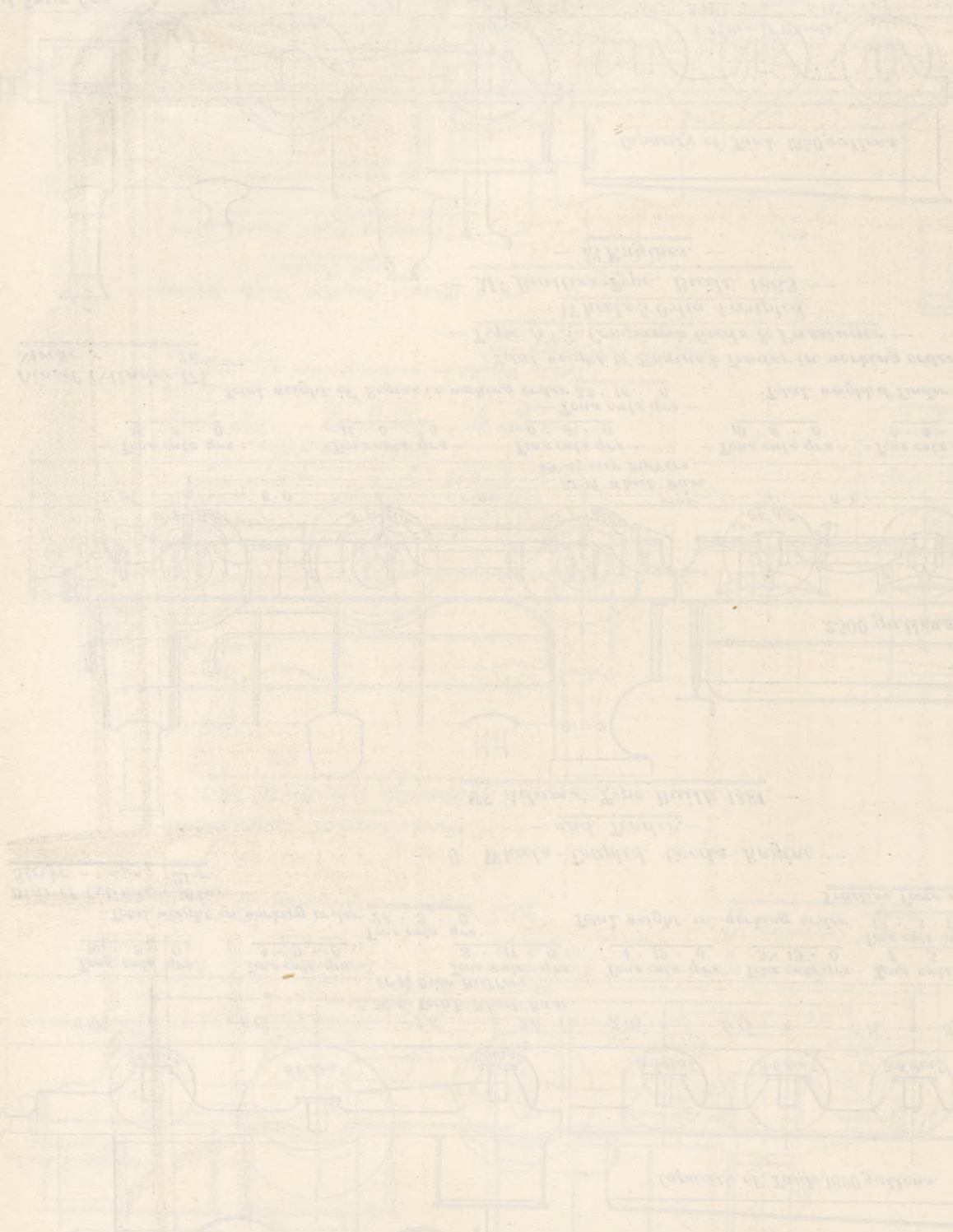
SENOR JOSE PASOS, writing on the proposed Nicaragua Canal to the *Times*, says:—"Some short time since both French and English newspapers published the statement that the Senate of the United States had issued a decree authorising the formation of a company for making the Nicaragua Canal, under the control of the Government of the Union, in conformity with the existing treaty between both Governments. The President of Nicaragua has by cable ordered me to deny the existence of the treaty referred to with the Government of the United States stipulating a control over the Canal; and, as representative of the Nicaragua Government in England, I have to declare that my Government in granting any concession, or in undertaking the work, will not omit any means to secure the strictest neutrality of the route for the benefit of the maritime Powers having an interest in the free passage thereof. There is no doubt that the treaty which has been alluded to, in announcing the decree of the American Senate, is the one known by the name of Zavala Frelinghuisen, made in 1884, and which lapsed shortly afterwards, inasmuch as it was not ratified by the Senate of the United States."

EVER since the iron ore traffic, occasioned by the development of steel and iron manufacture in Ayrshire, was commenced at Port Glasgow about five years ago, the Harbour Trust of that town have made every effort to meet the growing requirements of the trade. During the past month, it may be stated, the traffic at the harbours has exceeded that of any other preceding month since the iron ore traffic commenced, about 1000 tons of iron ore per day having been despatched by rail. In order to discharge the steamers arriving from abroad with the necessary despatch, it was found expedient, when the trade was commenced, to make additional wharfage, and this the Trust effected at the outside of the then existing harbour, the new wharf constructed costing about £2500. The borrowing powers of the Trust becoming exhausted about this time, application was made and Parliamentary powers obtained to borrow to the extent of £100,000. Thereupon the Trust set about the improvement of the existing harbour by deepening and otherwise rendering them more convenient and useful. According to plans prepared by Messrs. Bell and Millar, of Glasgow, the entire side of the east harbour was strengthened and a wharf constructed at a cost of about £3000. In pursuance of this scheme of improvements, a jetty, forming the outmost wall of the mid harbour, has been wharfed in a like manner to the above at a cost of about £1500. To facilitate the working of the railway traffic, large additions have been made to the lines of rails. At present a new wharf is being made round the walls, dividing the mid from the east harbour, the estimated cost being £2000. Excepting the first-mentioned extension, the whole of the work of improvement has been done by unemployed tradesmen under the direction of the Trust officials. While the harbours have thus been placed in condition for carrying on a largely increased traffic with the utmost promptitude, a means of employment has at the same time been provided for large numbers of the local unemployed.

THE FORTH BRIDGE.—PIER TUBE RIVETTING CAGE.

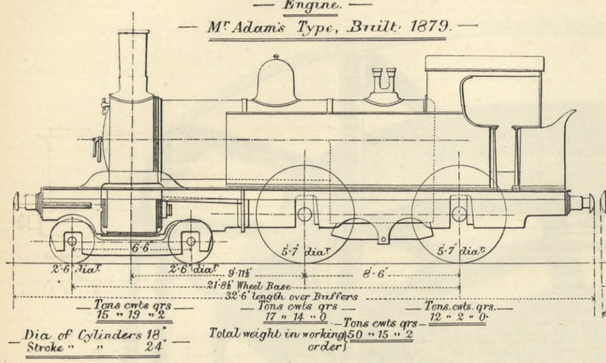
SIR JOHN FOWLER AND MR. B. BAKER, MM. INST. C.E., ENGINEERS.

(*For description see page* 193.)



LOCOMOTIVE ENGINES ON THE SOUTH-WESTERN RAILWAY. FROM 1851 TO 1886.

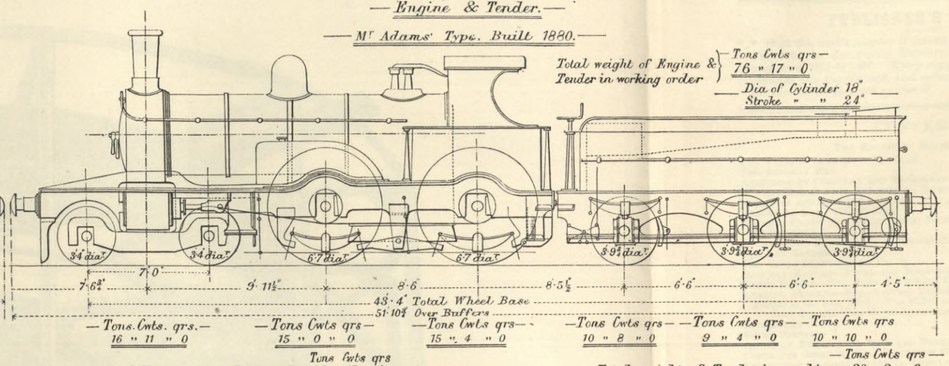
— 4 Wheels Coupled Bogie Tank —
— Engine. —
— Mr Adam's Type, Built 1879. —



Tons cwts qrs 15 " 19 " 2 — Tons cwts qrs 17 " 14 " 0 — Tons cwts qrs 12 " 2 " 0
Total weight in working order 50 " 15 " 2
Dia of Cylinders 18"
Stroke " " 24"

— Type No 2 Duke Class. —
— Wheel 6'6 dia.r single. —

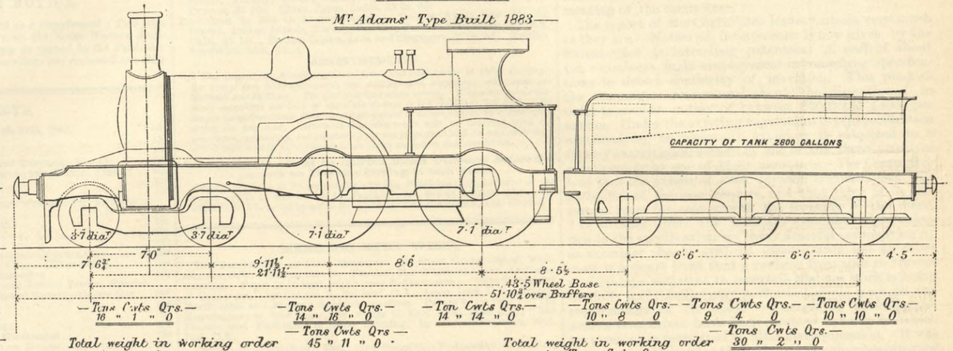
— 4 Wheels-Coupled Bogie Express —
— Engine & Tender. —
— Mr Adams' Type. Built 1880. —



Total weight of Engine & Tender in working order — Tons Cwts qrs 76 " 17 " 0
Dia of Cylinder 18"
Stroke " " 24"

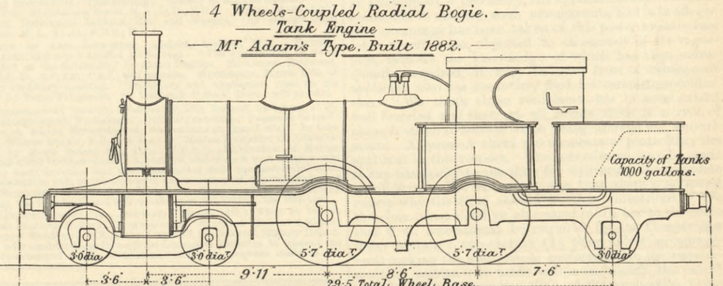
Tons Cwts. qrs. 16 " 11 " 0 — Tons Cwts qrs 15 " 0 " 0 — Tons Cwts qrs 15 " 4 " 0 — Tons Cwts qrs 10 " 8 " 0 — Tons Cwts qrs 9 " 4 " 0 — Tons Cwts qrs 10 " 10 " 0
Tons Cwts qrs
Total weight of Engine in working order 46 " 15 " 0
Total weight of Tender in working order 30 " 2 " 0

— 4 Wheels-Coupled Bogie Express. —
— Engine & Tender. —
— Mr Adams' Type Built 1883 —



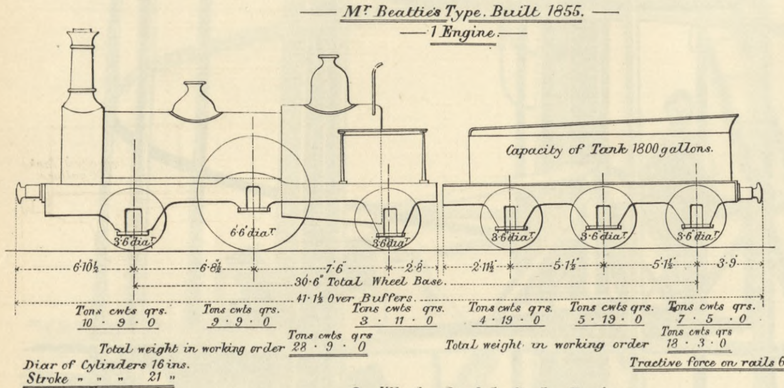
Tons Cwts Qrs. 10 " 1 " 0 — Tons Cwts Qrs. 14 " 16 " 0 — Tons Cwts Qrs. 14 " 14 " 0 — Tons Cwts Qrs. 10 " 8 " 0 — Tons Cwts Qrs. 9 4 0 — Tons Cwts Qrs. 10 " 10 " 0
Tons Cwts Qrs
Total weight in working order 45 " 11 " 0
Total weight in working order 30 " 2 " 0
Dia of Cylinder 18"
Stroke " " 24"
Total weight of Engine & Tender in working order — Tons Cwts Qrs. 75 " 13 " 0

— 4 Wheels-Coupled Radial Bogie. —
— Tank Engine —
— Mr Adam's Type. Built 1882. —



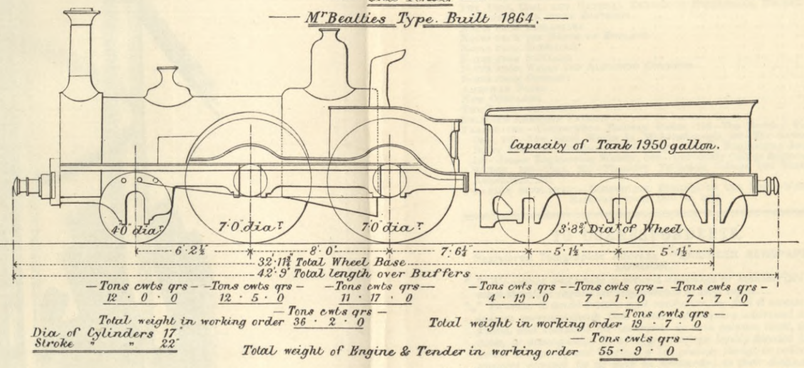
Tons cwts qrs 13 · 0 · 0 — Tons cwts qrs 15 · 0 · 0 — Tons cwts qrs 14 · 10 · 0 — Tons cwts qrs 9 · 10 · 0
Tons cwts qrs
Dia of Cylinders 17½"
Stroke " " 24"
Total Weight in working order 52 · 0 · 0

— 4 Wheels-Coupled Tank Engine —
— Mr Beatties Type. Built 1855. —
— 1 Engine. —



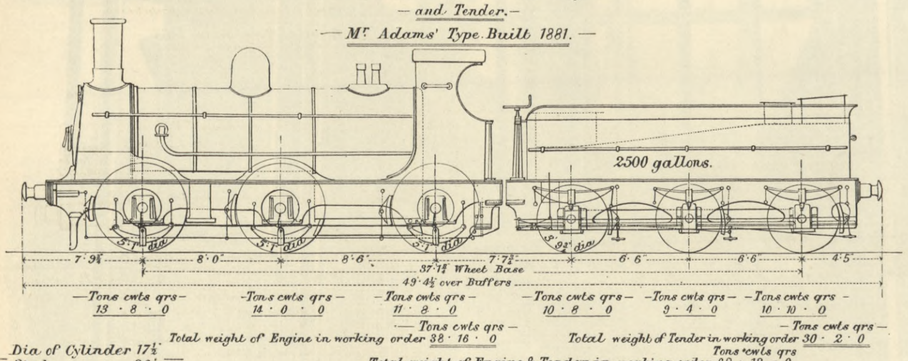
Tons cwts qrs. 10 · 9 · 0 — Tons cwts qrs 9 · 9 · 0 — Tons cwts qrs. 3 · 11 · 0 — Tons cwts qrs. 4 · 19 · 0 — Tons cwts qrs. 5 · 13 · 0 — Tons cwts qrs. 7 · 5 · 0
Tons cwts qrs
Total weight in working order 28 · 9 · 0
Total weight in working order — Tons cwts qrs 13 · 3 · 0
Diar of Cylinders 16 ins.
Stroke " " " 21 "
Tractive force on rails 6892 lbs.

— 4 Wheels-Coupled Passr Engine. —
— and Tender —
— Mr Beatties Type. Built 1864. —



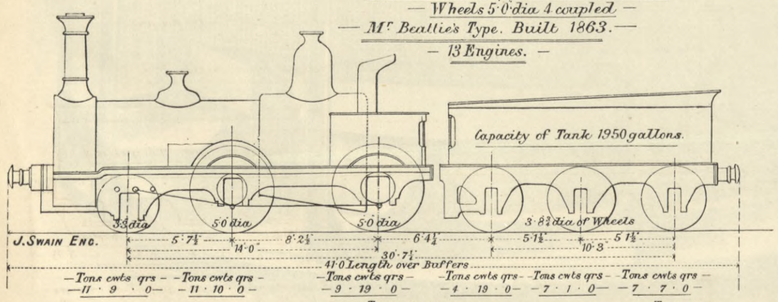
Tons cwts qrs 12 · 0 · 0 — Tons cwts qrs 12 · 5 · 0 — Tons cwts qrs 11 · 17 · 0 — Tons cwts qrs 4 · 19 · 0 — Tons cwts qrs 7 · 1 · 0 — Tons cwts qrs 7 · 7 · 0
Tons cwts qrs
Total weight in working order 36 · 2 · 0
Total weight in working order — Tons cwts qrs 19 · 7 · 0
Dia of Cylinders 17"
Stroke " " 22"
Total weight of Engine & Tender in working order — Tons cwts qrs 55 · 9 · 0

— 6 Wheels-Coupled Goods Engine —
— and Tender. —
— Mr Adams' Type. Built 1881. —



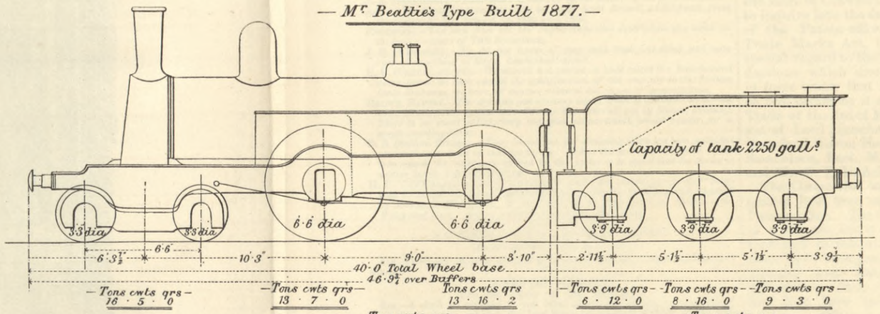
Tons cwts qrs 13 · 8 · 0 — Tons cwts qrs 14 · 0 · 0 — Tons cwts qrs 11 · 8 · 0 — Tons cwts qrs 10 · 8 · 0 — Tons cwts qrs 9 · 4 · 0 — Tons cwts qrs 10 · 10 · 0
Tons cwts qrs
Total weight of Engine in working order 38 · 16 · 0
Total weight of Tender in working order 30 · 2 · 0
Tons cwts qrs
Total weight of Engine & Tender in working order 68 · 18 · 0
Dia of Cylinder 17½"
Stroke " " 26"

— Type No 3 Company's Goods & Passenger —
— Wheels 5'0 dia 4 coupled —
— Mr Beattie's Type. Built 1863. —
— 13 Engines. —



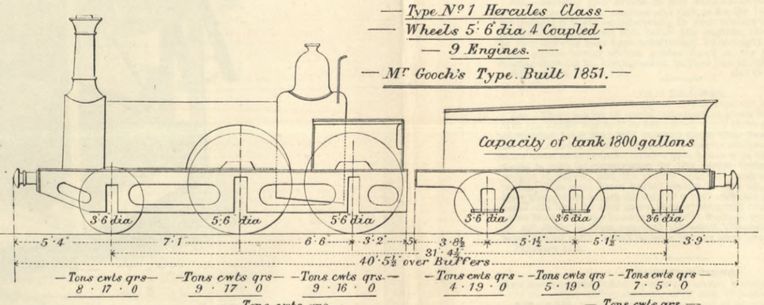
Tons cwts qrs — 11 · 9 · 0 — Tons cwts qrs — 11 · 10 · 0 — Tons cwts qrs — 9 · 19 · 0 — Tons cwts qrs — 4 · 13 · 0 — Tons cwts qrs — 7 · 1 · 0 — Tons cwts qrs — 7 · 7 · 0
Tons cwts qrs.
Total weight in working order 32 · 18 · 0
Total weight in working order — Tons cwts qrs 19 7 0
Dia. Cylinders 16"
Stroke " " 22"
Tractive force on rails 9982 lbs.

— 4 Wheels Coupled Bogie Passr —
— Engine & Tender. —
— Mr Beatties Type Built 1877. —



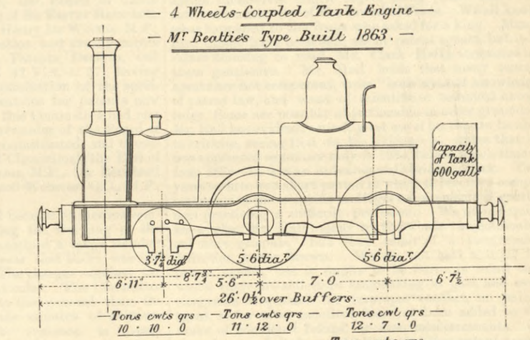
Tons cwts qrs 16 · 5 · 0 — Tons cwts qrs 13 · 7 · 0 — Tons cwts qrs 13 · 16 · 2 — Tons cwts qrs 6 · 12 · 0 — Tons cwts qrs 8 · 16 · 0 — Tons cwts qrs 9 · 3 · 0
Tons cwts qrs
Total weightin working order 43 · 8 · 2
Total weight in working order 24 · 11 · 0
Tons cwts qrs
Total weight of Engine & Tender in working order 67 · 19 · 2
Dia of Cylinders 18½"
Stroke " " 26"

— Type No 1 Hercules Class —
— Wheels 5'6 dia 4 Coupled —
— 9 Engines. —
— Mr Gooch's Type. Built 1851. —



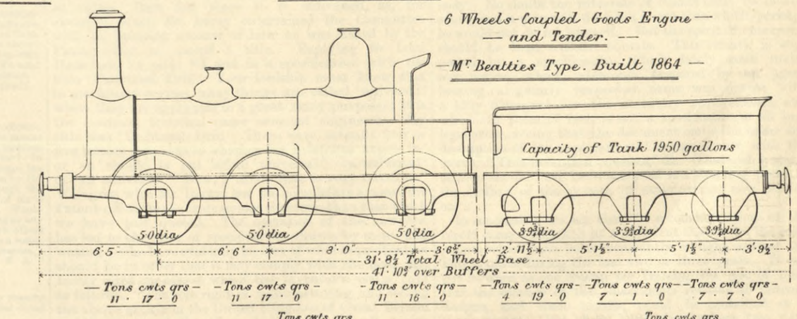
Tons cwts qrs 8 · 17 · 0 — Tons cwts qrs 9 · 17 · 0 — Tons cwts qrs 9 · 16 · 0 — Tons cwts qrs 4 · 19 · 0 — Tons cwts qrs 5 · 19 · 0 — Tons cwts qrs 7 · 5 · 0
Tons cwts qrs
Total weight in working order 28 · 10 · 0
Total weight in working order — Tons cwts qrs 18 · 3 · 0
Dia of Cylinder 15"
Stroke " " 22"
Tractive force on rail 7500 lbs.

— 4 Wheels-Coupled Tank Engine —
— Mr Beatties Type Built 1863. —



Tons cwts qrs 10 · 10 · 0 — Tons cwts qrs 11 · 12 · 0 — Tons cwt qrs 12 · 7 · 0
Tons cwts qrs
Total Weight in working order 34 · 9 · 0
Diar of Cylinders 16½"
Stroke " " 20"

— 6 Wheels-Coupled Goods Engine —
— and Tender. —
— Mr Beatties Type. Built 1864 —



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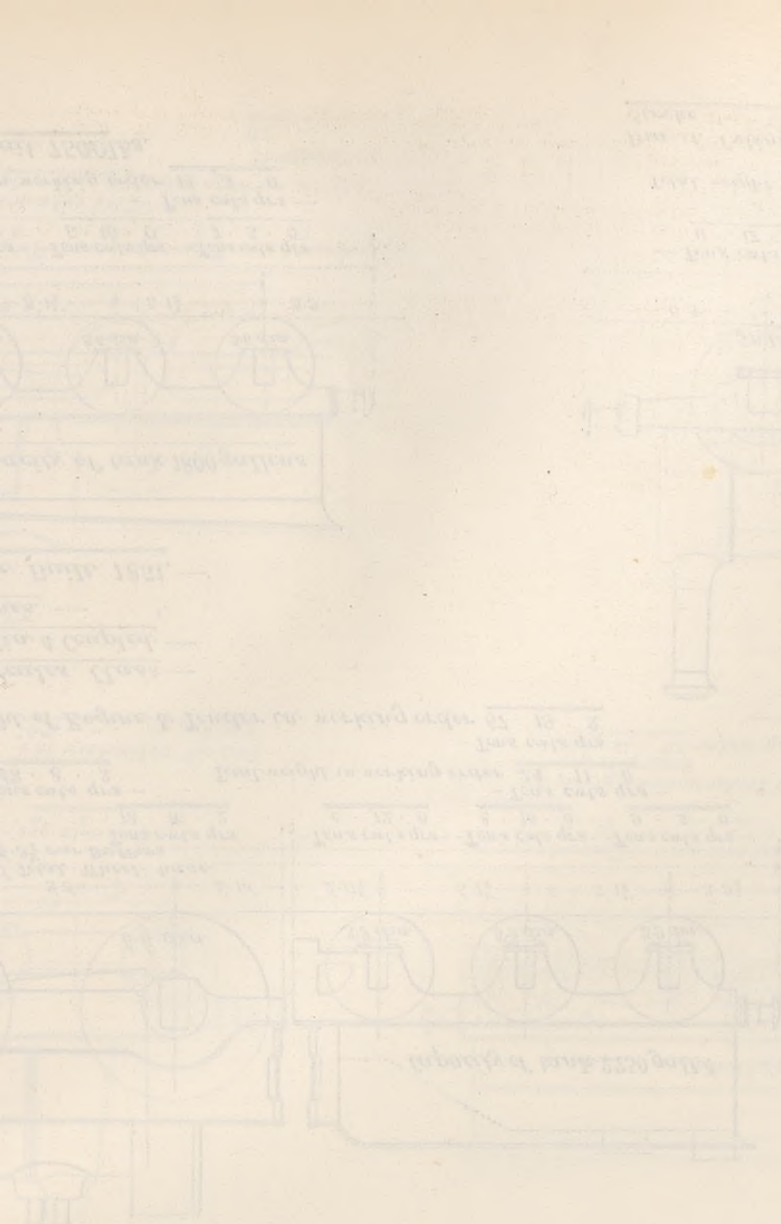
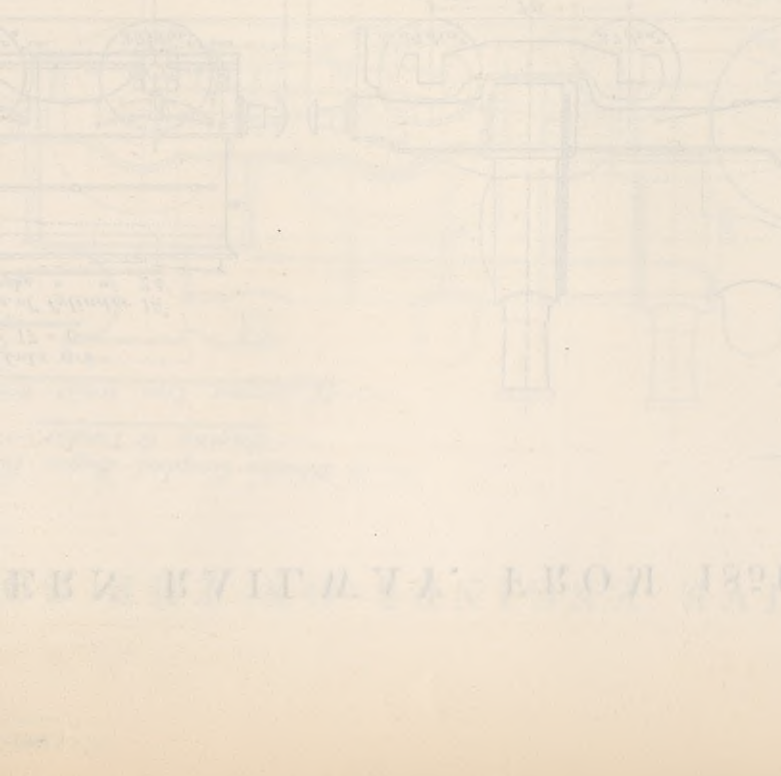
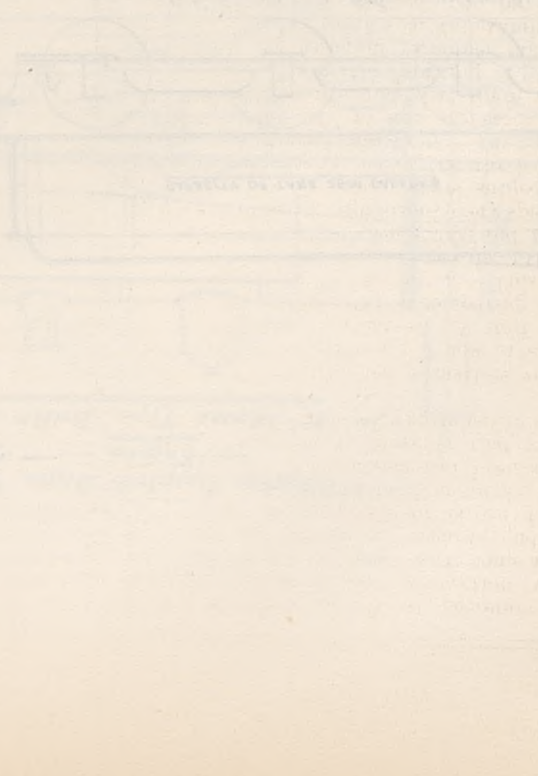
Tons cwts qrs
Total weight in working order 35 · 10 · 0
Tons cwts qrs
Total weight in working order 19 · 7 · 0
Dia of Cylinder 16½"
Stroke " " 22"
Tons cwts qrs
Total weight of Engine & Tender in working order 54 · 17 · 0







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PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31 *Beekman-street.*

PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement a Two-page Engraving of Locomotive Engines on the South-Western Railway, from* 1851 *to* 1886. *Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

CONTENTS.

THE ENGINEER, March 11th, 1887. PAGE

TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

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

*** *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.*

W. H. C.—*Cite the work from which you quote.*

J. B. (Doncaster).—*Your letter is clearly of the nature of an advertisement.*

A. A.—*The Great Eastern was built by John Scott Russell, at Millwall, from the designs of Mr. Brunel, in* 1856 *and* 1857.

ENGINEER.—*You can find all the engravings and description you want in the back numbers of* THE ENGINEER.

J. D. (Whitwell).—*We do not know of any such book, but think you may hear of something at Goy's, Leadenhall-street.*

E. C. (Cannon-street).—*We should not ourselves have called it a Ramsbottom valve, but as we have quoted the specification of the engineer to the Indian State Railways, we have, of course, allowed his choice of nomenclature.*

BROWN RAPPEE.—*For driving gas engines where space is available we do not know of any better system than Dowson's, as carried out by Messrs. Crossley. There is no small satisfactory coal-gas plant which would answer for a single dwelling-house.*

D. S. (Sutton Bridge).—*Your invention for stopping ships has been patented over and over again in various forms. It has the great defect that at moderate speeds the resistance offered to the water is so small that the device is useless for the intended purpose.*

H. P. T. (Chicago).—*You will probably find what you require in the "Text-book on the Mechanics of Materials and of Beams, Columns, and Shafts," by Mansfield Merriman. It is published in New York by Messrs. John Wiley and Sons. Rolled joists or beams are dealt with.*

MACHINERY FOR GALVANISING SHEETS.

(To the Editor of The Engineer.)

SIR,—Will any of your readers give me the names of manufacturers of above?

X.

OATMEAL MILLING.

(To the Editor of The Engineer.)

SIR,—I shall be obliged if you will allow me to ask, in your correspondence column, what is the best book on oatmeal milling, giving construction and erection of machinery.

ENGINEER.

March 6th.

PUMPS FOR INDIAN STATE RAILWAYS.

(To the Editor of The Engineer.)

SIR,—Noticing your article in last week's number giving illustrations of the 6-horse power engines and pumps for the Indian State Railways, we thought it might be interesting to your readers to know that as these pumps are placed about 80ft. below the engines, the timber rods shown in your drawing have been substituted by wrought iron pump rods with roller guides, having sliding guides fixed on the top girder. We send tracing showing the arrangement, in case you should like to illustrate.

Kilmarnock, March 9th. GLENFIELD CO. (Limited).

OLD BRASSES.

(To the Editor of The Engineer.)

SIR,—There is a lot of useful information given in your query column. Will you kindly add to it by informing me if there are any known means of treating brass that will prevent those little flaws and seams forming on the surface of brasses exposed to heavy compression and wear? In some cases, as in brass locomotive axle-boxes with underhung springs, the metal is both in compression by the piston thrust and tension by the weight of engine, and the cracks gradually extend right through the metal. This worn brass heated seems by the sputtering, &c., of oil to have changed its nature entirely to a very ordinary porous metal. Would some oils help on this more than others, and would annealing or any other treatment help to counteract it? Perhaps some of the new alloys do not suffer so from constant vibration, although I have seen a somewhat similar action with phosphor bronze large connecting-rod brasses.

February 14th. W. A.

SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

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Remittance by Bill on London.—Austria, Buenos Ayres and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili, £1 16s. Borneo, Ceylon, Java, and Singapore, £2 0s. 6d. Manilla, Sandwich Isles, £2 5s.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Session 1886-87. Tuesday, March 15th, at 8 p.m.: Ordinary meeting. Paper to be read, with a view to discussion:—"The Treatment of Gun-steel," by Colonel E. Maitland, R.A., Assoc. Inst. C.E. Friday, March 18th, at 7.30 p.m.: Students' meeting. Papers to be read:—"The Manufacture of Raw Sugar," by Walter C. Kerr, Stud. Inst. C.E.; "The Process and Machinery of Sugar Refining," by Louis Martineau, Stud. Inst. C.E.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—Wednesday, 16th inst., at 7 p.m.: Ordinary meeting. Paper to be read:—"Rural Sanitary Authorities," by Herbert D. Appleton, A.R.I.B.A.

ROYAL INSTITUTION.—This evening: "Society in the 4th Century A.D.," by the Ven. Archdeacon Farrar, M.A., D.D., F.R.S. Friday, March 18th: "Mental Differences between Men and Women," by George John Romanes, M.A., LL.D., F.R.S., M.R.I.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Tuesday, March 15th, at 8 p.m.: Applied Art Section. "The Application of Gems to the Art of the Goldsmith," by Alfred Phillips. Sir George Birdwood, M.D., LL.D., K.C.I.E., C.S.I., will preside. Wednesday, March 16th, at 8 p.m.: Ordinary meeting. "Machinery and Appliances used on the Stage," by Percy Fitzgerald. Sir Frederick Pollock, Bart., will preside.

METEOROLOGICAL SOCIETY.—Wednesday, 16th instant, at 7 p.m., at 25, Great George-street, Westminster: Ordinary meeting. Papers to be read: "Notes on taking Meteorological Observations on Board Ship," by Captain D. Wilson Barker, F.R. Met. Soc.; ""Marine Temperature Observations," by Hugh Robert Mill, D.Sc., F.R.S.E. Exhibition of Marine Meteorological Instruments and Apparatus, and of such new instruments as have been invented and first constructed since the last Exhibition. The Exhibition will, at the request of the secretary of the Institution of Civil Engineers, be open in readiness for their meeting on Tuesday evening, the 15th inst, and will remain open till Friday, the 18th inst.

GEOLOGISTS' ASSOCIATION.—Saturday, March 12th: Visit to British Museum (Natural History), Cromwell-road. Entrance Hall at 2.30 p.m. Dr. Henry Woodward, F.R.S., the Keeper of the Natural History Department, will conduct them through the Geological Galleries to inspect the recently-arranged "Type Collections," and the progress made in the Fossil Reptile Gallery.

THE ENGINEER.

MARCH 11, 1887.

THE REPORT ON THE PATENT-OFFICE.

ON the 30th December, 1885, the Board of Trade appointed a Committee, consisting of Sir Farrer Herschell, the Earl of Crawford, and Baron Henry De Worms, M.P., to inquire into the duties, organisation, and arrangements of the Patent-office, under the Patents, Designs, and Trade Marks Act, 1883 (46 and 47 Vict. c. 57), having special regard to the system of examination of the specifications which accompany applications for patents now in force under that Act. After this Committee had met on two occasions it was, by another order of the Board of Trade of the 3rd of March, 1886, reconstituted, and to consist of Lord Herschell (then Lord Chancellor), the Earl of Crawford, Baron Henry De Worms, M.P., Sir Bernhard Samuelson, Bart., M.P., Sir Richard Webster, Q.C., M.P., and Mr. C. T. D. Acland, M.P.

The Committee was appointed because numerous complaints had been made concerning the working of the Patent-office. The Committee examined a large number of witnesses, but it does not appear that there was any thorough investigation made. The charges against the office have been general and particular. The Committee directed their attention more to the general than the particular. Their report with the minutes of evidence has just been published. The evidence is dreary reading. When it does not consist of vague suggestions or remarks, it relates to minutiæ of official procedure, which have no interest for the general public; even for inventors or patentees indeed it is of little or no value. Here and there it is enlivened, as, for example, when Mr. Imray entertained the Committee with an amusing account of how he was asked by the Patent-office to amend a title. Replying to Lord Herschell, he said: "I sent in a specification with the title 'Universal Drill.' Your lordship must know that in machinery a great many things are called 'universal' when they are applicable to a great many purposes; it is the common technical name amongst engineers. My title was 'Universal Drill.' There were actually four or five letters passed as to whether the indefinite article 'a' or 'an' should be put before 'universal'—'a universal' or 'an universal.' Now, I think that is very frivolous." We agree with Mr. Imray; but the complaints against the Patent-office are of a more serious character than that which we have just quoted. The operation of the new law has led to the filing of specifications drawn by men—and women—who have evidently no idea of what a specification should be in order that it may comply with the law. Mr. Imray cited one case in which the inventor's claim runs as follows, "The sole right of manufacturing and selling the above article in the United Kingdom of Great Britain and Ireland and the Channel Islands, and all rights granted by the Patent Law, also the power to proceed against any person infringing, imitating, or selling the same under any other name." The most practical evidence was given by Mr. Trueman Wood, secretary of the Society of Arts, whose former connection with the Patent-office enabled him to speak with some authority on the wants of the public as regards indices and abridgments. From the inconsequent nature of some of the replies to the queries of the Committee, it might almost be inferred that the evidence had been altered in some way. The probability is, however, that the blame lies altogether with the witnesses who failed to grasp the meaning of the committee.

The report of the Committee leaves matters very much as they are. Notice of interference is now given by the Patent-office to intending patentees. A staff of about ten examiners finds employment in comparing specifications to detect similarity of invention. This practice the Committee recommend should be discontinued in order to save an outlay of between £3000 and £4000 per annum. Under the existing regulations every specification examined by an assistant examiner is subjected to a further examination either by one of the three principal examiners or by one of their assistants. The Committee hold that the extent of such revision is greater than the necessities of the case require, and that there is in this respect room for economy in the working of the office. "In all cases where the assistant examiner takes objection to the specification we think a careful examination by an examiner should still be insisted upon, but in other cases it appears to us that a revision from time to time of a percentage sufficient to ascertain that the work is being carefully and intelligently performed would meet all the requirements of the case." Concerning amendments, serious complaints have been made of the way in which an inventor is permitted to alter his specification. It was stated to the Committee that when an examiner has reported that the invention has not been fairly described, and that an amendment is necessary, the applicant occupies months sometimes in making such amendments, and it is alleged that advantage has been taken of this power to introduce into a specification, objected to on account of its vagueness, matters the knowledge of which has been subsequently acquired, it may be even from a subsequent applicant who has meantime filed his complete specification. "We think these complaints are to some extent well founded, and that, at all events, there is a risk of abuse from an indefinite time being allowed for amendments. At present there are no means of controlling the applicant in this respect. The amendment may be made at any time prior to the date for delivering the complete specification. We are of opinion that there is no sound reason why the time should be thus unrestricted. We therefore recommend an alteration in the law to the effect that if an amendment be required by the Comptroller under section 7, sub-section (1), then unless an amendment making the application conformable to the requirements of section 6 be made within one month, the patent should date only from the time of the application being made so conformable, and not from the time of the original application."

A considerable portion of the Blue-book is occupied by considerations about patent agents. One of the recommendations of the Committee is that a roll of patent agents should be formed, but the advantages of the scheme are not quite obvious. Perhaps, too, the patent agents themselves might regret being placed under the autocratic authority of the Board of Trade. We all know what happened to the frogs who asked for a king. Many hard things have been said about patent agents, but it is rather amusing to read Mr. Clark Hall's strictures on these gentlemen. Mr. Hall holds that many patent agents are not competent, from "both want of knowledge of patent law, and want of scientific or technical knowledge. Some are possibly objectionable on other grounds." Mr. Hall has evidently made good use of his time to be able to criticise, seeing that in his evidence he states that he was appointed examiner only in 1884, before which time—from 1878—he was an indexing and abridging clerk. Two years seem to be a short period in which to become a competent judge of the scientific and legal acquirements of gentlemen practising a difficult profession. We do not quite know what Mr. Hall means by the words "objectionable on other grounds," but they admit of a disagreeable deduction being drawn. We do not hold a brief for patent agents, but it ought to be borne in mind that whilst there are solicitors languishing in gaol, and even clergymen suspended for improper conduct, no patent agent, so far as we recollect, has ever been added to the ranks of convicted felons, or even misdemeanants. On the other hand, it is not to be denied that patent agents are not in all cases as careful as they ought to be. The Institute of Patent Agents could hardly do more useful work than exercising a salutary discipline throughout the body. No doubt the interests of clients must be looked after; and a man will do for a client that which perhaps he would not do for himself. But the spirit of enterprise should be kept within bounds. This remark is suggested by a specification which lately came under our notice, which, although prepared by an agent bearing a greatly respected name, was drawn with a lofty disregard for the statutory requirements, and which, in point of fact, is not a specification at all in a legal sense, seeing that the document omits the name and description of the applicant and begins at once with the words, "This invention consists," &c. That such a specification should have been accepted is a standing proof of the futility of the system of examinations now carried on.

In conclusion, we say that the recommendations of the report cannot be taken as a sufficient answer to the complaints which have been incessantly brought against the Patent-office during the last two or three years. It was put forward as one reason for framing the Act of 1883, that the essence of the enactments relating to patents, designs, and trade marks, could be contained in a single statute. But there have already been two Acts, and a third is now required, to be followed by a Committee to see how the thing works, and which may recommend yet another Act. The soundness of nearly every

criticism which we have penned on the original Bill is being demonstrated by the course of events.

FRAUDS IN THE IRON TRADE.

All who have at heart the commercial reputation of Great Britain cannot but view with dismay the revelations recently made in connection with the iron trade. It has been proved beyond a doubt that the practice is by no means uncommon of stamping inferior makes of finished iron with imitations of well-known brands. A circular, issued last year by the South Staffordshire Ironmasters' Association, states plainly, as the result of proved facts, that it has been the practice of unscrupulous dealers to mingle a small quantity of genuine iron, every rod or bar of which is branded, with a large quantity of a cheaper make, not possessing the same strength or intrinsic value. In one instance that has come to light, only four tons of the genuine quality of iron were used in sixty tons of chain specified to be of high-class branded iron; and in another, all the iron in a chain was of a quality inferior to that specified, although a certificate of test was given by the maker of the chain. The value of such a certificate will be dealt with below, meanwhile we will show how the chain is made up so as to consist apparently of the high-class iron stipulated for. It is the practice of leading ironmasters to have a well-known brand stamped upon every bar; and this brand an unscrupulous chainmaker takes good care to preserve intact upon as many links as possible, and if each bar were stamped twice over, by mistake or otherwise, his purpose would be all the better served. The remaining links are then made up of unbranded and inferior, though not necessarily bad iron, and it is left to be inferred that they are composed of those portions of the rod in which the brand does not occur, or that the brand has been obliterated at the weld.

There are sufficient Government testing houses about the country to warrant purchasers in refusing to accept a certificate from any private or unauthorised testing house, for the value of a certificate depends upon its being given by an independent and entirely uninterested party. It is by no means uncommon, as documentary evidence exists to prove, that a chain is delivered with a very official-looking certificate of test on a printed form, but signed by the same person as superintendent of the testing house who is also manager of the works where the chain was made. Not a bad guarantee—although not absolutely sure—that the brand and quality of iron desired in a chain or other article is really used, would be for the purchaser to ascertain from the ironmaster that the necessary quantity of iron of the desired brand and quality had really been supplied to the manufacturer of the chain or other article. There should be no misconception or misapplication of trade terms, and the broker should not be allowed to put his own interpretation on time-honoured appellations. "Best Staffordshire iron" has hitherto been held to mean iron made from the pure ores and coke of that county. But now the practice is by no means unknown of importing the less pure Northampton ore and Derby coke, adding, perhaps, a little of the genuine article to save the conscience, and then calling the resulting metal "best Staffordshire iron," because it was made in Staffordshire. Then, again, "best best best" means, or should mean, "thrice worked iron;" but brokers have now the air of wishing it to be thought that "treble best iron" is simply synonymous with a good quality of iron, and pooh-poohing the acceptation of the words in their obvious and hitherto accepted sense.

A proof that the term "best best best" is applied in this loose way is afforded by a circular recently sent round to manufacturers, offering to supply small quantities of "treble best" steel, with consignments of iron, to meet requirements and save two deliveries. Now what can this term mean as applied to steel? There is certainly no third or even second working in this case, and yet the term is used unblushingly as a bait to the consumer to accept what purports to be an extra quality of steel. It is high time that trade terms should cease to bear a fictitious or conventional signification. Most people are now aware that "merino" goods are made from a mixture of wool and cotton, instead of from the fleece of the merino sheep. But it would prevent all misconception in such a case, when the term is used in the trade instead of the true sense, to stipulate that the word in question be printed between inverted commas, just as limited liability companies are obliged to print the word "limited," or its abbreviation, after their title. This would be far simpler, and afford a far greater protection to the public than such a statement, printed in very small letters, as, "This is sold as a mixture of coffee and chicory." By all means let producers and merchants call their goods by any name they please, mahogany instead of stained deal, gold instead of aluminium bronze, or leather instead of paper; but let it be at the same time obvious to the public that these are only trade terms, instead of an indication of their true quality.

Not very long ago a well-known iron-making company received an order, which, however, they honestly declined, for supplying a quantity of the cheapest iron they could make, branded "Best Staffordshire refined." If this order had been executed, not only the company, but all honest ironmasters in Staffordshire would have lost in repute. In some far-off country, like India, for instance, whence it would be difficult to verify the matter, the broker would be free to reason somewhat in the following manner:—"Staffordshire produces the best iron in England; this is evidently best Staffordshire by its brand; you see what it is worth. Now try mine, which does not pretend to so high a quality;" and then he would have every facility for getting off his hands a consignment of iron, good, perhaps, in itself, but certainly far better apparently through the unfair comparison, with, of course, a considerable profit to himself, while the really excellent iron of Staffordshire would henceforth be excluded from that market. Again, specifications of ironwork often provide that certain parts shall consist of such-and-such a brand of iron, "or iron of equal quality." Now, the appreciation of what is a quality equal to that named should certainly not be left to the merchant who supplies it. If a particular brand or quality is specified, the reason is, probably, that the engineer knows what it is capable of standing, or that it is suitable for a particular purpose. Therefore the wiser course would be to insist upon having that particular brand and no other. If, however, he has no particular wish in the matter, it will be sufficient to stipulate that the iron be capable of standing certain tests at an independent testing-house, without mentioning a special brand merely by way of ornament to the specification, and with no intention of insisting upon that brand.

What we have pointed out with special reference to the iron trade also applies, in one respect or another, to many other branches of industry, viz., the attempt to palm off an inferior article to the one desired, specified or paid for. If people want a cheap and inferior article, by all means let them have it, but openly, and not under false colours. It is, however, too bad that they should believe they are getting a good quality when in reality it is a bad one, which they only find out when it fails to fulfil the desired object. So many and so various are the "tricks of trade" that we fear but limited results will be achieved by a prosecution here and there, when some specially barefaced proceeding is brought to light; but it is just as well that the eyes of both makers and consumers should be opened to frauds which are habitually practised, so that they may take precautions for protecting their interests.

THE EIFFEL AND JUBILEE TOWERS.

The notion that "they manage things better in France" than we do here is by no means always verified. A vehement protest from leading artists and literary men in Paris has been issued against the construction of the Eiffel Tower. But the tower is to be built nevertheless, and M. Lockroy, the Minister of Commerce and Agriculture, ridicules the opposition which has been offered to it. The work of preparing the foundations is already in hand, and the giant structure, 1000ft. in height, is apparently destined to become an accomplished fact. London has been threatened with a gigantic tower, less lofty than "the hideous thing" about to be reared on the Champ de Mars, but apparently more hideous still in regard to its design. Cecil-court, St. Martin's-lane, was marked out as the spot where the "Victoria Jubilee Tower" was to be erected. The material was to consist mainly of brickwork, and the height was to be 420ft. Architecturally the design was of awful ugliness, but commercially the enterprise was expected to prove satisfactory, as it was reckoned that thousands of persons, in the course of a year, would pay for admission to enjoy the commanding view to be obtained from the lofty summit of the structure, the ascent being facilitated by an hydraulic lift. But in London we have a matter-of-fact body called the Metropolitan Board of Works, and a prosaic statute designated the Building Act. The projectors of the tower made application to the Board for authority to proceed with the structure; but the Board had an opinion of its own upon the subject, and considered the tower a very undesirable edifice to be erected in such a locality. Perhaps some people will be surprised to find that the Board had so much taste. Certain it is that the authorities at Spring Gardens looked upon the tower as a monstrosity, and as calculated to interfere with the architectural effect of Trafalgar-square. In short, the Board refused to sanction the structure, and if the legality of this decision can be maintained, London will owe to this quiet interposition on the part of the Metropolitan Board its deliverance from the impending danger of having a most unsightly structure erected where it would especially offend the eye, and where it could not possibly be hidden. A tall, gaunt edifice, loftier than St. Paul's, would dominate all London, and would obtrude itself on the field of view for miles round the metropolis. Such a pile of brickwork would be an impertinence, and a source of perpetual vexation. The Society of Architects, when they heard of the hapless project, sent a memorial to the Metropolitan Board, protesting, in the interest of art generally, against the erection of the proposed structure. More fortunate than the artists and *literati* who protested against the Paris tower, these memorialists found their prayer granted, and the official sanction withheld. Unless the authority of the Metropolitan Board in this matter can be successfully disputed, London is rescued from the infliction of the Jubilee Tower; but Paris must groan beneath the shadow of the iron version of the Tower of Babel, to be finished by the end of 1888, and to cost £194,000. Frenchmen have profound respect for the Lord Mayor and Corporation; some portion of their regard may be now bestowed upon the Metropolitan Board.

SPANISH IRON EXPORTS.

One of the features in the iron trade which is of great importance is the growth of the Spanish iron trade. It is shown not only in an enlargement of the exports of ore from Bilbao, but in the fact that there is now a trade from that port in pig iron—a trade which, if small in comparison with ours, is not inconsiderable. In the first two months of the present year the iron ore shipped from Bilbao was over 610,000 tons, or more than 80,000 tons in excess of the shipments during the corresponding period of the previous year. In the same time there were sent out of Bilbao between 17,000 and 18,000 tons of pig iron, about half of which was sent foreign and the remainder coastwise. This quantity of pig iron is small when put against the shipments from Glasgow, and still smaller when it is compared with those of Barrow or Middlesbrough. Still it is a not unimportant commencement of the crude iron trade for a country like Spain, which is far behind in metallurgy. It is remarkable, when looked at from one point of view, that there is this year so large an increase in the exports of iron ore from Bilbao—remarkable because it has been stated that some of the mines of the great foreign owners are showing such signs of exhaustion that they are looking to other countries to find supplies. But the increased export is simply the response to the higher prices for iron ore, and to the beginning of the rise in the ocean freights. The higher freights at the time when the Baltic is usually stopped have brought a plentiful supply of tonnage—a supply so large that the turns of the steamers at the wharves have been very long. There has been the desire to make the most of the advance in the price of ore, and the enlarged number of furnaces in blast using hematite ores has made that large import into the smelting countries needful. It is doubtful whether the export of iron ore from Bilbao will continue to advance in the future as it has of late. There is not only that question of the duration of the supply we have hinted at, but there is the certainty that Spain will want to smelt more of her ores in her own domain. She needs to buy from us coke and coal for the purpose, so that the change from selling her ores to selling crude iron is not one which is entirely a loss to us though for part of the quantity of hematite iron needed she becomes a competitor with us in the non-producing markets. Still the total output of iron, as we have said, is insignificant; that sold in the crude state and sent out of the port of Bilbao was last year about 100,000 tons, and this year it promises to be a little more. But that quantity is simply about six weeks' shipments from our own river Tees, and it is certain that in our own land, with the deficient supply of native hematite iron ores, we are increasing our production of steel-yielding irons. Whilst therefore we may look with interest to the progress of the youngest of metallurgical nations, we may notice that her production of pig iron must of necessity be limited by the largeness of the sales of iron ore, past and present; and we need have little fear that while she sells so much ore, and has to import her fuel for smelting, she will become much of a competitor with us in the markets needing crude iron.

THE ROYAL AGRICULTURAL SOCIETY.

A deputation from the Agricultural Engineer's Association recently had an interview with the Implement Committee of the Royal Agricultural Society of England, and urged a number of reasons for a reduction in the heavy charges which of recent years have been enforced for space at the annual shows, and also for descriptions of the exhibits in the official catalogues. At the Society's monthly Council Meeting, on March 2nd, Mr. J. Hemsley, Chairman of the Committee, mentioned that they deferred offering any suggestions until they had an opportunity of fully discussing the whole subject. A letter from the Agricultural Engineer's Association urging a fuller representation of the mechanical department on the Society's Council, was then read and referred to the Selection Committee, whose duty, we understand, is to select names for the approval of the Council as vacancies occur. Both these matters are of great interest and importance to agricultural engineers, and we hope soon to be able to record a satisfactory outcome. At the same meeting the Hon. Cecil Parker, as chairman of the Dairy Committee, brought forward a recommendation that in the trials of the one-man cream separators at the Newcastle Show in July next sufficient milk should be supplied, as required, to charge each machine, and that these twenty gallons of milk should be served out and dealt with by each machine, two men to be allowed to each, and not more than one man at a time. In Nottingham there does not appear to be a very enthusiastic response to the appeal made by the local committee for the necessary fund which must be obtained before the Royal Agricultural Society can accept the invitation already given to hold a show there. The Duke of Newcastle is willing to increase his subscription to £100 if others will do the same; but the Duke of Portland declines to give more than he has already promised, and the Duke of Rutland, Lord Galway, and some other landowners, refuse to subscribe to the fund. As Mr. F. S. J. Foljambe says, "the benefits likely to accrue to the town from the visit of the Society are hardly appreciated." The Town Council have been asked to authorise the giving of the required guarantee, on the understanding that every effort shall be used to prevent the Corporation from suffering loss.

THE HUNDRED AND TEN TON GUN.

The 110½-ton Elswick breech-loading gun was again fired in the Royal Arsenal last Thursday, March 3rd. Three rounds were fired. The first was with a charge of 850 lb. of German prismatic powder; when a velocity of 2142ft. per second was obtained with a pressure of 19½ tons per square inch. The second round was fired with a charge of 960 lb. of Waltham Abbey power, giving a muzzle velocity of 2104ft. for a pressure of 15·7 tons. The third round was fired with 850 lb. of German powder, with a velocity of 2149ft. and a pressure of 19·9 tons. These are remarkable results. The projectile weighs 1800 lb.; and the total energies of these three rounds therefore are, respectively, 57,320, 55,250, and 57,630 foot-tons. These are the largest amounts ever yet registered, though it must be noticed that the enormous energy calculated, viz., 61,190 foot-tons, due to a velocity of 2216ft. per second, has not yet been achieved, although a charge of 960 lb. has been employed. Looking at the reports of Krupp's 119-ton guns, we are inclined to think that we did not give him credit for the full weight of his projectile, which appears to be 2028 lb. This, with a velocity of 1900ft., gives an energy of 50,780 foot-tons, or about 6850 foot-tons less energy than in the case of the British (Elswick) gun. It will be observed that the pressure with the Waltham Abbey powder was so low as to encourage further efforts, we think.

LITERATURE.

The Steam Engine. By George C. V. Holmes, Whitworth Scholar, Secretary to the Institution of Naval Architects, &c., London: Longmans, Green, and Co. 1887.

The number of treatises on the steam engine published in Great Britain within the last half century is very large; so large that the world may express some wonder that an addition to this library should be deemed necessary. Those, however, who are most familiar with existing treatises on the steam engine best know that in each and all there is some drawback, some want which impairs its usefulness. Rankine, for example, is too mathematical, and too unwieldy in his methods for mechanical engineers; Rigg's admirable book is too large and too costly for the greater number of students; Professor Cotterill is too abstruse; Mr. Sennett is too limited in his range. Mr. Holmes has in the volume before us endeavoured to avoid the defects of other writers. The book, an octavo of 528 pages, is of moderate size. The price is small enough to place it within the reach of the student who has not much money to spare. It is well printed and fairly well illustrated. All these are points in its favour, and suffice to excite a friendly interest in a reviewer; nor will a perusal of the book disappoint the expectations which may be formed of it. It has been well planned, and is well executed. Mr. Holmes makes no claim to originality—he tells us so much in his preface; yet the statement that the work is not original must be taken with a pinch of salt. There is a good deal to be found in it that cannot be found in other treatises on the steam engine, as we shall show further on. In his preface Mr. Holmes points out that there are some important points put into an accessible form for beginners. These are—(1) "The Science of Thermodynamics," (2) "The Influence of Inertia and Momentum in Quick Running Engines," (3) "Geometrical Methods of Working Slide-valve Problems," and (4) "The Investigation of the Causes of Loss of Efficiency in Steam Engines." Concerning the

first hitherto little has been said in the smaller treatises on the steam engine, the student being supposed to get himself up in heat with some such book as Clerk Maxwell's. The only author who has dealt at all exhaustively with the effects of inertia and momentum in a book is Rigg, to whom Mr. Holmes acknowledges his indebtedness. As to the geometrical slide-valve problems, Mr. Holmes has adopted Zeuner's method. It will be enough to say of this that the number of English drawing-offices into which it has found its way is extremely small. Concerning the fourth point, next to nothing has appeared in book form worth reading since Mr. Isherwood published, nearly a quarter of a century ago, his masterly preface to the second volume of "Experimental Researches in Steam Engineering," a costly work, which has been little read in this country. It will be seen, therefore, that Mr. Holmes has to a large extent covered ground which has been comparatively unoccupied. A book on the steam engine resembles a ship being victualled for a long voyage; the space is limited—the number of things which it is desirable or necessary to take on board is unlimited. That caterer will give most satisfaction who makes the best selection. Something must be left out. Care must be taken that no one thing is in excess. Mr. Holmes has, as we have said, selected judiciously. He has, however, done more than this; he has, on the whole, put what he has to say in an attractive and intelligible form before his readers. He does not presuppose that they know much, and this saves unpleasantness subsequently.

In the space at our disposal it would be useless to attempt to give an exhaustive review of Mr. Holmes' book. We shall better serve our readers if we deal with some of the more interesting statements, arguments, or propositions which it contains. In doing this we shall have occasion to take exception to certain things which can be supplied or corrected in the second edition, which we have no doubt the work will soon reach.

In dealing with the laws of steam, our author confines himself almost entirely to dry steam. Now, unfortunately, the engineer has little or nothing to do with dry steam, and the lack in the book of nearly all information concerning the laws of vapours, which are quite different from those regulating the behaviour of dry saturated steam, is to be regretted. A great deal of space, comparatively, is taken up with Pambour's theory of the steam engine. To this we do not object; but the student of average intelligence will not be satisfied with Mr. Holmes' explanation of an important point. De Pambour's theory is based on two propositions. The first is that when an engine is running at uniform speed the resistance of the load is precisely equal to the total effective pressure on the piston. With the second proposition, which is that the steam made in the boiler is equal exactly to that used in the cylinder, we need not concern ourselves. The first proposition is obviously based on the theorem that action and reaction are equal and opposite, so that a force is always measured in amount by the resistance. If, now, the student asks how it comes to pass that a steam engine works at all when the load opposed to the piston is precisely equal to the driving pressure intended to overcome that load, he will get no answer from Mr. Holmes. He contents himself with saying, that if the average pressure on the piston were greater than the resistance, the motion of the piston would be accelerated; if it were less it would be retarded. This is, of course, not only reasoning in a circle, but making an untenable assumption. According to the laws of motion, *the driving force on a piston never can be in excess of the resistance for even an infinitesimal fraction of a moment of time*, and for this reason the cause of acceleration must be sought elsewhere. Mr. Holmes has, however, this to be said for him, that he teaches what he was taught. Perhaps we have the merit, if such it be, of being the first to call his attention to a distinct and flagrant defect in the teaching of mechanics. In dealing with train resistances, Mr. Holmes does not allude to the curious fact that the bulk or volume of a train largely affects the resistance due to the atmosphere even on a calm day, when flange friction is not called into play. In dealing with combustion, we notice that he regards the principal source of waste in smoke as the carbon suspended in it, and does not insist, as he ought, on the circumstance that the chief source of waste is the loss of unburned carbonic oxide; nor does he point out that this may take place to an enormous extent in fires burning without smoke. Giving the theoretical evaporative value of a pound of coal at 15 lb. of water, he adds that no boiler in practice can approach this performance. He has forgotten Lord Dundonald's experiments with the boilers of the s.s. Janus, which evaporated over 14 lb. of water from 212 deg. In considering the efficiency of boilers, he regards the transmission of heat through the plates as a function of the conducting power of the metal and the difference between the temperature inside and outside the plate only, saying not one word about the important phenomena of receptivity and emissiveness, as explained by Peclet in his *Traité de la Chaleur*. These, and a few similar omissions, which it is not necessary to particularise, are the principal defects we have detected in the book.

The eleventh chapter is the most important, we think, in the volume. It is really a treatise in itself on the principal causes of loss of efficiency in steam engines. It is very interesting, and, on the whole, has been carefully and cautiously written. When there is ground for so much diversity of opinion it is not to be supposed that every one will agree with the author's conclusions, but few will assert that he has not written what is worth reading. We see that he accepts the heat trap theory to explain the economy of triple expansion engines. Yet if he will take the trouble to work out for three cylinders as he has done for one, the amount of condensation which must take place as a result of the extension of cooling area due to the multiplication of cylinders and pistons, he will find reason to doubt the soundness of the theory, which, furthermore, is easily refuted by the circumstance that the initial condensation in the small cylinder of triple expansion engines is usually enormous. The true reason why triple expansion and other compound engines are economical is that the steam which results from re-evaporation is used expansively. We fear that Mr. Holmes dismisses the problem presented by the steam engine too lightly. Writing for students it is, of course, undesirable that he should plunge very deeply into such matters, but no harm would have been done by hinting that engineers do not quite understand everything that takes place in a steam engine. Most anomalous results present themselves daily; and these are still the despair of those who try to formulate a true theory of the steam engine.

The formulæ given by Mr. Holmes for finding pressures in receivers of compound engines are complex, and engineers very seldom trouble themselves with them, as the pressures obtained by calculation never—and we use the word advisedly—agree with those obtained in practice. This last has settled, as far as it can be said to be settled, the best ratios for the diameters of cylinders to each other.

In the appendix is a very ingenious, original, and useful steam table.

In conclusion, we warmly congratulate Mr. Holmes on having the courage to use throughout English measures and weights instead of the decimal system. The utility of his book for English students has been thereby enormously increased.

Engineer Studies. By Major E. M. Lloyd, R.E., late Professor of Fortification, R. M. Academy, Woolwich. London: Chapman and Hall. 1886.

We have bestowed more attention than usual on this work. We laid it aside, in fact, for deliberate reading. The subject is dealt with in an interesting way, and probably is made as popular as is possible consistently with its professional character. To any reader of fortification it is a fascinating book. The peculiarity is the manner in which the various features in fortification are identified with their authors. Of Vauban, Montalembert, and Carnot, we have professional histories, and the individual character of the men is happily connected with their work. This gives special interest to each feature, and would, we think, enable most minds to grasp it more readily, and put it in its place more truly. We regard the book, however, as suited to a limited class of readers. We doubt if one unacquainted with fortification would follow the descriptions, unaccompanied as they are by illustrations. The portraits of the three eminent engineers are very good engravings, but they are no substitute for what we think is demanded, namely, simple cuts showing their work. Also, we think, that all the more modern constructions receive very scant notice, though undoubtedly the general plan and objects of modern forts are well put before the reader. Considering who the writer is, it could hardly be otherwise. On the whole, the greater portion of the work is pleasant light reading for engineer officers. The last part is more important, and deserves careful attention. This is the part that we wish was longer and more full. Iron turrets and shields Major Lloyd regards as "luxuries," and he does not depend much on them, but he regards iron caponiers with favour. Machine guns are specially recommended for flanking ditches. The chilled iron forts have the objection made against them that we have made ourselves, namely, the impossibility of subsequent strengthening; but their good features are not noticed. It surprises us also not to find any notice of Twydell, or even Horsesands. This is the very book where we should have expected to find the former discussed.

BOOKS RECEIVED.

Screw Threads and Methods of Producing them; with Numerous Tables and Complete Directions for Using Screw-cutting Lathes. By Paul N. Hasluck. London: Crosby Lockwood and Co. 1886.

Graphic and Analytic Statics in their Practical Application to the Treatment of Stresses in Roofs, Girders, Piers, and Frameworks. By Robert Hudson Graham. Second edition, revised and enlarged. London: Crosby Lockwood and Co. 1887.

Flow of Water in Open Channels, Pipes, Sewers, and Conduits. By P. J. Flynn, C.E. Van Nostrand's Science Series. New York: D. Van Nostrand. 1886.

Compensation for Personal Injuries by Rail, Road, and River. By T. J. Wesley Bennett, F.R.S.L. London: The *Commercial Gazette* office. 1886.

The Gas Engineer's Chemical Manual. By J. Alfred Wanklyn. London: Scientific Publishing Company. 1886.

Practical Electricity: a Laboratory and Lecture Course. By W. E. Ayrton, F.R.S. London: Cassell and Co. 1887.

The Modernised Templeton. The Practical Mechanic's Workshop Companion. By W. Templeton. Fifteenth edition, revised, modernised, and enlarged by W. S. Hutton, C.E. London: Crosby Lockwood and Co. 1887.

The Steam Engine. By George C. V. Holmes, secretary Naval Architects. London: Longmans and Co. 1887.

Railway Problems: an Inquiry into the Economic Conditions of Railway Working in Different Countries. By J. S. Jeans, F.S.S. London: Longmans and Co. 1887.

Journal of the Society of Telegraph Engineers. No. 64. Vol xv. Edited by F. H. Webb. London: E. and F. N. Spon. 1887.

Jarrold's Norwich and Eastern Counties Almanack and Clerical Directory, 1887. Norwich: Jarrold and Sons. 1887.

The Metal Turners' Handybook: a Practical Manual for Workers at the Foot Lathe. By Paul N. Hasluck, A.I.M.E. Second edition, revised. London: Crosby Lockwood and Co. 1887.

The A B C of Modern Dry-plate Photography. 22nd edition. London: The Stereoscopic Company. 1887.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Charles H. Pellew, chief engineer, to the Landrail, to date March 10th; and William John Firks, engineer, to the Griffon, to date March 16th.

The Derby Society of Engineers.—On Tuesday last a paper was read by Mr. Samuel Waddington, Stud. Inst. C.E., on "The Westinghouse Brake and its Working," which was freely illustrated with drawings of the various parts and their application. An animated discussion followed, and the paper, like many others of its predecessors, was a decided success.

AMERICAN DEMAND FOR IRON AND STEEL.

The following statement, which appears in the *American Iron Trade Review*, shows pretty clearly the decrease in exports and the increase in imports of manufactured iron and steel in the United States in 1886, as compared with 1885:—

"The following figures as to the imports and exports of iron and steel in the United States in 1886 are set forth in the annual statistical tables just issued by the United States Treasury Department, for an advance copy of which we are indebted to the Chief of Bureau of Statistics:—

Imports.	Exports.
"The imports of iron ore into the United States in 1886 were 1,039,433 tons, an increase of 166 per cent. over 1885.	"The exports of iron ore from the United States in 1886 were 2041 tons, an increase of about 100 per cent. over 1885.
"Our pig iron imports footed up 361,768 tons in 1886, or 146 per cent. more than the previous year.	"Our pig iron exports footed up 8849 tons in 1886, or 42 per cent. more than the previous year.
"Scrap iron was imported in 1886 to the amount of 13,821 tons. This is an increase of 451 per cent. over the imports of 1885.	"We exported no scrap iron in 1886.
"The imports of bar iron in 1886 fell off 8 per cent. from 1885, when they footed up 70,502,419 lb.	"The exports of bar iron in 1886 fell off 3 per cent. from 1885, when they footed up 1,866,389 lb.
"From 2138 tons of steel rails in 1885, our imports increased to 41,581 tons in 1886—or nearly 18½ times more in 1886.	"From 7484 tons of steel rails in 1885, our exports decreased to 2117 tons in 1886—being 3½ times more in 1885 than in 1886.
"There was a falling off of nearly one-half in our imports of cotton-ties in 1886 from 1885. In 1885 they were 41,151,329 lb.; in 1886, 23,120,328 lb.	"We exported no cotton-ties in 1886, and cannot manufacture them to advantage under the present unjust ruling of the Treasury Department.
"We increased our imports of steel hoops, bands, strips, sheets, and plates 80 per cent. in 1886, over those of 1885. The figures are:—1885, 5,288,507 lb.; 1886, 9,549,427 lb.	"We exported no steel hoops, bands, strips, sheets, or plates in 1886. Of band iron we exported 404,546 lb., an increase of about 22 per cent. over 1885.
"A large increase in our importations of steel ingots, blooms, slabs, billets, and bars was to be expected, but it is somewhat surprising to learn that we imported in 1886, 334,403,640 lb.—an increase over 1885 of nearly 400 per cent.	"Our exports of steel ingots, bars, and rods in 1886 were 173,058 lb., a falling off from 1885 of 70,350 lb.
"Large as were our imports of tin-plates in 1885—512,056,092 lb.—they were 12 per cent. larger in 1886, viz., 577,217,362 lb.	"We manufactured no tin-plates in the United States in 1886, and consequently exported none, nor can we until adequate protection is afforded.
"Of wire rods, we imported in 1886, 306,802,528 lb., or 45½ per cent. more than in 1885.	"We exported no wire rods in 1886, but our exports of wire aggregated 8,669,655 lb., an increase of 31 per cent. over 1885.
"In 1886 we imported 1,697,883 dols. worth of machinery. This was 75 per cent. in excess of the valuation in 1885.	"In 1886 we exported 7,197,690 dols. worth of machinery. This was about 5¼ per cent. less than the valuation of 1885.
"The total valuation of all our imports of iron and steel, and manufactures thereof, in 1886 footed up 41,630,688 dols., against 31,144,552 dols. in 1885—an increase in 1886 of 33⅓ per cent.	"The total valuation of all our exports of iron and steel, and manufactures thereof, in 1886, footed up 14,865,044 dols., against 16,622,511 dols. in 1885—a decrease in 1886 of about 10 per cent.

The large importations of several of the articles enumerated above were necessitated by the heavy home demand, which could find no adequate supply from American mills and furnaces, even though run to their fullest capacity."

It is evident that English manufacturers of rails, iron or steel sleepers, wheels, axles, tires, springs, and other manufactured iron and steel could, in spite of the tariff, find a good market for their wares in the United States, Canada, and Mexico. Numerous inquiries are made by those unable to procure early delivery of such material; but owing to the fact that few English firms advertise, or take any pains to make American railroads and consumers conversant with their names, many orders are lost to English makers. It is anticipated that 12,000 miles of railroad will be constructed in the United States during 1887, and it is therefore evident that not only will that country be unable to supply all the material required, but that no surplus will remain for export to her immediate neighbours, Canada and Mexico. In both these countries, and especially in the latter, English makers are not so hampered with restrictive tariffs and are on an equal footing with American makers, who have, of course, to pay a higher price for ore and labour.

Many of the larger machine tools—both iron and woodworking—in Canadian railroad shops and factories are of American make. These tools are procured in the United States because they are not made in Canada, but an enterprising English tool maker could easily secure many orders were he to visit Canada personally and ascertain carefully the special requirements of Canadian users.

Wrought iron spoke wheels with steel tires and Mansel fastenings are fast supplanting chilled cast iron wheels under the best sleeping and passenger cars on both American, Canadian, and Mexican railroads. Large quantities of these wheels have been imported from England, but great complaints have been made at the quality of the tires. A firm that could supply wrought iron car wheels with good steel tires and axles could do a very profitable business in the United States. Both Krupp, of Essen, and Cockerills, of Seraing, have entered the business and are selling numerous trial orders of wrought iron wheels for both cars and locomotives in the United States. Cast steel wheel centres with steel tires, as used on many English railroads, are as yet unknown in America, though cast steel is largely used for locomotive crossheads and other similar parts.

A favourable opening for steel sleepers presents itself in Arizona and New Mexico, where timber is scarce and decays

CONTRACTS OPEN—RAILWAY FERRY OVER THE GANGES.

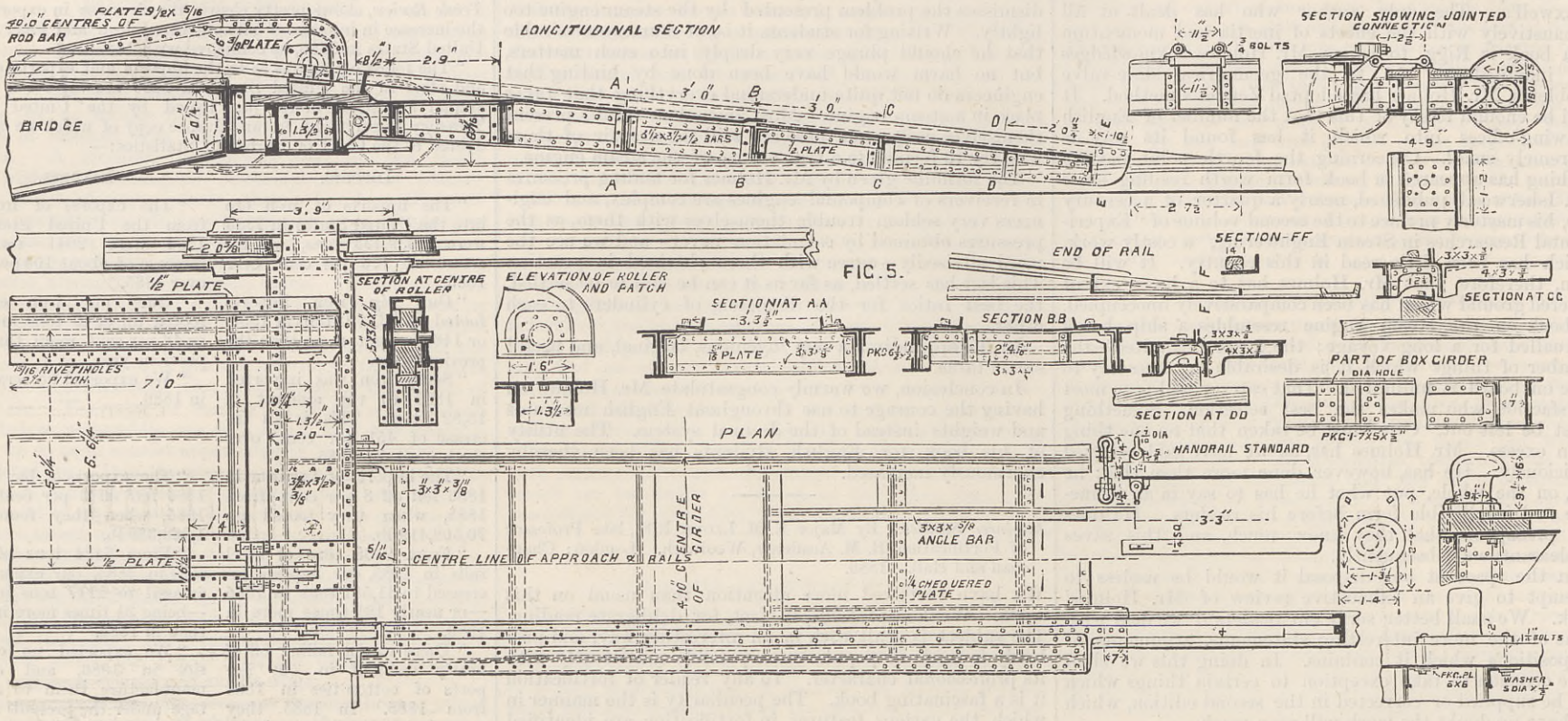


FIG. 5.

rapidly. English steel rail makers will always find a market in the United States as long as the quality of English rails is superior to the soft and hastily made rails turned out by the majority of American rail mills. The construction of 12,000 miles of new railway means an enormous consumption of steel rails in addition to the large quantity wanted for renewals on 125,000 miles of railway now in operation in the United States. A little enterprise and the strictest attention to the quality of their products will secure a large share of this trade for English rail makers.

CONTRACTS OPEN.

BENGAL AND NORTH-WESTERN RAILWAY—GANGES FERRY.

The work comprised in the contract includes the construction, supply and delivery in England, or in Calcutta, of the whole of the steel work and iron work for two steel landing stages, each 100ft. long, 40ft. wide, and 6ft. 8in. deep, together with the windlasses, chain cables, and anchors for mooring the landing stages, with duplicate moorings, for transporting trains across the Ganges. Two steel pontoon bridges, each 70ft. long from centre to centre of the bearing rollers, 13ft. wide, and 5ft. deep, and two sets of steel approach girders, together with all bolts and spikes for securing the planking and timbers, all rivets, bolts, chains, rails, &c., to complete the construction of the work in India, with an addition of 50 per cent. to the net number of rivets, and of 10 per cent. to the net number of bolts required, for waste.

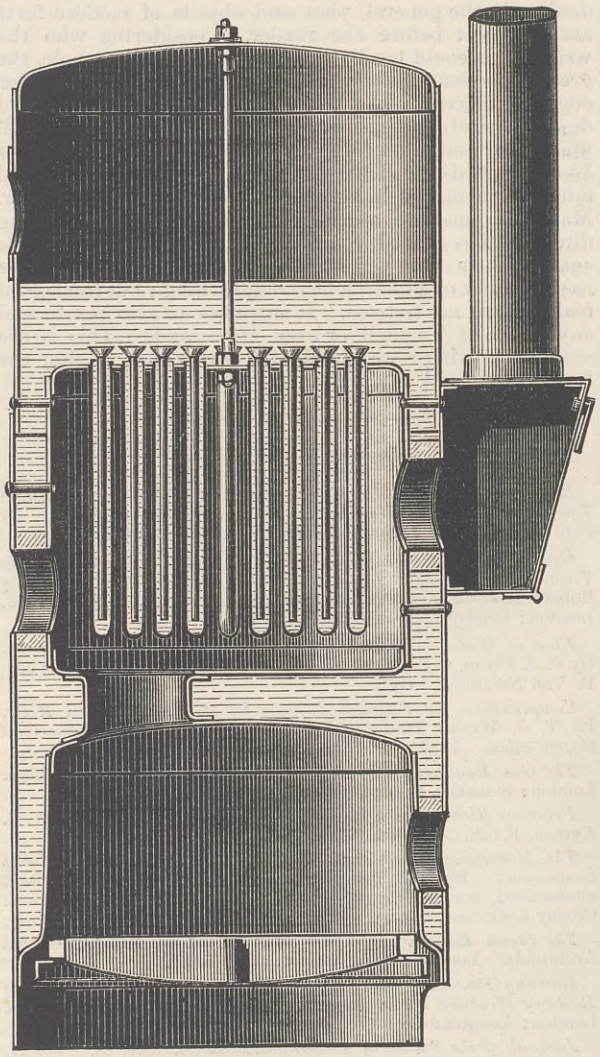
The construction of the various parts of the work is shown on five sheets of drawings, numbered 254 to 258, from which our engravings have been prepared. Drawing No. 254 includes Group Fig. 1, and shows the general arrangement of one landing stage, with its bridge and approach girders. Drawing No. 255 includes Groups Figs. 2 and 3, and shows the landing stage in detail. Drawing No. 256 includes Group Fig. 3, and shows further details of the landing stage, and of the connecting plates of the roadways of the landing stage and bridge. Drawing No. 257 includes Group Fig. 4, and shows the pontoon bridge, the platform for connecting the landing stage with the barges using the landing stage, and also the standards and machinery for raising and lowering the connecting platform. Drawing No. 258 includes Group Fig. 5, and shows the approach girders, details of the mooring posts for the landing stage, and the section of the rail to be used on the landing stage, bridge, and approach girders. The four windlasses for the mooring cables of each landing stage are not shown on the drawings. Full details of the anchors, of the windlasses, and of any additional girders required for carrying them, of the hawse castings, of the machinery for raising the connecting platforms, of the bilge pumps, of the wheels for the approach girders, and of any other parts not fully shown on the drawings, are to be drawn by the contractor and submitted to the engineers of the company for approval before being worked to, it being the intention of the contract that it shall include all work necessary for the moorings of the pontoons and their connections with the barges on the one side and the shore on the other, and all appliances to make the work absolutely complete. Every part of the landing stages, bridges, and approach girders is to be of steel, unless otherwise specified or shown on the drawings. The whole of the rivets used throughout the work are to be of steel.

The steel and wrought iron must be of such strength and quality as to be equal to the following tensional strains, and to indicate the following percentages of contraction of the tested area at the point of fracture:—

	Tensional strains per square inch. tons	Percentage of contraction in 8in.
Steel in plates either with or across the grain, angle or flat bars not less than ..	27	30
Or more than	31	
Steel rods for rivets not less than	25	40
Or more than	28	
Wrought iron bars	24	20
,, ,, plates..	21	8
,, ,, across the grain	18	3

The landing stages are each to be of the following dimensions:—100ft. long over the end plates, 40ft. wide over the angle bars of the frames, and 6ft. 8in. deep over the angle bars of the frames and the deck beams. They are each to be divided into twenty water-tight compartments by three longitudinal and four transverse bulkheads, and are to have a recess on one side to received the bridge. The part of the deck between the end of the bridge and the connecting platform is to be raised on girders to a higher level, and is to be sloped to the ordinary level of the deck towards each end of the landing stage. The frames and deck beams are spaced 2ft. apart from centre to centre. The plating generally throughout is to be ¼in. thick, with covers $\frac{5}{16}$in. thick.

The pontoon bridges are each to be 70ft. long from centre to centre of the bearing rollers, 13ft. wide over the angle bar frames, and 5ft. deep over the angle bars at the middle of the pontoons. They are each to be divided into twenty-one water-tight compartments by two longitudinal and six transverse bulkheads. The frames and deck beams are to be spaced 2ft. 6in. apart from centre to centre, measured horizontally. The plating generally is to be ¼in. thick, with inside and outside covers, each ¼in. thick. The longitudinal angle bars of the sides and bulkheads are to be 4½in. by 4½in. by ½in. each, in two lengths. All covers in the top, bottom, and sides are to be treble rivetted and arranged as chain rivetting; the outer line at each end of the cover is to have alternate rivets omitted. The angle bars of the frames and bulkheads are to be 2½in. by 2½in. by $\frac{5}{16}$in. The manhole covers are to be fitted with rings for lifting, and any other ironwork to make them complete. The rivet holes in the 4½in. by 4½in. by ½in. angle bars are to be $1\frac{3}{16}$in. diameter, and are to be arranged for double rivetting. The



SECTION

VERTICAL MULTITUBULAR BOILER.

rivets to be spaced 2½in. from centre to centre on each line, and the rivets on each line are to reel with those on the adjacent line. The overlap of the longitudinal seams of the top, bottom, sides, and longitudinal bulkheads is to be $1\frac{3}{16}$in. These seams are to have rivet holes $\frac{5}{16}$in. diameter spaced 2in. from centre to centre.

Each landing stage is to be moored at the up-stream end by two of Martin's patent anchors of 38 cwt. each, connected to the windlasses by 1¾in. diameter chain cables, and at the down-stream end by two of Martin's patent anchors of 26 cwt. each, connected to the windlasses by 1½in. diameter chain cables. Forty fathoms of 1½in. diameter, and forty fathoms of 1¼in. diameter, wrought iron chain cables are to be provided for each landing stage, together with all necessary shackles, &c., required to connect the chains to the windlasses and to the anchors. Each landing stage is to have four windlasses of a construction to be approved of by the engineers, for lifting the anchors, or for adjusting the position of the landing stage. Each landing stage is to be fitted with five 3in. diameter gun-metal bilge pumps.

Each bridge is to have a portable hand bilge pump of a construction to be approved by the engineers. The pump is to be of a construction suited to its being worked through the manhole of any compartment. Sir A. M. Rendel is the engineer.

Tenders are to be delivered by noon on 21st inst. to Mr. E. L. Marryatt, Secretary, 237, Gresham-house, Old Broad-street, London, E.C.

COMBUSTION CHAMBER VERTICAL MULTITUBULAR BOILER.

The accompanying illustrations represent a new patent vertical multitubular boiler, arranged so as to give a large amount of heating surface with the most efficient and economical results in working. It is simple in construction, all the parts are readily accessible for examination and cleaning, and a good circulation of water is secured. The fire-box has a dome-shaped top, from which a plain flue or short-neck tube leads directly to a combustion and tube chamber, and the products of combustion pass through this into the tube and combustion chamber and amongst the tubes, and afterwards escape through a passage at the opposite side to the smoke-box and chimney. The tube and combustion chamber is formed wholly inside the cylindrical shell, and there is a water space between its bottom and the top of the fire-box. The tubes used are what are commonly known as "Field" tubes, or tubes solid-welded at one end They are fixed vertically in the crown of the tube chamber, and hang down to within a short distance of the bottom of the chamber. The tubes being protected from direct contact with the fire, are much less liable to burn out than they otherwise would be. The shell is of the usual type, with the top stayed to the crown of tube chamber, with long screwed bolts, and there is a door on one side of the shell in a line with the lower portion of tube chamber for cleaning. The illustration represents a boiler 9ft. high by 4ft. diameter, having seventy tubes, but for marine purposes they are made of larger diameter and not so high. Durability, economy of fuel, and moderate cost, are some of the features claimed for this type of boiler by the makers, the Grantham Crank and Iron Company, Grantham.

LOCOMOTIVE HISTORY ON THE SOUTH-WESTERN RAILWAY.

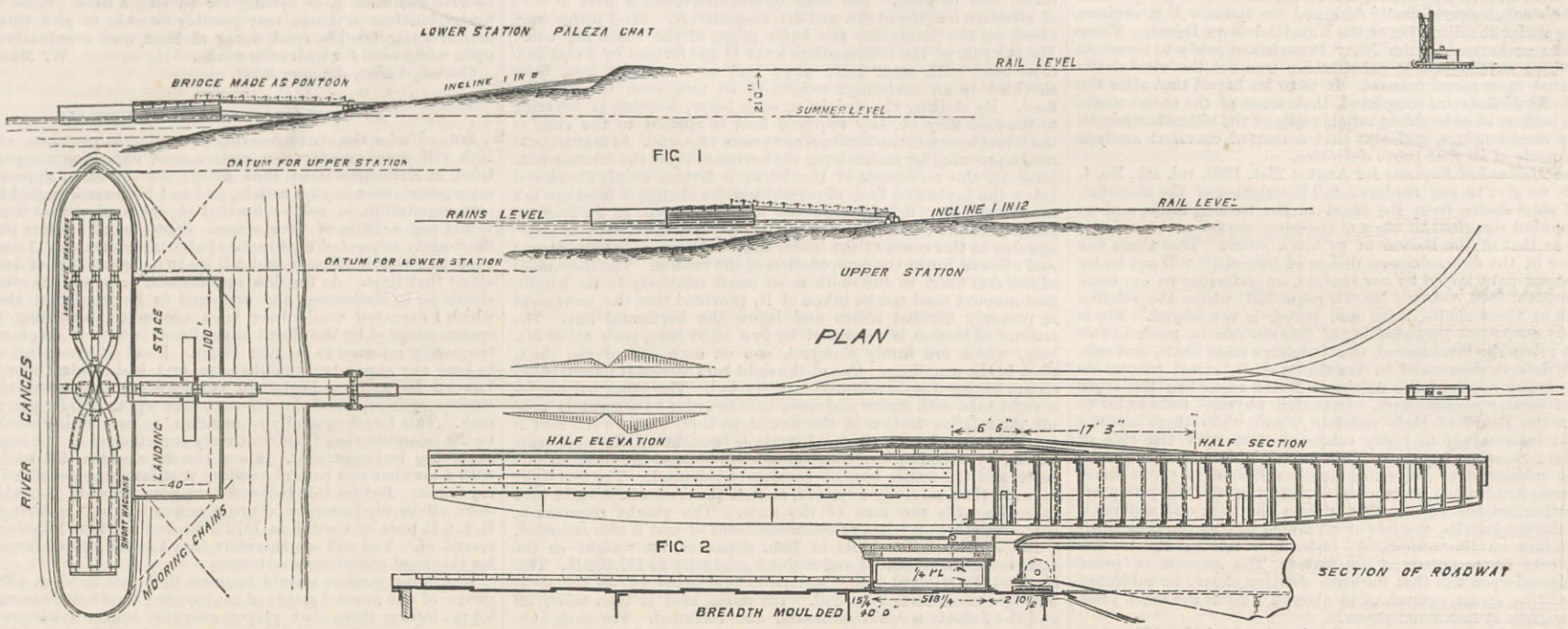
By the courtesy of Mr. W. Adams, M. Inst. C.E., Locomotive Superintendent of the London and South-Western Railway, we are enabled to publish this week a two-page engraving illustrating the history of the locomotive engine on that line between 1851 and the present year, a period of thirty-six years. The contrast between Mr. Gooch's engine of 1851, weighing 28 tons 10 cwt., and Mr. Adams' bogie expresses of 1880 and 1883, is well marked. By far the larger number of locomotives on the South-Western line has outside cylinders. The ten-wheel tank engines, employed principally in working traffic in and round London, are well worth attention. These are very powerful engines, with a tractive force of 110 lb. per pound piston pressure. It is a noteworthy fact that the engine mileage on the South-Western was for many years greater than on any other line in the kingdom; and on it were probably tried a greater number of experiments than on any other in Great Britain. The late Mr. Beattie used double grates with fire-doors one above the other, and burned coal in early days with much success. He used balanced slide valves and various systems of water-heating; and many of his devices for securing brasses and working out details were original and good.

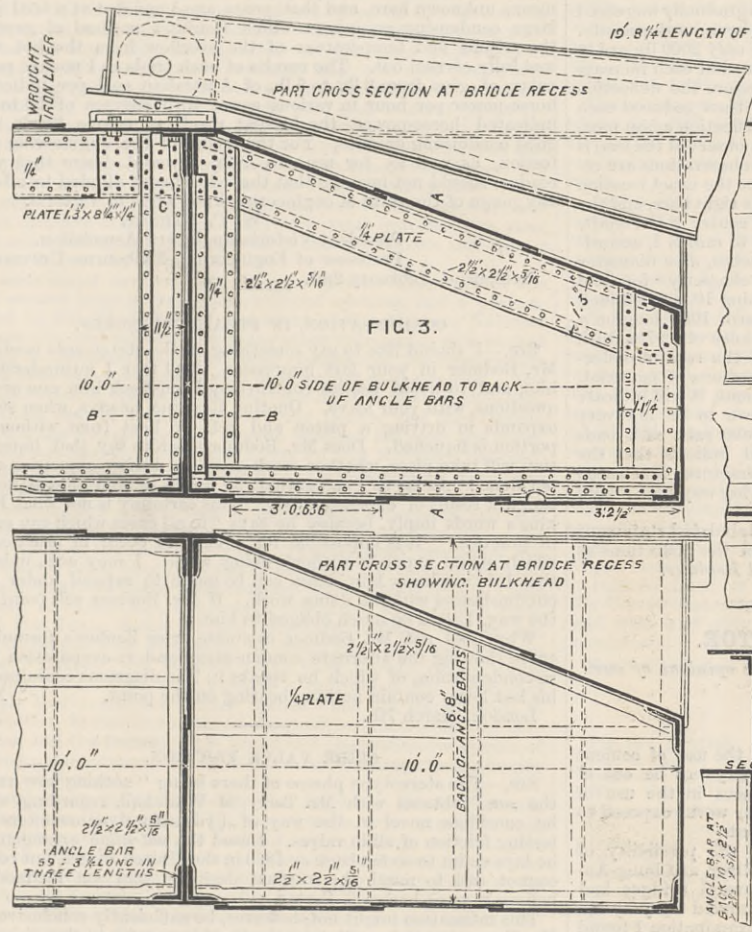
Mr. Adams has to work under different conditions. His traffic is very heavy, and his engines have complied satisfactorily with all the demands made on them. They are specially remarkable for their great strength of parts, resulting in a minimum of repairs.

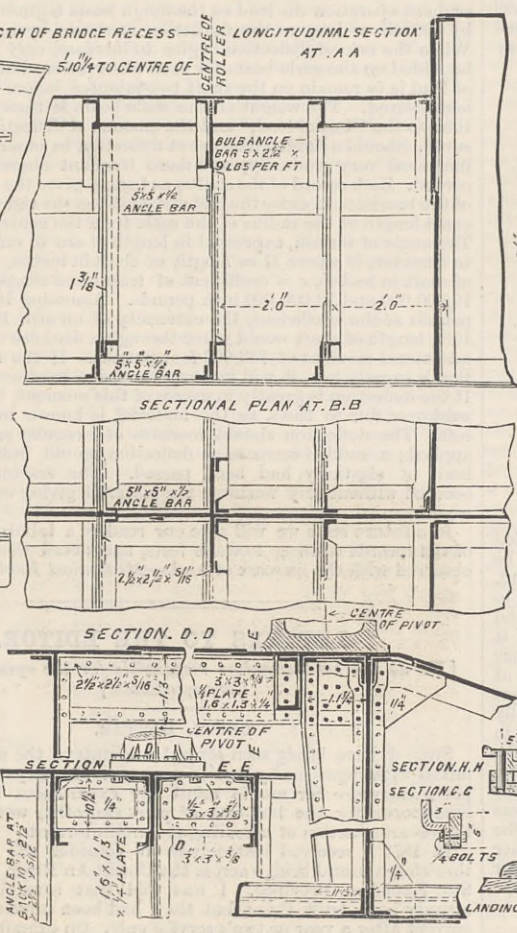
University College Engineering Society.—The sixth evening meeting of this ses ion was held on March 2nd, Professor L. F. Vernon Harcourt in the chair. A paper was read by Mr. R. J. Durley, Stud. Inst. C.E., on "Modern Breech-loading Guns." After mentioning one or two of the older forms of breech-loading ordnance, the paper briefly discussed the reasons leading to the substitution of breech for muzzle-loading guns, and for the use of slow-burning in place of quick-burning powder. It described the Krupp, Elswick, and Royal Gun Factory systems of construction, with special reference to the method of breech closing adopted in each case. The author shortly sketched some of the forms of carriages and projectiles employed, and concluded by giving results obtained by the chief modern big guns. The paper was illustrated by a number of diagrams. A discussion followed, in which several members of the Society took part.

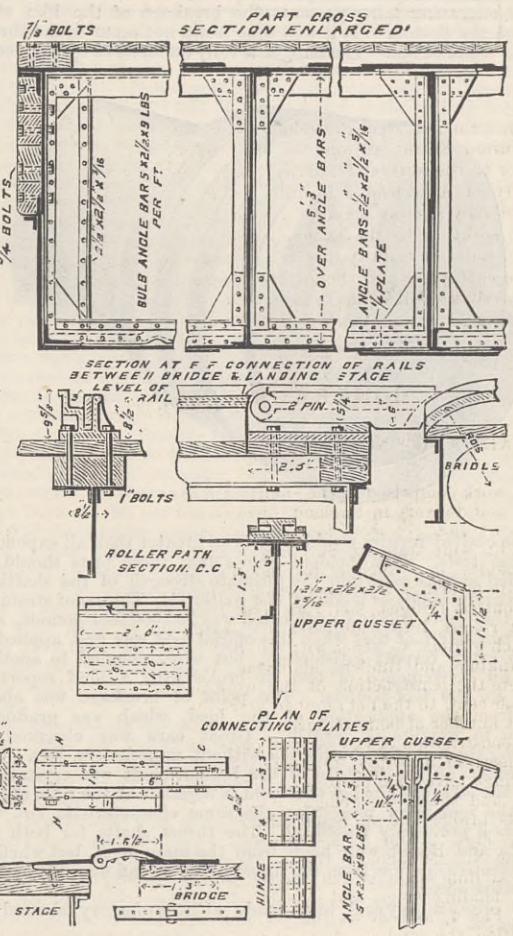
CONTRACTS OPEN.—RAILWAY FERRY OVER THE GANGES.

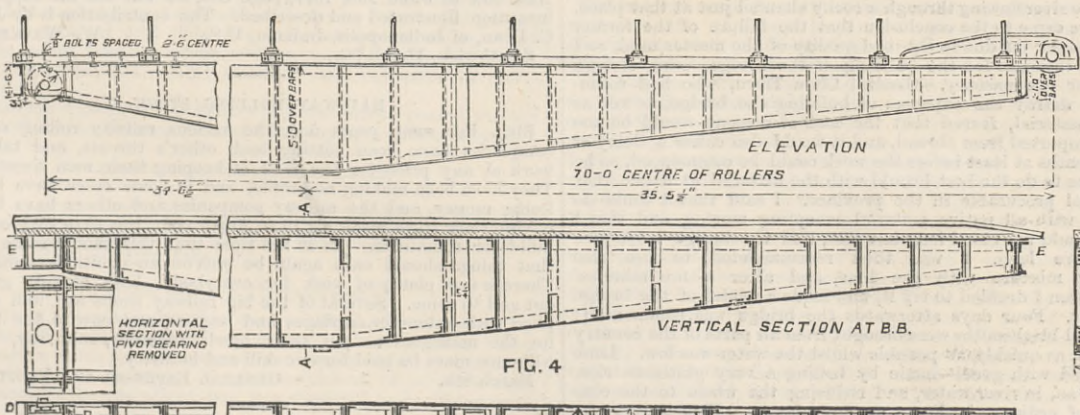
(*For description see page* 198.)

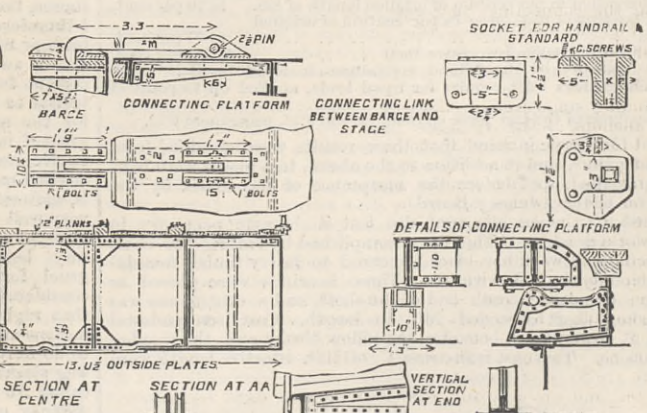


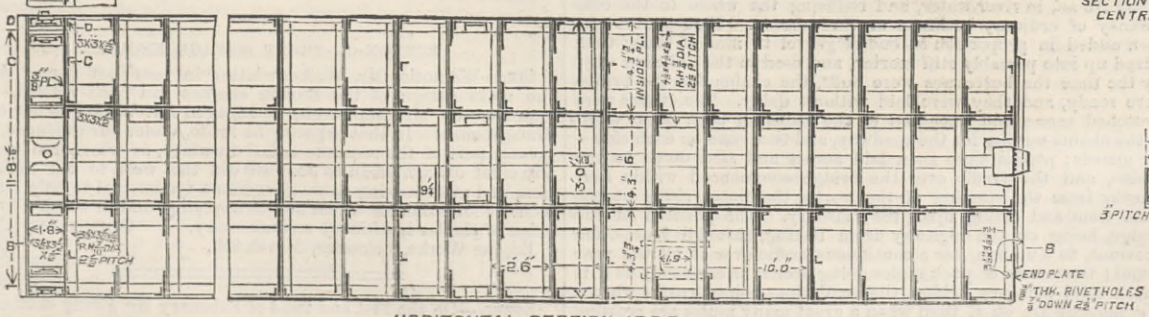


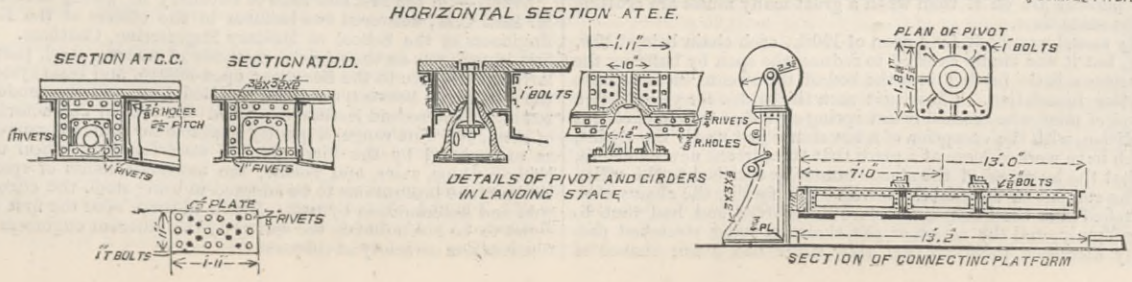










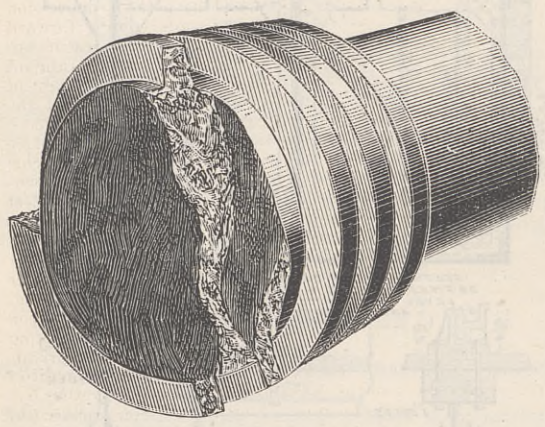


TESTS OF STEEL SHAFTING.

We have watched with more than ordinary interest the progress of the tests now being conducted at the New York Navy Yard, upon the steel shafts originally designed for the new U.S. cruisers building under the direction of the Naval Advisory Board. These tests were authorised by the Navy Department solely to ascertain if the views entertained in substituting iron for the steel shafts were based upon sound reasons. It is to be hoped that after the present official tests are completed, that some of the sound shafts may be broken, so as to obtain reliable data of the ultimate strength of large steel forgings, and also that a careful chemical analysis may be made of all that prove defective.

In the *Mechanical Engineer* for August 21st, 1886, vol. xii., No. 4, page 39, we give to our readers a full description of the manufacture of steel shafts, from the ingot to the turning lathe, and we are somewhat surprised to observe the complete failure of so large a shaft as that of the Boston at so low a stress. That there was any error in the dimensions or design of this shaft will not be for one moment entertained by our readers, on referring to our issue of May 29th, 1886, vol. xi., No. 11, page 126, where the relative strength of these shafts, solid and bored, is considered. Nor is there any doubt but that shafting of this size can be made in this country; but the breakage of the Dolphin's main shaft, and subsequent defects discovered in her thrust shaft, raised reasonable doubts in the mind of the Advisory Board regarding the other shafts of similar manufacture. Extended physical tests failed to convince the Board of their reliability, and while there was not sufficient information to justly condemn them, yet the risk of acceptance was too great to be assumed, unless they could be actually submitted to a twisting stress sufficient to prove them. This course involved so great a loss of time that the Navy Department authorised the substitution of iron shafting, and ordered a test of the steel shafts, the loss of all failing to pass the prescribed tests falling on the contractor, and those coming up to the standard to be accepted as duplicates. The amount of proof strain agreed upon was that the steel shafting should be subjected to a twisting stress equivalent to about 2·1 times the mean twist of the engines at maximum power.

This engraving fairly presents the breakage of the 16in. steel shaft of the Boston. It is well that it did not occur in the thrust bearing while at sea. The danger is fully understood by engineers



but the cost of repairs would have been greater than all expended in these tests. The incident shows that these tests should be extended so as to ascertain the ultimate strength of the shafting, and a careful analysis made of the material. The proof strain to which this shaft was to be subjected was 733,000 foot-pounds, and it is a singular fact that when this official test was first applied it was in every respect satisfactory, but when coupled to another shaft for convenience of test, it broke with a loud report at about 487,600 foot-pounds. The point of breakage was about 24ft. from the application of the load, which was gradually applied in weights of 5000 lb. Great care was observed in applying them at stated intervals without unnecessary jars. The appearance of the fracture of the broken shaft was crystalline, about the 50 square inches that held it together at the time of the test; the remainder presenting the same characteristic, but was dark, as if previously fractured. The thrust shafts for both the Atlanta and Boston were made from the same ingot, but whether this defective one was from the upper or lower end does not appear of positive record.

The original physical tests made at manufactory showed as folllows:—

Ultimate tensile strength in 8in. specimen	87,368 lb.
Final elongation in per centum of original length of 8in.	18·30 per cent.
Area of fracture of test piece in per centum of original area	56·00 per cent.
Elastic limit in pounds per square inch	46·300 per cent,

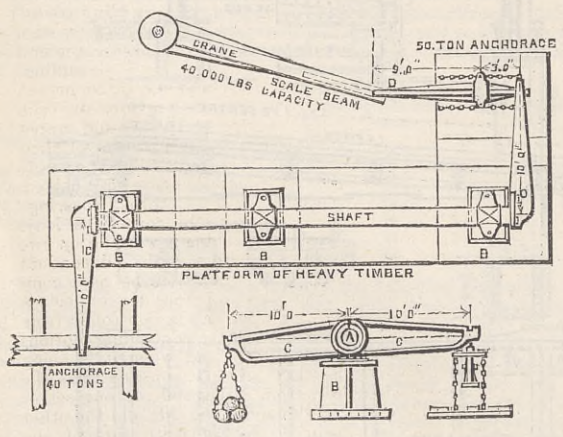
Appearance of fracture.—Fibrous crystalline—material ductile.

The elongations were regular for equal loads, applied up to point of failure.

The analysis of the test piece showed, carbon 0·38, manganese 0·82.

It is to be borne in mind that these results were obtained from 8in. test pieces, and in addition to the above, test pieces were bent cold, quenched, &c., before the acceptance of the shafts by the Inspector of the Advisory Board.

In order to make the requisite test it became necessary to improvise a machine. This was accomplished by resting the shaft A in two ordinary pillow blocks, secured to heavy timber foundations strongly bolted together. These bearings were placed as near as convenient to each end of the shaft, ond a central one was used when shaft exceeded 26ft. in length. Cast iron pedestal plates, B, were placed between the pillow blocks and the wooden foundations. Two cast iron arms, C, of 10ft. effective length were



secured to the ends of the shaft, one on each coupling, by well fitted bolts and cross key in the regular bolt holes, and key seat of the coupling. A cast iron coupling was made for the screw end of each propeller shaft.

One of the arms C was stationary, being securely anchored to the ground by heavy weights of about 40 tons. The other arm C was secured to the short arm of an intermediate lever D, the longer arm of which was connected by a chain and shackle to the heavy weighing beam scales of 40,000 lb. capacity. This weight beam was suspended from the foundry crane so that it could be raised and lowered. The arms of the intermediate lever D were of effective lengths of 9ft. and 3ft. respectively. Steel plates were fitted on the levers for the knife edges of the shackling bolts. The fulcrum of the intermediate lever D was formed by a cast iron cross-head with steel knife edge and two wrought iron bolts shackled to an anchorage weight of 50 tons sunk beneath the floor. By shifting the weight on scale beam, hoisting or lowering as the case may be, any required load is applied to the ends of the levers to obtain the torsional movement required. As means could not be provided for maintaining the horizontality of the intermediate lever D, the movement of the latter is divided evenly above and below the horizontal line, thus reducing the change of leverage to a minimum. For this purpose the lever is placed in an inclined position at the commencement of the test, and the change of leverage due to this cause at the initial and final loads is to be measured and allowed for in the computation of the results. The movement of the arm fixed to the shaft is so small relatively to its length, that account need not be taken of it, provided that the movement is properly divided above and below the horizontal line. The amount of torsion is measured by two sight bars, each about 6ft. long, which are firmly clamped, one on each end of the shaft, close to the couplings. One of the sight bars carries at its extremity an arc having a scale minutely sub-divided. The other bar carries a sight tube with lenses and cross lines in order to accurately read off the relative motion of the two sight bars. Before the load is applied to the levers, an equal strain is brought on the anchoring chains, by adjusting the nuts on the eye bolts of the intermediate lever, and the weigh beam is accurately balanced. The two sight bars are then carefully adjusted, so that the cross of the sight tube coincides with the zero of the scale. The weight required to balance the weigh beam at commencement of test is also recorded.

In the case of the shafts of 16in. diameter, the weight on the scale beam was balanced and run out gradually to 187,600 lb. This is called the "initial load," and deflection observed on the sight bars by this stress is recorded. The initial load is then taken off and the deflection again measured and recorded. For each subsequent operation the load on the weigh beam is gradually increased by 5000 lb. as long as the deflection increases by a uniform rate. When the rate of deflection begins to increase, only 2000 lb. are to be added on the scale beam for each observation, and each increase of load is to remain on the shaft two minutes before the deflection is measured. The weight on the scale beam is then reduced each time to the "initial load," and the amount of deflection again measured. Should a sudden increase of deflection be observed the load is increased very gradually, and more frequent observations are recorded. Each record of the shafts, as tested, gives the exact location of the bearings, likewise the distance between the sight bars, and the exact length of the radius of the scale from the centre of the shaft. The angle of torsion, expressed in length of arc to radius 1, accord- to Rankine, is where M = length of shaft in inches, d = diameter of shaft in inches, c = coefficient of transverse elasticity—for steel 10,000,000 and 12,000,000 inch pounds. Assuming 10,000,000 inch pounds as the coefficient, the extremity of an arm 10ft. long on a 10ft. length of shaft would move through a distance of 1·97in. with a torsional moment of 733,000 foot pounds. If the rate of deflection is greatly less, it will indicate excessive hardness of material. If the deflection is greatly in excess of this moment, it will indicate weakness due to flaws, as the material is known to be not very soft. The deflection should increase at a regular rate with loads applied; a sudden increase of deflection would indicate that the limit of elasticity had been passed. The fracture illustrated occured without any warning, the material giving way with a loud report.

In a future issue we will give our readers a tabulated statement of the records relating to these tests, and detail the deflections as observed with the increase of load.—*Mechanical Engineer.*

LETTERS TO THE EDITOR.

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

GRUEL MORTAR.

Sir,—I have lately seen several accounts of the use of cement mixed with sugar for hydraulic purposes. It may not be out of place therefore for me to relate my experiences in the use of lime mortar for the building of piers and other works exposed to the scouring action of a roaring mountain torrent.

In 1873 I received instructions to consider the possibility of throwing a useful bridge across the Chung-An River, at Chung-An-Stu, Kueichou Province. I was told that several bridges had already been built there, but they had been carried away by the current after a year or two's service only. On examination I found that there was an excellent foundation for buttresses on both shores, the river flowing through a rocky channel just at that place. I therefore came to the conclusion that the failure of the former bridges might be due to the bad quality of the mortar used, so I sent in an estimate for the building of the bridge, using foreign cement for the masonry. General Chou Tawu, who had volunteered to defray the expenses of building the bridge, as well as for the material, feared that the cost of cement would be too great if imported from abroad, and it would also cause a delay of twelve months at least before the work could be commenced, so he advised me to do the best I could with the material at hand—that is, material procurable in the province. I said that I could do very well with all native material excepting mortar, and that I thought could not stand long in water, and the bridge must give way before long. I was then recommended to use rice gruel for mixture with the lime, and after a few minutes' consideration I decided to try it, and made a model of the bridge that night. Four days afterwards the bridge was commenced; masons and blacksmiths were brought from all parts of the country to do work as quickly as possible whilst the water was low. Lime was slacked with gruel—made by boiling a very glutinous rice, called *No mi*, in river water, and reducing the whole to the consistency of ordinary molasses or thereabouts. Fine gravel was then added in proportion of one of gravel to nine of lime; then mixed up into passably stiff mortar, and used in the ordinary way. By the time the buttresses were built, the chains for the bridge were ready, and they were laid without delay. Ten chains were stretched across and anchored to the rocks on both sides; eight of the chains serving for the roadway, and two—one on each side—for guards; planks were then laid across and tied down to the chains, and the traffic over the bridge commenced within four months from the starting of the works, the water rising at the same time and acting upon the masonry. The position of the bridge, being on the highway from Peking, through Knei-Chou Province, to Yun-nan, has a continuous traffic over it all the year round; thousands of pack mules going over it as carelessly as if it was a solid masonry bridge, the oscillations being greater when a few persons are on it than when a great many mules are crossing at the same time.

My model was made for a span of 190ft., each chain being 210ft. long, but it was finally decided to reduce the span by building the buttresss a little further into the bed of the stream, so as to have a better foundation. I have not seen the bridge for years, but a friend of mine who crossed it last spring says that it is in excellent condition, with the exception of a few stones just under the chains, which have worked loose at a place that the current never touches, so that the looseness of the stones cannot be ascribed to the action of the current on unsuitable mortar. The fact is, the chains were stretched over the buttresses before the mortar had had time to set properly, and the action of the chains in being stretched probably disturbed them, so that they never had a fair chance of trying the qualities of the mortar. Those parts of the butt resse that are exposed to the action of the current having remained in good condition during the past thirteen years are, I think, satisfactory proofs that the mortar was good, and that it is not likely to give way now, after setting for so long a time. Some of our bridge-builders at home may possibly be able to give this gruel mortar a fair trial, in fresh water at least, and eventually decide upon using such for hydraulic works. W. Mesing.

Canton, China, January 22nd.

AN EXTRAORDINARY ENGINE TRIAL.

Sir,—Under the above heading you refer in your issue of Dec. 10th with some severity to a certain most unfortunate experiment tried in Melbourne some time since. As my name appears with some prominence in your article, and as I have some regard for my own reputation, as well as for that of our Agricultural Society, I would beg a little of your space. Some months before the trial the Society requested me to act as judge in this matter. I declined, expecting that business would call me to a distant part of Australia about that time. As the date approached, I found that after all I should be in Melbourne, and arranged to be present at the trial, which I expected would have been conducted according to the system adopted by the Royal Agricultural Society of England, and frequently referred to in your pages. I had at the outset offered to lend any apparatus I might have, and had handed over to Mr. Lewis a Richards' indicator, in perfect order and provided with various springs suited for all pressures up to 200 lb. per square inch. This I wish specially to mention, as your article would lead to the inference that I had indirectly contributed to the result by supplying bad apparatus. About two days before the trial I met with a peculiar and painful accident that for a time confined me to my house. But for this I should have been present; I should have done all in my power to secure a proper test on the lines of the R.A.S.E. tests at Cardiff in 1872—the last test that I have any full record of. You will see therefore that I am in no way responsible for this most unfortunate outcome.

Lest your readers should imagine that this incident affords a gauge of the general status of engineering knowledge amongst us, let me inform them that proper scientific engine trials are by no means unknown here, and that years ago I assisted at a trial of a large condensing engine, in which Donkin's method of gauging the volume and temperature of the overflow from the hot well was fully carried out. The results of such trials as I possess particulars of, give from 3 lb. to 5 lb. of Australian coal per indicated horse-power per hour in various cases, with engines of 50 to 150 indicated horse-power, the highest result of course being with good condensing engines. For the credit of the engineering profession, as well as for my own sake, I would desire that your readers should not imagine that the experiment alluded to affords any gauge of the state of engineering knowledge in Victoria.

W. C. Kernot.
President Victoria Engineers' Association.
Professor of Engineering, Melbourne University.

Melbourne, February 2nd.

CONDENSATION IN STEAM CYLINDERS.

Sir,—I should like to say something on the statements made by Mr. Bodmer in your last impression, but I fear I misunderstand him, and to avoid useless controversy I must ask him one or two questions, with your leave. Quoting Rankine, he says, when steam expands in driving a piston and gets no heat from without, a portion is liquefied. Does Mr. Bodmer mean to say that liquefaction will take place whether work is done during expansion or is not done? As far as I can gather, he seems to hold that liquefaction is a result of expansion only. This certainly is not what Rankine's words imply, because he says "in all cases which can occur in practice." It is impossible for a case to occur in practice in which steam expands without doing work. I may add, indeed, that I do not know how steam can be made to expand under any circumstances without doing work. If Mr. Bodmer will point out the way, I shall be much obliged to him.

Why does not Mr. Bodmer calculate from Zeuner's formulæ a curve showing the alternate condensation and re-evaporation and re-condensation, of which he speaks? The diagrams contained in his last letter contain nothing bearing on the point. X.

London, March 7th.

SLIDE VALVE FRICTION.

Sir,—The stereotype phrase of there being "nothing new under the sun" obtains with Mr. Terry, of Whitehall, regarding what he considers novel in the way of hydraulic dynamometers for testing friction of slide valves. I used the self-same arrangement he lays claim to so far back as 1870 in the United States, but really cannot call to mind the original designer, and am inclined to believe it was Charles T. Porter.

This intimation might not, however, be sufficiently conclusive for Mr. Terry, but if he will take the trouble to refer to the *Scientific American* of June 2nd, 1877, page 340, he will see his supposed invention illustrated and described. The contribution is by John C. Dean, of Indianapolis, Indiana, U.S. W. Walker.

Smethwick, March 7th.

RAILWAY ROLLING STOCK.

Sir,—For some years now the various railway rolling stock companies have been cutting each other's throats, and taking work at any price for the sake of keeping their men together. They have been making no profits, and in some cases have been losing money, and the railway companies and others have been having their stock made for 10 to 20 per cent. less than they could build for themselves. Is it not time that this should cease and that things should once again be put on an equitable footing? There is now plenty of work for everybody, both already given out and to come. Several of the big railway shops are well supplied with orders for carriages and wagons, and now is the time for the managers to put their heads together, and say, We will once more be paid for our skill and industry.

March 8th. General Expenses and Profit.

BURTON-ON-TRENT SEWAGE ENGINES.

Sir,—We notice Mr. Walker's letter in your last issue. After the main design of the Burton engines had been settled, and approved by Mr. Mansergh, we engaged Mr. Walker as our chief draughtsman. In that capacity he made, under our guidance, the greater part of the requisite detail drawings, as we should expect any chief draughtsman to do. He did this work to our satisfaction, and after leaving us we gave him a testimonial to help him to secure a situation for which he was applying, and in which a knowledge of similar machinery was necessary. Gimson and Co.

Engine Works, Leicester, March 8th.

Steel.—On the 21st and 22nd of February Mr. Ewing Matheson, M. Inst. C.E., delivered two lectures to the officers of the Royal Engineers at the School of Military Engineering, Chatham. The first lecture was on the modern methods of making steel, particularly in reference to the Bessemer open-hearth, and basic systems, the differences between steel and puddled iron, and the modes of testing. The second lecture described the special characteristics of steel, the wide range of quality available for different purposes, as exemplified by the kind of steel used for rails, wheel tires bridges, ships, axles, and boilers, the increased limits of span in bridges, the precautions to be adopted in using steel, the effect of cold and deterioration by rust. These lectures were the first of a series to be given during the spring by the different engineers and scientists on a variety of subjects.

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

Soda motor.—A new form of locomotive, using caustic soda for the production of steam, has been invented at Minneapolis, Minn. A compound water and soda boiler is used, having a soda compartment and a water compartment, the latter having diagonal tubes connecting with horizontal water flues in the soda chamber. The process provides for the generation of steam by heat from the soda, the superheating of the steam and using it in the ordinary manner, and the turning of the superheated exhaust steam into the soda chamber to prolong the period of its activity. The steam is drawn from the dome, led by a pipe through the steam space over the fire-box, and passed back through a pipe in the fire-box and in the soda chamber to the cylinders. The exhaust is discharged into the usual breeches pipe and nozzle, but below the nozzle is a valve and a small branch pipe leading down to the bottom of the soda chamber, so that the superheated exhaust can thoroughly permeate the soda. The soda motors which were built to operate the suburban trains within the city limit—steam motors having been prohibited—were far from satisfactory, though it is reported that improvements are now being made. The above motor has probably been designed as an improvement.

Logging railroads.—The following is a list of the logging railroads in the lumber regions of the United States:—Alabama, 146 miles; Arkansas, 104; California, 144; Florida, 176; Georgia, 225; Kentucky, 44; Louisiana, 35; Maryland, 13; Michigan, 278; Minnesota, 3; Mississippi, 65; Missouri, 31; Nevada, 8; New Hampshire, 10; North Carolina, 117; Ohio, 18; Oregon, 7; Pennsylvania, 166; South Carolina, 170; Tennessee, 51; Texas, 153; Utah, 2; Vermont, 4; Virginia, 50; Washington Territory, 100; West Virginia, 22; Wisconsin, 56. Total, 2268 miles.

Kentucky coal for England.—The Breckenridge Coal Co., of Cloverport, Ky., has sent to Liverpool a shipment of 2000 tons of Breckenridge cannel to be used as a gas enricher by the Liverpool Gas Light Co. This cannel is one of the best gas enrichers, and is widely used in this country; if it fulfils the claims made for it there will be a considerable market opened for it abroad in competition with Australian shale and the best gas cannels.

Improvement companies in the South.—The resources and capabilities of the South are being developed and operated to a favourable extent, and a considerable proportion of the practical development is done by companies incorporated as land and improvement companies. These companies purchase land, establish towns, mill sites, mining properties, steel and iron works, &c.; build railroads, wharves, &c., and deal generally in land and mineral property. The Selma Land and Improvement Co., of Selma, Ala., has a capital stock of 3,000,000 dols., owns 3000 acres of valuable suburban and city property, and about 12,000 acres of rich mineral lands near the city; also a large hotel, warehouse, river frontage and other property. The company will build a railroad to the coal, iron, and marble districts of the Calaba valley, will erect iron furnaces, steel plant and a rolling mill, and operate a line of steamers and barges between Selma and Mobile.

A consolidated narrow gauge railroad system.—There are in the West several large narrow gauge railroad systems, and a project, headed by Mr. W. J. Palmer, President of the Mexican National Railroad Co., and interested in many other railroads, is now on foot looking to the consolidation of these systems and the construction of new lines to connect them into one comprehensive system. The principal existing systems which are interested in this consolidation, and which control minor lines, are the Denver and Rio Grande Railroad, the Denver and Rio Grande Western Railroad, the South Pacific Coast Railroad, the Texas, Santa Fé, and Northern Railroad, and the Mexican National Railroad. There would be a uniform gauge of 3ft. The Mexican National Railroad Co. has recently been reorganised with a view to its Colorado extensions, and Mr. Palmer is now in England to perfect financial arrangements for the construction of the necessary links. The principal extensions will be a line 800 miles long from the Denver and Rio Grande Railroad in Utah—near the Green river crossing—to the South Pacific Coast Railroad at Santa Cruz, Cal., which will give a route to San Francisco; the Texas, Santa Fé, and Northern Railroad will be run south through New Mexico to El Paso, Tex., and the Mexican National Railroad will be built north from Laredo, on the Texas state line, to El Paso, thus forming a continuous line northward through Mexico and the United States. The 3ft. gauge roads in the Western States have proved themselves practicable and economical, and the forming of a grand and comprehensive system of a uniform gauge cannot but be of immense advantage to the Pacific States and Mexico.

Naphtha gas locomotive.—On the Brighton Beach Railroad, running from Brooklyn, N.Y., experiments have recently been made with a street car, or tramcar, operated by naphtha gas. About 15 gallons of naphtha are carried on the roof of the car, and the gas-generating apparatus is situated on the front platform, its weight being balanced by the exhaust machinery at the other end. The car has attained a speed of eight miles per hour, but the inventors, Connolly Brothers, of New York City, manufacturers of gas governors, intend to do better than this. The 15 gallons will last a day, and naphtha can be purchased as low as 7 cents per gallon; making a total of 1·05 dols. per day exclusive of wages. The naphtha would take the place of from four to six horses, worth about 1000 dols., and costing about 20 dols. per week for maintenance.

Nicaragua Canal.—On February 21st the Senate passed the bill incorporating the Nicaragua Canal Company by a vote of 38 to 5.

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

(*From our own Correspondent.*)

A FEATURE of trade exists this week which should do something towards giving manufactured ironmasters a firmer position. This is the notice which the ironworkers have handed in for a reconsideration of the wages question. No definite amount of advance is yet mentioned by the operatives, but it is expected to be 10 per cent.

The ironworkers base their claim upon the 10s. advance on common finished iron recently declared. Inasmuch, however, as it is notorious that the advance is not being obtained, it is difficult to see how the men can genuinely support their notice, and the market generally looks upon it this week more as a set-off to the action of the employers in attempting to secure a revision of the extras now paid in the mills and forges. The prices which prevail now compared with those at the time of the last revision in wages, namely, in January last year, when puddling was fixed at 6s. 9d. per ton, show a reduction in bars of about 5s. per ton, while hoops, on the contrary, are better by from 2s. 6d. to 5s. per ton. Common bars at the earlier period were quoted £5 10s. down to £5; and hoops £5 5s. to £5 7s. 6d. for common, and £5 15s. to £6 for superior qualities. Sheets, singles, have fallen 5s. per ton, but doubles and lattens hardly 2s. 6d. per ton. Marked bars have fallen in the interval 10s. per ton.

The activity in the sheet trade is fairly maintained, and the mills mostly keep well occupied. The current supply is within the demand, and preparations are in hand for re-starting some sheet works which, through one cause or another, have of late been put to a stand in the Bilston and some other localities. Sheets of 20 gauge are £6; 24 gauge, £6 7s. 6d. to £6 10s.; and 27 gauge, £7 5s. to £7 7s. 6d. per ton.

The Shrubbery Iron and Steel Company, Wolverhampton, finding the demand for galvanising sheets larger than it can fill, has resolved on the laying down of two additional mills; but they will not be ready for a couple of months or so yet. The extensive Swan Garden Works, Wolverhampton, of Messrs. J. Lysaght and Co., are in regular operation on galvanising sheets.

Orders in the galvanised sheet trade are not over abundant, and the revival which some time ago appeared has hardly been maintained. The Australian demand keeps much quieter than had been anticipated, and orders from India are militated against by the excessively low prices attached and by the low rate of exchange. From South America and South Africa, however, some good lines are being received, and the seismic disturbances on the Riviera are resulting in inquiries for immediate supplies to repair the ruin which has been occasioned.

Most of the galvanising firms are moderately well engaged, and some are very busy, but the call for roofing work is decidedly quiet, and prices of such work have been cut up seriously. Prices of galvanised sheets vary from £10 2s. 6d. to £10 10s., according to quality delivered Liverpool in bundles of 24 gauge.

The extent of new business doing in manufactured iron is, as regards unmarked bars, hoops, and strips, very moderate. Buyers are not prepared to enter the market with rates, as now, against them. Best bars are without change at £7, and second qualities at £6, while common bars are £5 to £5 5s.; hoops, £5 10s.; and hinge strip, £6.

Plate makers report continued inactivity in demand, and sharp competition from Lancashire, North Staffordshire, and other districts. Tank plates are £6 10s., and boiler plates £7 10s. to £8 10s. easy.

Makers of small sizes of bars, both rounds and squares, are firmly demanding the recent advanced "extras," and they have met with more success than attaches to the efforts of makers of ordinary sizes when attempting to get the 10s. advance declared in Birmingham. The small sizes which are most readily commanding the advance are ⅜in. and ⅝in., upon which an extra 10s. a ton is being obtained.

The condition of the pig iron market in Birmingham to-day (Thursday) was not such as to inspire confidence among holders, yet there was an absence of any tendency to act hastily and part with iron on terms much reduced. The direction of the market is unmistakeably downwards, sympathising as it does with Scotland and Cleveland. Derbyshire and Northampton pigs are weaker by 2s. per ton compared with former maximum rates, and to-day's prices, compared with those of January of last year, are better by barely 2s. per ton. At that time Northamptons were 38s. delivered here; Derbyshires, 39s. to 40s.; while Lincolnshires were 41s. to 42s. This week Northamptons are 38s. 6d. to 40s. easy; Derbyshires, 40s. to 42s.; and Lincolns, 42s. easy.

Hematites are likewise scarcely so strong as lately, though prices are still 4s. 6d. to 5s. per ton better than early in 1886. Hematites, which at the former date were quoted at 53s. to 54s., are to-day quoted 57s. 6d. to 60s., delivered here from the West coast.

Native pigs are changing hands in only small quantities at the moment, but deliveries are going away well from the furnaces, and there is not much variation in prices. The furnaces now blowing number in South Staffordshire 32, in North Staffordshire 18, Shropshire 6, Derby, Notts, and Leicester 24, and Northampton 15, and Lincoln 13.

It is gratifying that the branches of the iron trade with which this district is most intimately associated show generally a better tone as compared with last year. According to the Government returns issued this week, there has been a steady advance in the iron trade, the exports during February amounting to 275,277 tons, an increase of 48,882 tons, or 21¾ per cent.; and the value £1,660,984, an increase of £49,802, or just over 3 per cent. This shows that while the quantity exported largely increased, the price has not materially altered.

In pig and puddled iron there was an increase of £49,897, or 41 per cent.; in telegraphic wire, £24,351, or 128 per cent.; in cast and wrought, £4407.

On the other hand, there were decreases of £11,530, or about 10 per cent., in bar and angle iron; of £101,197, or 32 per cent., in railroad iron; of £8942, or 4 per cent., in hoops and steels. The United States has taken a largely increased quantity of railroad iron, and with other countries the supply has been fairly maintained.

The following are the figures relating to values:—

Iron.	Month of February. 1886. £	1887. £	Two Months 1886. £	1887 £
Pig and puddled	120,284	170,681	255,287	320,058
Bar, angle, &c.	109,563	98,033	242,779	201,572
Railroad	310,870	209,673	566,042	501,694
Wire	44,476	41,087	97,644	83,848
Telegraphic ditto.	19,286	44,137	87,909	58,579
Cast and wrought	277,560	281,967	616,018	646,269
Hoops, sheets, &c.	212,280	203,338	447,418	446,258
Old iron	30,340	96,919	45,870	164,587
Steel, unwrought	76,800	207,960	149,883	344,244
Hardware and cutlery	213,494	193,496	445,901	442,855
Machinery	464,362	530,323	950,880	1,111,251
Steam-engines	164,328	258,844	346,669	466,905
Tin-plates	404,886	319,932	742,853	595,847

The ironworkers of South Staffordshire are entering with much spirit into the proposed National Conference at Manchester, believing that their position will be much improved by co-operation with ironworkers of other districts.

The Belgian girder competition question is up again. Enlarging one of the Board Schools at Wolverhampton, the builder is using iron girders to carry the floor and the roof such as have been specified by the architect. Upon inquiry I learn that the iron is of Belgian manufacture, being supplied through a Birmingham firm of bridge and roofing makers. Why they should have gone to Belgium rather than to the North of England is not yet clear. Probably it may turn out that Middlesbrough makers were unable to supply as promptly as the Belgians, and the matter was one of urgency. Some thirteen tons of Belgian girder work are being put in, seventeen of the rolled girders for carrying the floor being of 22ft. to 24ft. lengths and of 16in. by 6in. size, while the thirty-two rolled joists for carrying the roof vary from 5ft. to 9ft. long, and are about 5in. by 2in. size. It would not appear that there is any difficulty in the way of home makers rolling these sizes, nor is it at present thought that there would be much difference between the Belgian and English prices. Some other explanation must probably be sought.

Some valuable contracts are about to be placed on the market by the Indian railways. Plate girders of 20ft. and 40ft. spans, fish plates, fish bolts, and spikes are required by the State Railways; and the Bengal and North-Western Railway Company are inviting tenders for the supply of landing stages, pontoon bridges, and approach girders. Iron work, including wheels and axles, is likewise required by the Southern Mahratta Company.

Local cast iron pipe founders are endeavouring to secure the contract for 5000 yards of mains required by the Newport sanitary authority; while some Tipton and James Bridge firms are understood to be tendering for the supply of a water tower required in connection with the Liverpool Corporation Waterworks.

It is stated that if the condition of the Cradley Heath chainmakers does not improve, the whole of the trade will have to be called out again. The poverty among them is increasing daily, and the position of those in work is said to be rendered precarious by the continued practice among some of the employers of the truck system.

A proposition to hold an Exhibition at Hanley next year illustrative of local products, and of the appliances used in connection with them, has received the assent of the townspeople, who have appointed a representative committee to carry the decision into effect.

At the twentieth annual meeting of the South Staffordshire and East Worcestershire Institute of Mining Engineers, held at Dudley, on Monday, Mr. C. H. Treglowa—Messrs. Tangye's—was elected president for the ensuing year. In his address, he trusted that he should see the time when advantage would be taken of the great power of electricity, not only for lighting, but for the purposes of doing work about the collieries which could now only be accomplished by steam and compressed air.

An important question of contract in the iron trade was decided in the Birmingham County Court on Wednesday. In an action brought by a Walsall firm of ironmasters against a Birmingham steel consumer for breach of contract, His Honour decided that the term "delivery as required" in the contract meant delivery within a reasonable time. Considering the size of the order—only a small one—His Honour contended that four months was ample time to allow for acceptance. The consumer had declined to take the concluding deliveries after a period of something like fifteen months, and the Judge gave a verdict for the plaintiffs with damages and costs.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Everything is quite at a lull in the iron trade of this district, and the past week has brought forward little or no business of any weight either in common pig iron, hematites, or finished iron. There seems to be a general waiting for the end of the quarter, and for the remainder of the present month little more than a very dull market can apparently be looked forward to. One of the most serious problems in prospect is how manufactured ironmakers, when they have to renew their contracts, are to meet the present position of the market. Makers of finished iron, except in sheets, have been able to establish but very little real advance upon the low rates which were ruling some time back, whilst the raw material, although during the last few weeks there has been some retrocession in price, still stands in advance altogether out of proportion to any increased price which has been obtainable on manufactured goods. Finished iron makers are placed in this position, that on the present basis of pig iron prices, and the prices ruling in the market for their manufactured goods, they can only keep their works going at a very serious loss. In the event of their not being able to get either better prices for finished iron, or being able to place contracts for pig iron at much lower prices than makers are now asking, the only alternative would seem to be the closing of works, and the solution of this problem is being anxiously looked forward to in the market. Some people look upon the present depression as only temporary, and talk of an increased trade coming forward as soon as the market can again steady itself. The present unsettled condition of the market and the disturbed prospects abroad are no doubt tending to keep in suspense a considerable weight of business which sooner or later will have to be given out, but the indications are still wanting of any real improvement in the condition of trade generally, and the reaction which has taken place following upon the cessation of buying for America only confirms what I long since pointed out in my "Notes," that in the improvement which so suddenly manifested itself with the close of last year there was the serious element of weakness that it was not being backed up by any materially increased activity in the iron-using branches of industry in this country.

There was about the usual average attendance in the Manchester iron market on Tuesday, but again very little actual business doing. Nominally quoted prices for local and district brands of pig iron were without change from last week, some certain makers asking 39s. 6d. to 40s. 6d., less 2½, and one or two of the district brands being quoted at 39s. to 40s., less 2½, for forge and foundry qualities delivered equal to Manchester, but these figures are altogether out of the market, as there are makers of Lincolnshire iron prepared to accept 1s. to 1s. 6d. per ton under the above prices, and even then they find themselves undersold by second-hand parcels. Actual selling prices are scarcely governed by the nominal list rates, as where there is actual business to be done makers are open to entertain offers, but except occasional small sales of foundry qualities there is really little or nothing doing. In outside brands there have been some transactions in Middlesbrough foundry, where sellers have been willing to give way upon the prices that makers have recently been asking, and good named brands have been sold on the basis of 44s. to 44s. 4d., net cash, delivered equal to Manchester.

Hematite makers still hold on to about 58s. 6d., less 2½, as their quoted price for No. 3 foundry, delivered into the Manchester district, but they are not booking orders at this figure, and second-hand parcels could be bought readily at about 57s., less 2½, delivered here.

In manufactured iron, except that sheet makers are kept busy, business continues extremely slow, and with makers mostly very much in want of specifications to keep them going, low prices are taken to secure prompt orders. Sheets are firm at about £6 10s. to £7 per ton, delivered into the Manchester district, but bars do not average more than £5, and hoops can be got at £5 5s. to £5 7s. 6d. per ton delivered.

In the condition of the engineering trades there is no very material change to notice; the absence of any real weight of new work coming forward is still the general complaint, and the keen competition for any orders that are to be got keeps prices down so excessively low that in the majority of cases they are anything but remunerative.

In the branches of industry largely dependent upon the engineering trade, such as iron and brass founders, nut and bolt makers, &c., extreme slackness continues the general report.

A specially designed planing machine of large size, with double screw, and arranged to work either as one combined machine or as two separate tools, has just been completed by Messrs. Hetherington and Co., of Manchester, for one of the Government dockyards. This twin machine is constructed to plane 15ft. long by 12ft. 6in. wide and 8ft. high. Three tool boxes are carried on the cross slide rest, and one on the face of each standard. The table is built in two separate pieces, each about 6ft. wide, which can be traversed independently or in combination, as required, and the tool boxes on the slide rest, which are all self-acting and each independent one of the other, can be worked either wholly or partly in connection with either table, or in combination with both tables, and can be controlled from either side of the machine, according to the necessities of the work in hand. The tables are traversed by steel screws and steel bevel wheels geared up to a cross-shaft at the end of the bed. In the centre of this cross-shaft there is a coupling, by means of which the two halves of the machine may be connected or disconnected as required. Belt pulleys are provided on each side of the machine, arranged with double strap bars and tappet motion, by means of which the belts have only to travel their own width, thus saving wear on the pulleys. The nuts on the driving screw are of gun metal, made in halves, with each of the screws formed into a thrust bearing, having eight collars, and one end made in the form of a loose sleeve for taking up wear. When the machine is working as two distinct tools, there are tumblers and stops with independent action on each side of the machine, but when working as a combined machine the two sets of tumblers and stops are connected, and with the stopping and starting motion can be controlled from either side of the machine as desired. All the controlling motions of the machine are in fact in duplicate, and when it is being worked as a combined machine they are so connected that the machine can be controlled entirely from either side, or one set of tools can be in the charge of a workman on one side and the other set in the charge of a workman on the opposite side of the machine. Attached to the stop stay, between the uprights, is a bracket, carrying an arrangement for raising or lowering the cross-slide, which is worked by a chain from the side of the machine, the power being transmitted by a cross-shaft, worm gearing, and screws. The dimensions of the machine, which complete weighs about 55 tons, are as follows:—Length of table inside the dishes, 15ft.; width of the combined tables 12ft. 6in.; length of bed,

23ft. 9in. by 10ft. 6in. ; and depth, 18in. ; height of standards, 12ft. 8in. ; breadth at base, 7ft. 3in. ; length of cross-slide, 18ft. 8in. ; width, 2ft. 2in. ; width of V's from slides, 9in. ; and diameter of steel traversing screws, 5in.

As an illustration of the ingenious application of engineering principles to small domestic appliances, I may mention that Mr. John J. Royle, of Manchester, has introduced a self-pouring tea-pot, in which the self-pouring action is created by pneumatic pressure exercised on the tea by a special form of lid, forming in reality a cylinder and piston. This cylinder slides within the body of the pot, and on the top is a non-conducting knob having a small hole through it to act as an air inlet. To pour out the tea the cylinder is drawn up, allowing the air to enter through the hole in the knob, then by closing this hole with the finger and pressing down the cylinder the tea is forced out through the spout in proportion to the quantity of air that has been let into the cylinder. Another novelty which Mr. Royle has just brought out is an improvement in hose pipe unions, in which the connection is made internally instead of externally as in other unions ; the hose pipe is forced through a cone-shaped union connection, and then, inside the pipe is screwed an expanding ferrule which at once locks it firmly in position, thus dispensing with all wiring or other fittings outside the pipe.

The demand for coal continues to quieten down, especially in the best sorts for house-fire consumption, and the lower qualities are only in moderate demand for steam and forge purposes. Engine classes of fuel move off fairly well for mill and chemical manufacturing purposes, but the demand for salt works is extremely dull. Collieries are not working more than an average of five days a week, and the better sorts of round coal are plentiful in the market, with a tendency to ease down slightly in price, but the current quoted rates remain without change, and at the pit-mouth average 9s. for best coals, 7s. 6d. seconds, 6s. common house-fire coals, 5s. 6d. steam and forge coals, 4s. 6d. to 5s. burgy, 3s. 6d. to 4s. best slack, and 2s. 6d. to 3s. per ton common sorts.

The shipping trade continues active, but if anything there is some falling off, and there is no difficulty in buying steam coal delivered at the high level, Liverpool, or the Garston Docks at 7s. per ton, although 6d. above this figure is still being got in some cases.

Barrow.—There is not much change to note this week in the state of the hematite pig iron trade of this district. The demand remains good on American, Colonial, and Continental account, and there is reason to believe it will improve; but it is probable that on home account the demand will remain quiet, as home consumers have not in any way responded to the improved tone which has established itself in the demand on foreign account. It is confidently expected that the inauguration of the spring season will bring about a good demand on home account; but it is evident at present that home buyers are slow to give orders. The business doing in hematite pig iron is large; but, as a matter of fact, it is being done with speculators and merchants rather than with producers. Holders of stocks have either been compelled to reduce them, or have been somewhat afraid of the future, and have therefore reduced the weight of stock they had in hand; while, on the other hand, makers who have been well employed and fully supplied with orders for four or five months to come have maintained quotations at 50s. per ton net at makers' works for mixed parcels of Bessemer iron, and 49s. for No. 3 forge and foundry samples. They hold firmly to these quotations, and the easier tone which has been demonstrated in the market is giving place to a lighter tone, and a general disposition even on the part of holders to increase prices. Inquiries from all quarters seem to indicate that a better demand is springing up, and with this condition of affairs it is easy to realise that the action of holders will not prejudice the market so far as prices are concerned, but will tend to bring makers and buyers more nearly in harmony than they are at present. Steel makers experience a very large demand for rails, blooms, billets and bars, but they are nearly fully sold forward and cannot undertake any very large contracts for early future delivery. Prices are firmer, at £4 7s. 6d. for heavy sections of rails net at makers' works or f.o.b., and mild billets at £4 2s. 6d. per ton. Shipbuilders have booked no new orders, and finished ironworkers are doing but a little trade. Iron ore is in full and brisk demand, at from 12s. to 13s. 6d. per ton. Coal and coke are in increasing demand, and prices are steady. Shipping is well employed, and a brisk season's trade is expected.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

Further orders for railway material continue to be received by Sheffield firms. Messrs. Craven Brothers and Co., Darnall Carriage and Wagon Works, have booked an important order for rolling stock—carriages—for the Cheshire Lines Committee, to the value of £20,000. The same firm are engaged on contracts for the Midland, Metropolitan, and Great Northern Railways. For the latter they have taken an order for 1000 sets of railway wheels. Other firms are fully engaged on tires, wheels, springs, &c., and several establishments have work in hand sufficient to keep them going for three months. In steel rails no further contracts have been placed by the Midland Company, who have now 5000 tons in course of execution at the Phœnix Bessemer Works. Though hematites do not appear so firm, rails are gradually stiffening in value.

The Sheffield Town Council, at a special meeting on Monday, decided to oppose the Trent Navigation Bill now being promoted in Parliament. It is proposed by the Bill to levy a toll of 6d. per ton on all goods carried on the river Trent between the Humber and Gainsbrough. It was stated before the Parliamentary Committee of the Sheffield Town Council that such tolls would be imposed on all goods carried by water from Sheffield to Hull, or from Hull to Sheffield, as they passed along the Trent from the point where the Stainforth and Keadley Canal enters the river to the point where the Trent joins the Humber. At the Town Council meeting a letter was received from the solicitors to the Trent, Burton-on-Trent, and Humber Navigation Company, stating that it had been determined not to ask for any special powers with respect to the river Trent between Gainsbrough and the outfall of the river into the Humber, and that the Bill now before Parliament will be amended accordingly. The Council held that the letter was perfectly satisfactory, but in order to see that it was carried out, it was necessary to present the petition against the Bill. The Trent Navigation Company intend by its Bill to provide for the improvement and maintenance of the navigation of the river Trent from Weldon Ferry, in the counties of Derby and Leicester, to the river Humber, in the county of Lincoln, and for other purposes.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The pig iron market has been irregular this week. A considerable speculative business has been done in warrants. Scotch warrants have been sold pretty largely on several days, but the prices were only slightly depressed in consequence. Dealings in Cleveland warrants have been nearly all for the month, the rates being generally a shade higher. In the case of Cumberland warrants, the prices are again somewhat lower. The inquiry for Scotch iron for shipment continues great, and the deliveries are nearly all those of pigs that were ordered a considerable time ago. The past week's shipments were 6988 tons, as compared with 6675 in the corresponding week of 1886. Most of the furnaces that were put out of blast during the colliers' strike are now again in operation, but the output is still much smaller than it was at this time last year. Pigs are being sent into the warrant stores at the rate of from 400 to 500 tons a day.

Business was done in Scotch warrants in the warrant market on Monday down to 42s. 10½d., afterwards improving a little to 43s. 1½d. On Tuesday transactions occurred up to 43s. 4d., and back to 43s. 0½d. cash. On Wednesday transactions occurred at 43s. 3½d. to 44s. 4½d. cash. To-day—Thursday—the market began strong, at 43s. 9½d., but receded and closed at 43s. 9d. cash. Stocks in Connal's, 848,800 tons.

The current values of makers' iron are somewhat lower than they were a week ago, as follows :—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 50s. 6d.; No. 3, 44s. 6d.; Coltness, 56s. 6d. and 46s. ; Langloan, 53s. and 46s. 6d.; Summerlee, 54s. 6d. and 44s. 6d.; Calder, 52s. and 43s. 6d.; Carnbroe, 47s. and 42s.; Clyde, 48s. and 43s.; Monkland, 45s. and 41s.; Govan, at Broomielaw, 45s. and 41s.; Shotts, at Leith, 50s. and 45s.; Carron, at Grangemouth, 52s. 6d. and 44s. 6d.; Glengarnock, at Ardrossan, 49s. and 43s.; Eglinton, 45s. and 41s.; Dalmellington, 47s. and 42s. 6d.

The makers of Scotch hematite are disposing of all their output—that of seventeen furnaces, making about 300 tons each a week—to the local steel makers, none of it coming into the open market.

The steel trade is active as far a regards the operations at the works; but there is very little doing in the placing of fresh orders, although makers do not in all cases quote the full advance in prices. Indeed, since the breakdown of quotations in the pig iron market, it has been apparent to all concerned that the steel prices had been fixed at too high a level compared with those prevailing in England ; but so far no formal reduction has been made, although each firm is at liberty to make its own terms.

There has been much more business in the coal trade in the past week.

Conferences of employers' and workmen's delegates, called for the purpose of considering the present state of the coal trade and the demand of the colliers for an advance of wages, for which the recent strike took place, were held in Glasgow this week. It may be recollected that the colliers returned to work on the masters promising that such conferences would be called within ten days. The first conference was held on Tuesday, and at it were sixteen delegates from the different districts of Lanarkshire, excluding Airdie, and an equal number of masters' representatives. The Lord Provost of Glasgow presided, and a lengthy discussion took place, in the course of which it was contended for the masters that the men ought to work full time—six, instead of five days a week—as the restriction greatly increased the cost of working the collieries. The delegates of the men argued that the only question to be discussed was that of the demand of 6d. per day advance of wages, and that other matters should not be gone into. The Lord Provost ruled that the discussion should embrace the time of employment as well as the question of wages. Ultimately, the masters agreed to give the advance of 6d. a day provided the men would agree to work six days a week, and also take part in negotiations for arranging a method of settling such disputes in future by means of a sliding scale of payment based upon the variations in prices. A similar conference of delegates of masters and employés from Airdrie, Slamannan, and Bathgate was held on Friday. Other meetings will probably be held to hear the decision of the colliers.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The coal trade may be regarded as brisk, and railways are benefitting by it. More than fifty locomotives are kept in steam at Pontypool Great Western Railway system, and other railways are correspondingly busy.

Newport and Swansea showed an increase over late averages in their exports of last week, but Cardiff was slightly below. Yet, trade is tolerably sound and prices on the whole firm. Sales have been effected at 8s. 9d., but a larger quantity at 8s. 6d. Rhondda No. 3 is firm at 8s. 6d. and will likely see a higher price. The small steam coal trade is getting very busy, and I shall not be surprised at 5s. being touched again. A good deal is selling at 4s. 6d. Coke is in good demand at last week's quotations. Pitwood has been cleared off in large quantities, and the old price of 17s. seems to be nearing. Late sales have been at 16s. 6d., and stocks are getting small.

I am glad to chronicle this general activity, which is somewhat shared by the iron and steel trades, though on Monday there was not much done. Prices offered for rails are not entertained, and as long as blooms, steel sleepers, and steel bars are in demand, makers pay little heed to rail offers, and keep their works going with other matters.

As it is, prices remain about £4 best steel. It is fortunate that labour is cheap in the ironworks, a good deal of it is only at a trifle above 2s. per diem. Exports, foreign, have been limited this week so far, and have been confined to a cargo of bars for Smyrna and of iron for Rouen.

Imports of iron ore are on the increase, and the ironworks are getting up full stocks.

There is a good deal of fluctuation in the tin-plate trade, and prices vary with rumours of the re-starting of old works and promotions of new companies. Last week little could be had of cokes and Bessemers under 13s. 6d., but this week sales have been effected at 13s. 3d. and inferior brands far less, though makers of best brands hold out for higher ; offers are being made by buyers for as low as 12s. 3d. to 12s. 6d., but rarely taken.

Siemens are much stiffer, and as much as 14s. is asked and obtained. Close upon 47,000 boxes were shipped from Swansea last week, and as a good deal of tonnage is expected in, the stocks, now amounting in Swansea alone to 176,000 boxes, will be reduced.

A local merchant regards the outlook of this trade as serious. Gadlys Works, Aberdare, are to be re-started, and out of the thirteen works which have been idle, one by one they are dropping in. At present make and sale are fairly equal, but with a double make, "where are we?" Prices now are up a penny too high, but if forced down a shilling per box this will be ruinous. The local merchant suggests confining the make again, but this has been tried. The fact is that the process of weeding out, which has commenced, must go on until the weak ones have gone to the wall, and less capital is embarked in the business.

A small strike has occurred at Cwmavon copper works.

The difference at Treharris Colliery is now nearly adjusted, the men returning on old terms, and I am glad to hear that the Pentwyn men, Machen, have followed suit.

One or two meetings of colliers have occurred this week with reference to the last 2½ per cent. reduction, but results have not transpired.

At the annual meeting of the Monmouthshire and South Wales Coalowners' Association this week Sir W. T. Lewis was elected chairman, and Mr. Colquhoun vice-chairman. Three new collieries were added to the list of the Association, which now includes fifty-five collieries, and represents an output close upon 13 million tons annually.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

Now that the favourable results of the elections is known, the reserve men, after their fourteen days' exercise with the new repeating arms, have all returned to their work, and the war scare has somewhat subsided, the iron trade in the West has begun slowly and gradually to assume a firm tone again, and if buyers, kept back for a time through alarming causes, do not come forward all at once, still a buoyant tendency is visible in all directions, and business is again being taken up at the point at which it was left a few weeks ago. It has already been decided to blow in more blast furnaces in the spring or early summer, provided the war clouds have by that time disappeared, and, in spite of their present existence, there is an improvement in some branches this week to note, especially in the price of steel rails. In the East district also the trade has lost little of its firmness, the pig iron market of Silesia having maintained its prices well, and the rolling mills in the meantime having secured a considerable influx of orders. It would, however, be a fatal blow to the works in that district if the proposition now made and being discussed by the Russian Ministry to raise the duty on pig iron 15 to 25 kopecs per cwt. soon came into force. This measure has been in contemplation for some time, and, indeed, the Iron Industrials in Russia have gone so far as to desire that by degrees foreign iron shall be entirely excluded from the country. Forge pig iron has been paid for at M. 49, and foundry as high as 54 p.t. Iron mines, long laid off, are again being set to work, and their requirements will give the foundries and constructive works a little more to do, which has long been needed. Merchant bar iron has risen to M. 110 p.t. as base price, though 107·50 is about the average selling price, with extras according to sizes and sections. Common plates stand at M. 150 to 160 p.t. The Belgian and French markets are reported satisfactory. The works in the former country are well supplied with orders for some time to come, and the lower English notations have not affected prices. There is every appearance of an active building season coming. The prices of coal and cokes are unchanged.

A lamentable accident occurred a week or two ago at the Brison Ironworks, near Charleroi, through the breaking of a fly-wheel, which, besides killing and wounding thirty-five workpeople, made such havoc of the other portions of the machinery, roofing, and buildings, that it will take some months to reconstruct the works, and will throw 300 to 400 men out of employment during that time. Returning to the Rhenish-Westphalian market, the deliveries of all sorts of iron and steel goods continue to take place with regularity, and requirements are increasing gradually as time goes on, which is especially the case with ores, so that at many of the iron mines preparations are making for a more extensive output. The prices have recovered their firmness as a consequence of the rising tendency of those on the Spanish ore market. In the pig iron trade all is quiet for the time being, as consumers are not seeking to contract just now, partly because their immediate needs are covered, and partly on account of the still precarious outlook on the political horizon, and it is possible that this torpor may continue still a few weeks longer. The sale is regular, and the demand has so far increased that it is at least equal to, if it has not already surpassed, the production. In January 293,879 tons of pig iron were produced, and if the restriction of output is continued much longer there will certainly be a scarcity of it in the third quarter of the year. The prices are everywhere firmly maintained, and when the contracts for next quarter come to be made generally, they will in all probability rise. There is a talk of establishing a sort of warrant stores in the country. This is a step in the right direction, for the smelters here do not like to have more than ten days' or a fortnight's stock of pigs on the bank; the consequence is that in slow times of sale there are more ardent sellers than purchasers, which causes unusual competition, and, of course, low prices, which would be obviated to some extent if advances on stocks in the stores could be procured. As with everything else in the country, the Government would have a say in the matter, and probably legalise them if it do not meddle with the details much. Ores range in the Siegerland from M. 90 to 118 p.t. for roasted steel stone. Spiegeleisen from 50 to 59 with 16 per cent. Mn.; forge pig is 46 to 50, according to quality ; basic, 42 to 43 ; Bessemer, 51 ; Luxemburg, 34 to 35·20 ; foundry, 50 to 55 p.t. at works. The rolling mills are well engaged on old orders for bars, girders, and other sorts of sectional iron. New orders do not come in so plentifully as some weeks back, and purchasers here, as with pig iron, are taking up a waiting position. However, as the works have still orders on the books for some weeks to come, they are not anxious about making new contracts at present. The lowest price fixed by the convention for bars is M. 110 p.t. The thin sheet works are all satisfactorily employed, as far as orders are concerned, but even now the prices have not got up to what they should be in comparison to what the raw materials are costing, and the boiler and heavy plate mills have now enough orders booked to keep them well at work. Fine sheets are noted M. 135 to 145, boiler plates 145 p.t., and these prices are very firm. There is a better demand for steel than iron wire rods, and the works are still quite full of orders, many of them for export, for which the price is M. 115 p.t. The production of bar iron for February was 27,033, the deliveries amounted to 25,965, and the orders received were 31,720 t. The steel works are pretty well employed, but railway material does not come in satisfactory volume, therefore no foreign houses having lately competed here, and prices having gone up to a remunerative rate, as the last tenderings for rails, sleepers, and permanent way accessories will show, the works are contemplating again competing in foreign markets. The Baden Railway Administration gave out an order lately for 168,000 = 7000 t. of steel sleepers, one lot being taken at M. 117, another at 117·50, and a third at 116·90 p.t. For the Wurtemburg Railway a large order for 13,466 t. of rails and 10,679 t. of sleepers has been placed, the lots having been taken by the S.W. group and the western, or Rhenish-Westphalian works. The lost tenders for rails were M. 137, rising to 145·50, and for sleepers M. 131 p.t., delivered at Heilbron on the Neckar. The Lower Rhine works offered to deliver the rails M. 3 and the sleepers M. 5 cheaper if sent by water instead of rail. It must not be supposed that all the rails and sleepers which have been ordered by the State Railways within the last few months are for immediate use, because large portions of them are for delivery in the years 1888 and 1889. The last two months have been rather more encouraging for the wagon, machine, and iron construction shops, boiler yards, and foundries, but none have anything like as much work as they could undertake, and prices are still very far from satisfactory.

The warmer weather has weakened the home coal trade, but that for industrial coal, especially for coking, as also for coke, is increasing in volume. France, Luxemburg, and Lorraine are taking large quantities of the latter, so that stocks are nearly cleared off in Westphalia. The price is low and not remunerative, but is slowly rising. Coke costs M. 6·80 to 8·20 for best patent sorts, and furnace cost 5·40 to 6 p.t.

Finsbury Technical College Old Student Association.—The ordinary monthly meeting of the above society was held at the College, Leonard-street, E.C., on the 2nd inst. The president, Mr. Alfred Chatterton, B. Sc., occupied the chair. A paper was read by Mr. G. T. Moody, B. Sc., F.C.S., on "Rain as a Geologic Agent." The author referred to the vast changes wrought on the surface of the earth by the destruction of forests, and briefly stated the effects thereby produced on the atmosphere and climate of surrounding regions. He then reviewed the results achieved in the attempts to prevent the erosion of the sea shore by surface waves, and showed the geologic action produced by the embankment of rivers and the drainage of low-lying districts. Then followed a discussion of the changes brought about by mining, especially those due to the action of consumption of coal. In the discussion which followed, the president stated that at the present rate of consumption of coal the amount of CO_2 present in the atmosphere would be doubled in from 700 to 800 years, and expressed some doubts as to man being able to permanently exist in such an atmosphere. The following members also took part in the discussion :—Messrs. W. E. Sumpner, B. Sc., Rance, Warton, and B. Chatterton.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, February 25th.

THE following are the latest iron and steel quotations:—No. 1 foundry, 22·50 dols.; No. 2, 20 dols.; grey forge, 19·50 dols. Furnace capacity is being increased by the blowing-in of several furnaces that have been idle for years. Ordinary Bessemer is offered at 21·50 dols.; best, 22 dols. American Bessemer is in active demand at 20 dols. at furnace. Spiegeleisen is worth from 27·50 dols. to 28 dols. Steel rail blooms are wanted at from 29 dols. to 30 dols., with 30·50 dols. to 31 dols. asked. 30,000 tons of Bessemer pig iron was bought within a few days for early shipment. Steel rails are quoted at 40 dols. Business has been done at as low as 39 dols. There are large buyers for railroad building purposes in the North-West and West who have offered 38 dols., but without finding takers. From best information available it is probable that large steel rail orders will be placed abroad during March and April for steel rails to be delivered in the Gulf States and some lots on the Pacific Coast. The inquiries of this character foot up about 60,000 tons.

Blast furnace capacity has increased since January 1st to the extent of nineteen furnaces. Capacity has increased 9000 tons per week since that time. At no time in the history of the country has there been so much effort to increase the crude iron capacity. Rolling mills which have been dismantled for years are being put in running order; and with all this increase in capacity there seems to be a demand sufficient to absorb every ton purchased. 12,000 tons of spiegeleisen sold at from 28 dols. to 28·50 dols. Scotch iron is quoted at 20·50 dols. for Eglinton; Coltness, 23 dols.; Gartsherrie, 22·50 dols. The consumption of tin this year foots up 1500 tons, against 1450 last year. The market in tin-plate has been rather quiet. Consumers and jobbers, both East and West, are buying very little. 200 tons of lead sold at 4·40. The merchant iron demand has fallen off, although the consumptive demand for all kinds of iron and steel continue at the highest point.

NEW COMPANIES.

THE following companies have just been registered:—

Bavarian Lead Company, Limited.

This is a reconstruction of the Bavarian Lead Mining Company, Limited, in liquidation. It was registered on the 28th ult., with a capital of £120,000, in £1 shares. The subscribers are:—

	Shares.
Admiral J. Stoddart, 13, Queen's-gardens, W.	1
John Head, C.E., 12, Queen Anne's-gate	1
*J. R. Stewart, jun., 6, Leinster-street, Dublin, land agent	1
*T. T. Bewick, C.E., Suffolk House, Lawrence Pountney-hill	1
J. H. Kincaird, J.P., 6, St. Stephen's-green, Dublin	1
E. Garcke, Bedford Park, secretary to a company	1
*A. A. Wynne, C.E., 5, Westminster-chambers	1

The subscribers denoted by an asterisk and Messrsr H. J. Trotter and Sampson Hanbury are the first directors; qualification, 1000 shares; minimum remuneration, £150 per annum to each director, with an additional £250 for the chairman.

Flexible Boot and Shoe Riveting and Nailing Machine Company, Limited.

This company proposes to acquire and work inventions relating to the manufacture of boots and shoes. It was registered on the 1st inst., with a capital of £25,000, in £10 shares. The subscribers are:—

	Shares.
B. Boothman, Eccles, commercial traveller	100
*S. A. Squirrell, 1, Garden-street, Manchester, boot and shoe factor	1
*E. Heaton, Heywood, Manchester, shoe manufacturer	1
*J. Boothman, Heywood, Manchester, book-keeper	1
J. Hewitt, Cheetham, Manchester, book-keeper	1
J. G. Heywood, Salford, salesman	1
W. G. Griffith, 88, Mosley-street, Manchester, accountant	1

The number of directors is not to be less than four, nor more than seven; the first are the subscribers denoted by an asterisk, and Messrs. Wm. Shaw, J. Boyes, C. Watkins, J. Boothman, and P. Cave. The company in general meeting will determine remuneration.

Hotchkiss Ordnance Company, Limited.

This company proposes to take over the business formerly carried on under the style of Hotchkiss and Co., and subsequently under the style of Favarger, Kœrner, and de Latouche, ancienne maison Hotchkiss, Société en Commandite, in Paris and elsewhere, as manufacturers of and dealers in ordnance. It was registered on the 2nd inst., with a capital of £800,000, in £10 shares. The subscribers are:—

	Shares.
*Right Hon. Sir Edward Thornton, G.C.B., 40, Eaton-place	50
*Admiral W. W. Hornby, 6, Roland Houses, S.W.	50
*A. R. Grenfell, 4, Savile-row	50
*Lieutenant-General Sir R. O. Bright, K.C.B., Normandy Park, near Guildford	50
*O. C. Waterfield, J.P., 26, Throgmorton-street	50
W. R. Drake, 46, Parliament-street, solicitor	50
H. Williams, 46, Parliament-street, solicitor	50

The number of directors is not to be less than seven, nor more than twelve; qualification, £500 in shares or stock; the first are the subscribers denoted by an asterisk and Major-General Sir John Stoks, R. Abel Smith, Vice-Admiral Jean P. E. de Fauque de Jonquières, General C. A. Thaumas, Mont Theodore Favarger, Alfred Kœrner, and M. Jacques Creuze de Latouche; remuneration, £300 per annum, multiplied by the number of directors, inclusive of managing directors, and a further sum of £200.

John Hargreaves and Sons, Limited.

This is the conversion to a company of the business of cotton spinners and manufacturers carried on by Messrs. James Hargreaves and Joseph Hargreaves at Bridge End Mills, Whitworth, Lancashire. It was registered on the 26th ult., with a capital of £50,000, in £20 shares, with the following as first subscribers:—

	Shares.
*James Hargreaves, Whitworth, cotton spinner, &c.	100
*Joseph Hargreaves, Whitworth, cotton spinner	100
Mrs. S. J. Hargreaves, Whitworth	25
Mrs. J. Hargreaves, Whitworth	25
W. E. Whitworth, Facit, cotton spinner	1
R. Taylor, Oldham, accountant	1
J. R. Pilling, Bacup, accountant	1

The number of directors is not to be less than two, nor more than five; qualification, £500 in shares or stock; the first two subscribers are appointed permanent directors.

North Cornish (Australia) Gold Mining Company, Limited.

This company proposes to acquire mining properties in Victoria, Australia, or elsewhere, and for such purposes will adopt an agreement of the 1st inst., between Oliver Henry Lloyd and Walter George White. The company was registered on the 26th ult., with a capital of £150,000, in £1 shares. The subscribers are:—

	Shares.
G. P. T. Chave, 3 and 4, Great Winchester-street, solicitor	1
V. M. Elkington, 54, Windsor-road, Holloway, clerk	1
T. H. Tate Rogers, 3 and 4, Great Winchester-street, solicitor	1
A. R. Hanson, Lorne-road, Forest-gate, E., clerk	1
B. A. Wilkinson, 69, Caledonian-road, clerk	1
W. White, 118, Queen's-road, Peckham, merchant	1
A. T. Angus, 69, Holland-road, W., clerk	1

The number of directors is not to be less than three, nor more than nine; the subscribers are to appoint the first, and act *ad interim;* qualification, 100 shares; remuneration—chairman, £300 per annum, each director, £150 per annum. The chairman will be further entitled to 2 per cent., and each director to 1 per cent. of the balance of available profits after 20 per cent. dividend has been paid, but such additional sum is not to exceed in the aggregate £1500 per annum.

Ottoman Electric Works Company, Limited.

This company was registered on the 24th ult., with a capital of £50,000, in £20 shares, to establish electric works in Constantinople and other parts of Turkey and Egypt, and to secure the sale and exclusive right to manufacture and supply the Shippey incandescent lamps throughout the entire Ottoman Empire, including a secret process for the manufacture of carbons and metallic filaments for electric lighting. The subscribers are:—

	Shares.
J. F. Lovering, 77, Gresham-street, accountant	1
E. Easton, C.E., 11, Delahay-street	1
A. Beckwith, 10, Noble-street, export merchant	1
J. Todd, 14, Wentworth-road, Manor Park, engineer	1
H. Woodward, 20, Macfarland-road, Shepherd's Bush, electrician	1
R. Ward, 10a, Great George-street, electrical engineer	1
Major-General W. Ryrie Alexander, Dartmouth	1

The number of directors is not to be less than three, nor more than ten; the subscribers are to appoint the first; qualification for subsequent directors, £200 in shares or stock. The company in general meeting will determine remuneration.

Roorkee Foundry and Engineering Company, Limited.

This company was registered on the 1st inst., with a capital of £80,000, in £5 shares, to acquire the Roorkee Foundry and Ironworks, situate at Roorkee, in the north-west provinces of India, now worked by the Public Works Department of the Government of those provinces. The subscribers are:—

	Shares.
*General A. Fraser, R.E., 96, Holland-road, W.	1
*G. H. M. Batten, 3, Ralston-street, S.W., barrister	1
W. B. Mahone, 9, Colville-square, W.	1
C. E. Benn, 34, King William-street, merchant	1
A. E. Ashby, 3a, King William-street, merchant	1
H. Wace, 3a, King William-street, merchant	1
H. S. Corfield, 3a, King William-street, clerk	1

The number of directors is not to be less than three, nor more than seven; qualification, £200 in shares or stock. The first two subscribers and Mr. Hy. Prince are the first directors. The remuneration of the board will be such sum, not exceeding £600 per annum, as the directors may determine, with a further sum of £400 in each year in which the dividend exceeds £9 per cent. upon the paid-up capital.

"Rose" Primary Battery Company, Limited.

This company was registered on the 26th ult., with a capital of £50,000, in £1 shares, to adopt an agreement of the 22nd ult.—unregistered—for the purchase from George Fitzhardinge Rose, the letters patent for an electric battery. The company further proposes to manufacture and deal in electric machinery and appliances generally. The subscribers are:—

	Shares.
E. Oldenbourg, Thorndean Mill, Hall Park, N.	1
H. W. Spratt, Lee-road, Blackheath, architect	1
J. Sinclair, Woodville, Putney, engineer	1
J. A. Mason, 94, Grosvenor-road	1
C. Clark, 20, Great St. Helens, merchant	1
H. B. Bunkell, 46, Queen Victoria-street, surveyor	1
H. P. Partington, 40, Avenue Morceau, Paris	1

The number of directors is not to be less than three, nor more than seven; qualification, 20 shares; the subscribers are to appoint the first; remuneration, £300 per annum.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

1st March, 1887.

3111. FINISHING FELT HATS, J. Ashworth and J. H. Webber, Manchester.
3112. HYDRAULIC CRANES, A. B. Brown, Glasgow.
3113. SPRAY LAMPS, J. B. Hannay, Glasgow.
3114. ADJUSTABLE STRAIGHT WIRE CORN SCREEN, J. G. Hinnell, Essex.
3115. FASTENING KNOBS to SPINDLES, R. T. Grocott, Longport.
3116. CLAMPS, W. Clapham, Skipton-in-Craven.
3117. SHIELD for VENTILATORS, C. Gannaway, Glasgow.
3118. WATER-CLOSET BASINS or PANS, T. W. Twyford, Birmingham.
3119. SPIRIT LAMPS, W. Atkins, Birmingham.
3120. ATTACHING DOOR KNOBS to SPINDLES, E. Taylor, Birmingham.
3121. STOVES, &c., T. Cudlipp, London.
3122. PAPER TISSUE, H. J. Shawcross and B. H. Thwaite, Liverpool.
3123. STEAM-ENGINE CUT-OFF, &c., H. J. Allison.—(*L. and T. L. Dennis, United States.*)
3124. CRAYONS, H. J. Allison.—(*H. S. Myers, United States.*)
3125. ELECTRICALLY TRANSMITTING ARTICULATE SPEECH between DISTANT STATIONS, W. D. House, London.
3126. GAS-BURNER REGULATORS, &c., W. Beal, Birmingham.
3127. STAFF NOTATION of PRINTED MUSIC, J. Thomson, Hillhead.
3128. MAKING BREAD, &c., G. Grout and G. Shenton, London.
3129. GAS COOKING OVENS, E. P. Greenwood, London.
3130. KITCHEN ASH PANS, &c., R. Rowbotham, London.
3131. FIRE-EXTINGUISHING APPARATUS, T. A. Burrows, London.
3132. CASTING RINGS of METALLIC PACKING, A. A. Rickaby, London.
3133. SECURING KEYS in RAILWAY CHAIRS, J. G. Bell, London.
3134. STEAM WINCHES, F. W. Cannon, London.
3135. STEELS for CORSETS, H. S. Cowan, London.
3136. COMBINED RAILWAY CHAIRS and SLEEPERS, E. Basset, London.
3137. FIRE-ESCAPES, E. Bassett, London.
3138. CONTINUOUS FOOTBOARDS for RAILWAY CARRIAGES, E. Bassett, London.
3139. PHOTOGRAPHY, A. J. Boult.—(*A. Sichel, United States.*)
3140. PRODUCING INDUCED CURRENTS, J. C. Pürthner, London.
3141. FORCED DRAUGHT FEED, R. Fraser and J. B. Edmiston, Liverpool.
3142. CIGAR HOLDERS, F. W. Jones, London.
3143. FACILITATING ESCAPE from WINDOWS of HOUSES on FIRE, W. E. Heath, London.
3144. HYDRATES of BARIUM, &c., H. L. Pattinson, jun., London.
3145. OPENER for MEAT TINS, C. Price, London.
3146. CAPTIVE MILITARY BALLOONS, A. C. Henderson.—(*J. Bel, Spain.*)
3147. SYRINGE BOTTLE, N. C. Hamlin, London.
3148. DISTILLATORY APPARATUS, E. Luck, London.
3149. SYNCRONISING the MOVEMENTS of MOTORS, J. H. Johnson, London.
3150. THRASHING MACHINE, C. N. May and T. and W. Nalder, London.
3151. VACUUM PUMPING, A. G. Brookes.—(*Max Grèeven and Co., Germany.*)
3152. WEAVING ELASTIC FABRICS, W. Lapworth, London
3153. WEAVING ELASTIC FABRICS, W. Lapworth, London.
3154. STOPPERING BOTTLES, &c., A. H. Storey, London.
3155. NAILMAKING, H. H. Lake.—(*C. Hill, United States.*)
3156. NAIL EXTRACTORS, G. J. Capewell, London.
3157. DRESSING BAGS, M. Wolfsky, London.
3158. GIVING CURRENTS of ELECTRICITY on the INSERTION of a COIN, P. Everitt, London.
3159. BOTTLE STANDS, A. Watson, London.
3160. LENSES, H. L. H. Schröeder and J. Stuart, London.
3161. DIVIDING INSTRUMENTS, F. O. Ferguson, Middlesex.
3162. SHUTTLES, P. Haddan.—(*D. Porter, United States.*)
3163. COFFINS, H. J. Haddan,—(*C. Redl, Austria.*)
3164. ATTACHING CLASPS, O. Wollenberg, London.
3165. DRAIN PIPES, J. H. R. Rose, London.
3166. SEWING MACHINES, G. A. Crawford, London.
3167. BUTTONS, W. H. Beck.—(*La Société Rousselle, frères, Tirein et Cie., France.*)
3168. HYDRAULIC CEMENTS, &c., S. Trickett and J. Noad, London.
3169. SCALDER, &c., L. Watson, Middlesbrough-on-Tees.
3170. BALL CASTORS, R. H. Hughes, London.
3171. LOCKS, &c., J. M. Hart, London.
3172. ROYAL JUBILEE FROG, E. G. Rolland, London.
3173. MARINE TORPEDOES, S. H. Nealy and L. Hutchins, London.
3174. RHEOSTATS, P. Cardew, London.
3175. COVERING for FLASKS, &c., J. Rowley and R. S. Brock, London.
3176. FACILITATING the PACKETING of MONEY, H. Lonitz, London.
3177. VELOCIPEDES, W. Lee and D. Wiggins, London.

2nd March, 1887.

3178. SUBSTITUTE for GLASS for PHOTOGRAPHIC PURPOSES, J. E. Thornton, Moss Side.
3179. HYGIENIC MANURE, J. Hardwick and J. R. Shearer, London.
3180. SAFETY BARREL WHEEL for WATCHES, T. Morcom, St. Austell.
3181. PRODUCING NAP on TEXTILE FABRICS, J. Hardy, Bradford.
3182. TRANSPLANTING TREES, T. G. Messenger, Loughborough.
3183. HEATING RAILWAY CARRIAGES, J. Langfield and R. L. Martland, Manchester.
3184. STOPPERING BOTTLES, A. H. Roylance, Manchester.
3185. GIG MACHINES, A. Monforts, London.
3186. SCORING for BILLIARDS, H. Dobson and A. E. Wynn, Ilkley.
3187. FILTERING BEER, &c., J. Klein, London.
3188. SAFETY HINGE for STEPS, J. Staincliffe, Oakworth.
3189. TROUSER STRETCHER, F. R. Baker, Birmingham.
3190. SUSTAINING HANDLES in any POSITION, &c., G. Wragge, Gaythorn.
3191. WOOD FISHING REEL, J. Powell, Smallheath,
3192. ORNAMENTING a SPIRIT FLASK, T. L. Turnbull, Sunderland.
3193. ARRANGING HOOKS and EYES, H. Hartjen.—(*The Firm of Röderstein and Walter, Germany.*)
3194. EXTRACTING CORKS from BOTTLES, A. da Costa, London.
3195. SPINNING MULES, J. Holt, W., and W. Schofield, Manchester.
3196. REPS, G. P. Lee, Manchester.
3197. SEPARATING PLATES in BATTERIES, D. L. Salomons, T. Parker, and P. B. Elwell, Wolverhampton.
3198. SPINDLE MOUNTINGS, J. Morris, Manchester.
3199. BEDSTEADS, I. Chorlton and G. L. Scott, Manchester.
3200. BALL-COCK, J. Hookham, London.
3201. BATTLEDORE and CATCH BALL, W. W. Griffin, Liverpool.
3202. TROUSER SUSPENDERS, C. Steer, Clifton.
3203. CLOSING STRAINER PLATES, H. J. Rogers, Watford.
3204. RAISING WINDOWS, H. L. S. Nicol, Arbroath.
3205. BOTTLE BLOWING, W. A. O'Sullivan, Dublin.
3206. PACKING MACHINES, L. Heyligenstaedt, Berlin.
3207. PAPER for PRINTING, N. Macphail, Glasgow.
3208. VENTILATING SHEDS, W. C. Wood and W. Bracewell, Lancashire.
3209. PAINTS, W. F. Hurndall, Liverpool.
3210. HEATING APPARATUS, R. Fraser, Liverpool.
3211. INDICATING MEASUREMENTS of LIQUIDS, D. Fergusson, London.
3212. SUSPENDING CURTAINS, G. H. Perks, London.
3213. GRAB DREDGERS and EXCAVATORS, S. C. Harris, London.
3214. REGISTER CASH TILLS combined with COUNTER STANDS, J. Waltho, London.
3215. METERS for WATER, &c., J. Thomson, London.
3216. DOOR BOLT with AUTOMATIC INDICATOR, W. Walls, Bradford.
3217. CUTTING YARNS into LENGTHS, H. Grafton.—(*W. R. Grafton, Egypt.*)
3218. ENGINES for STEAM, &c., J. Holloway and A. Black, jun., London.
3219. STREET, &c., LAMPS, W. Morgan, London.
3220. REGULATOR for WATER-CLOSETS, H. L. Wethered, London.
3221. JOURNAL BEARINGS, A. J. Boult.—(*T. W. Broomell, United States.*)
3222. EXTINGUISHING OIL or SPIRIT LAMPS, &c., H. Dyer, London.
3223. CLEANING TRAM RAILS AUTOMATICALLY, J. Baptiste, London.
3224. CONDENSING APPARATUS, H. E. Newton.—(*E. Theisen, Germany.*)
3225. GENERATION of ELECTRIC ENERGY, R. Dick and R. Kennedy, Glasgow.
3226. CLEANING BRUSHES, H. P. Nichols, London.
3227. TRANSPORT and other CARTS, E. S. Copeman, London.
3228. WASHING, W. H. Neville, London.
3229. CLEANING TENNIS and other BALLS, J. Osmond, London.
3230. COMBINED PORTABLE BOILER and CENTRIFUGAL PUMPING ENGINE, Tangyes, Limited, and T. Jefferies, London.
3231. KNIFE-CLEANING MACHINES, J. W. Sutton, London.
3232. GAS LAMPS, J. W. Sutton, London.
3233. AUTOMATIC CARBON FEED, H. J. Haddan.—(*L. Levavasseur, France.*)
3234. ENEMAS, J. Annandale, London.
3235. PHOTOGRAPH and other ALBUMS, C. F. Fränzel, London.
3236. BOOMS for SAILING YACHTS, H. H. Lake.—(*F. C. Johnson, United States.*)
3237. MAGAZINE or REPEATING RIFLES, H. H. Lake.—(*G. V. Fosbery, United States.*)
3238. RAILWAY WAGON COUPLINGS, R. Claassen and P. Koenecke, London.
3239. RECIPROCATING PISTON ENGINES, G. J. C. D'urban Skinner, London.

3rd March, 1887.

3240. TREATMENT of COFFEE PORTER, &c., G. Epstein, London.
3241. BRUSHES, J. Feather, Skipton-in-Craven.
3242. WOOD BOXES, J. Magill, Manchester.
3243. WALL FITTINGS, R. G. Hammond and R. Ward, Ipswich.
3244. SPINNING and DOUBLING FRAMES, W. Lumb and R. H. Holt, Rochdale.
3245. FOG SIGNAL DETONATOR, H. Jephson, Derby.—*2nd March*, 1887.
3246. CONVEYING LUBRICANTS to SHAKER CRANKS, I. Morris, Bloxwich.
3247. OPERATING RAILWAY SIGNAL ARMS, H. Williams, Glasgow.
3248. CHROMO-LITHOGRAPHIC PRINTING, A. J. Béjot, Liverpool.
3249. CONNECTING BARRELS, E. Rouse, Manchester.
3250. CONCENTRATING the POWER of a SCULLER, T. P. Wood, Newcastle-on-Tyne.
3251. WEIGHING MACHINES, F. C. Lynde, Manchester.
3252. MAKING LEAD RIVETS, H. Bramall, Manchester.
3253. SPRING MATTRESSES, A. Haworth, Manchester.
3254. METAL CUP with PORCELAIN LINING, J. Booth, Sheffield.
3255. FIRE-EXTINGUISHING APPARATUS, W. Miller, Glasgow.
3256. ROOFING CLOTH, G. F. Jeffery, Leeds.
3257. PREVENTING OIL STAINS in LOOMS, W. Moscrop, Rochdale.
3258. BLOWING GLASS by MECHANICAL MEANS, R. E. Donovan, F. Hazlett, and J. Johnson, Dublin.
3259. CHILL ROLL REGULATOR, J. Rouson, Walsall.
3260. BUTTER PRINTING MACHINE, R. F. Kerr, Pollokshaws, N.B.
3261. SCOTCHING the WHEELS of FIRE-ESCAPES, &c., A. J. Lyon, London.
3262. ENGINES actuated by the EXPLOSION of AIR, &c., W. J. Munden, London.
3263. SPRINGS for the SADDLES of VELOCIPEDES, E. Redman, London.
3264. STOVES for BURNING FUEL, J. Roots, Orpington.
3265. OIL LAMPS, J. Roots, Orpington.
3266. RAISING SUNKEN SHIPS, W. M. Walters, London.
3267. PURIFICATION of COAL GAS, C. W. Watts, London.
3268. WIRE CUTTERS, &c., W. E. Norton, Sheffield.
3269. PREVENTION of DRAUGHT, &c., through DOORS, &c., J. Ellis and J. Trippett, Sheffield.
3270. PHOTOGRAPHIC CAMERAS, J. Lander, London.
3271. BURNING SOLID HYDROCARBON in MINERS' LAMPS, J. Gilchrist, Glasgow.
3272. CARRIAGES, R. S. Mushet, London.
3273. SCREW STOPPER TAP for BOTTLES, S. H. Musgrave, Acton.
3274. GENERATING STEAM, J. C. Stitt, London.
3275. SHADES and GLASSES for GAS, &c., LIGHTS, E. Moore, London.
3276. FITTINGS for COTTAGE FIRE RANGES, E. Richardson, London.
3277. DRESSING BAGS, &c., C. Drobig, London.
3278. SIGNAL BELLS, W. Bown, G. Capewell, and J. W. Flavell, London.
3279. SAFETY HYDROCARBON LAMPS, G. S. Symmons London.
3280. COLOURING MATTER for DYEING, &c., R. Chadwick and J. W. Consterdine-Chadwick, London.
3281. TAKING UP EXCESS of INK from PRINTED SHEETS in PRINTING MACHINES, F. L. Gueneau, London.
3282. BOBBINS for WINDING YARNS and TEXTURES, T. Brown and W. Pickstone, London.
3283. STORAGE of FOOD for MEN LIVING in COMPANIES, J. Nodder, Sheffield.
3284. PRESERVING PPARATUS, C. A. Sahlström, Aberdeen.
3285. RAISING and LOWERING the SIGHT BARS of GUNS, G. Stuart, Newcastle-on-Tyne.
3286. BULLET-PROOF GARMENTS, A. Grassmück, London.
3287. LETTER-PRESS PRINTING MACHINES, D. Cawlaw, Glasgow.
3288. PROTECTING the FROG, &c., o the HOOF of HORSES, &c., W. L. Pearce, London.
3289. BRACE and WASHER CUTTER, A Hoyton London.
3290. PRESSES for COPYING LETTERS, O. B. A. Klug, London.
3291. GAS, J. Howard and E. T. Bousfield London.

4th March, 1887.

3292. COMPOUNDS for DEODORISING, &c., PURPOSES, I. McMurray, Glasgow.
3293. RELEASING the TONGUES of BUCKLES, W. W Twigg, Birmingham.
3294. MAKING MOULDS for CASTINGS, S. Alley and J. A MacLellan, Glasgow.
3295. AUTOMATIC WINDOW WASHER and CLEANER, S. Hall, Leeds.
3296. CHIMNEY POTS, J. Taylor, London.
3297. LOOMS for WEAVING, R. Whalley and W. Wells, Blackburn.
3298. CRANES for LIFTING, W. James and J. Jones, Chester.

3299. Ventilating Apparatus, G. B. Moss, Lincoln.
3300. Metal Folding Case for Needles, &c., J. Morgan, jun., Studley.
301. Pipes for Conducting Liquids, T. Lockerbie, London.
3302. Cooking Meats, &c., H. Hazleton and A. Read, West Smethwick.
3303. Automatic Grabs and Grab Diggers, G. T. Peters, London.
3304. Separating Solid Matter from Alizarine, &c., R. Ried, Glasgow.
3305. Cattle Mark, C. K. Tomlinson.—(*C. P. Hayward, Buenos Ayres.*)
3306. Opening and Cleaning Cotton, &c., J., R., and J. Greenhalgh, Manchester.
3307. Finishing Cotton Velvets, &c., R. S. Collinge, Manchester.
3308. Sanitary Material for Bedding, &c., H. K. Spark and J. Warburton, Sheffield.
3309. Guillotine Machine for Cutting Paper Bags, J. Hall, Sheffield.
3310. Brake for Railway Vehicles, R. C. Sayer, Newport.
3311. Metallic Bearing Springs, A. S. Kirk and W. Fox, London.
3312. Table Catches or Fasteners, F. and H. Matchett, Birmingham.
3313. Garden and other Syringes, G. J. Williams, Birmingham.
3314. Football Boots, &c., W. R. Walsh, London.
3315. Heel Iron for Boots, &c., A. Dickinson, London.
3316. Cork or Tap Holes for Casks, T. H. W. Baldock, Birmingham.
3317. Preparing the Tops of Billiard Cues, J. Hicken, Portsmouth.
3318. Adjustable Bearings for Shafting, J. W. Newall, London.
3319. Holding Candles in Candle-sticks, J. W. Edridge, Birmingham.
3320. Kneading India-rubber, &c., R. Cowen, London.
3321. Parasols and Sunshades, E. H. Harris, London.
3322. Anchors, J., E., and J. Ford, Birmingham.
3323. Primary Batteries, C. L. Tweedale, Manchester.
3324. Folding Bedsteads, E. A. Gormly, Liverpool.
3325. Regulating the Dilution of Gas Mixtures in Three Cycle Gas Engines, J. Kerr, Kilmarnock.
3326. Safety Friction Washer, J. Kerr, Kilmarnock.
3327. Making, &c., Sashes for Windows, T. W. Helliwell, Halifax.
3328. Automatic Weighing Machines, J. Entwistle, London.
3329. Trough Decking for Bridges, T. A. Arrol, Liverpool.
3330. Combined Ratchet, &c., A. Quinlin, London.
3331. Refractory Bricks, &c., T. M. Rymer-Jones, Lee.
3332. Railway Vehicles, A. Reichwald, Newcastle-on-Tyne.
3333. Buffers for Railway Vehicles, A. Reichwald, Newcastle-on-Tyne.
3334. Serving Hot Plates, &c., S. H. Simpson, London.
3335. Burners for Gas, J. Smith and A. Emley, Newcastle-on-Tyne.
3336. Box for Packing Boots, T. Wright, Northampton.
3337. Fastenings for Cases used for Bottles, H. S. Wright, Newton Abbot.
3338. Furnaces, E. Crutchloe, London.
3339. Advertising, A. J. Boult.—(*G. Lagarde, Belgium.*)
3340. Shearing Machines, J. H. Wicksteed, London.
3341. Automatic Weighing Machines, &c., W. S. and F. Freeman, London.
3342. Measuring Coefficients of Self-induction, W. E. Ayrton and J. Perry, London.
3343. Advertising Books, J. Death, Middlesex.
3344. Bicycles, R. W. Smith, London.
3345. Tricycles, R. W. Smith, London.
3346. Lighting Carriages, I. A. Timmis, London.
3347. Locks, A. Shaw, London.
3348. Locks, S. Proctor, London.
3349. Flooring, J. F. Ebner, London.
3350. Stuffing Boxes, S. Criffin, London.
3351. Floors, R. Spence, London.
3352. Separating Matters, G. Gehring, London.
3353. Sewing Machine, J. Davies, London.
3354. Clips, H. M. Knight, London.
3355. Supplying Food to Animals, H. Jephson, London.
3356. Terne Plates, H. J. Kirkman, Middlesex.
3357. Hook, W. Potter, jun., London.
3358. Pump, M. A. and A. Michalees, London.
3359. Gas-stoves, H. J. Davies and H. C. Turner, Westminster.
3360. Signalling, S. T. Dutton, Middlesex.
3361. Perambulators, C. Thompson, London.
3362. Detecting Gas, J. W. Swan, London.
3363. Ice Machines, E. de Stoppani, London.
3364. Plugs, W. Williams, London.

5th March, 1887.

3365. Wagon Coupler, W. H. Roberts, Wiltshire.
3366. Water-proof Coats, J. Russel, Cork.
3367. Heating Furnaces, J. W. Newall, London.
3368. Looms, A. Flather, Bradford.
3369. Handles, H. H. Tye, Birmingham.
3370. Pen, W. J. Simmons and J. Hill, Taunton.
3371. Curling Hair, W. E. Moser, Liverpool.
3372. Fire-arms, A. Hosser, London.
3373. Tar Brush, J. Studd, Norfolk.
3374. Mounting Wire for Weaving, H. B. and A. B. Barlow, Manchester.
3375. Safely Extinguishing Lamps, J. Rowe, London.
3376. Spring Mattress, E. Smith, London.
3377. Medicinal Biscuits, S. S. Bromhead, London.
3378. Quoins, A. I. Reed.—(*G. E. Jones, United States.*)
3379. Sleeve Links, &c., W. E. Patterson, Birmingham.
3380. Spittoon, J. Bates, Sheffield.
3381. Automatic Circulation of Water in Boilers, J. A. Rowe, North Shields.
3382. Controlling Gas, R. Atherton, Newton Heath.
3383. Water Waste Preventer, R. Pickwell, Cardiff.
3384. Automatic Gas Regulator, J. Friend, Exeter.
3385. Hydraulic Machinery, C. S. Madan, Manchester.
3386. Cricket Bats, R. F. J. C. Allen, London.
3387. Trap Plate for Gulleys, G. E., G. F. A., and H. T. Mills, Cambridge.
3388. Charging Retorts, A. Lentz, Liverpool.
3389. Dyeing, &c., Aniline Blacks, F. Towlson and E. Weldon, Manchester.
3390. Register Grates, J. A. McKee, Belfast.
3391. Securing Sheet Metal Plates, W. Orr and P. S. Brown, Glasgow.
3392. Portable Baths, C. J. Etherington, London.
3393. Artistically Coloured Pictures, W. H. May, London.
3394. Stopping and Reversing Engines, W. Allan, London.
3395. Variable Expansion Gear, J. Y. Johnson.—(*J. Hepworth, Canada.*)
3396. Checking the Flow of Gas, S. and J. Chandler, London.
3397. Cramps, Grips, &c., T. Lister, Sheffield.
3398. Steam Generators, J. G. H. and C. T. Batchelor, London.
3399. Knife-cleaning Boards, J. A. Crowe, London.
3400. Displaying Advertisements, J. E. Mercadante, Rio de Janeiro.
3401. Metallic Sleepers and Chairs, J. Livesey, London.
3402. Working Breech Blocks, &c., J. Farcot, London.
3403. Universal Lock-works, C. Markmann and L. Petersmann, London.
3404. Rotary Door Check, S. Coombs, London.
3405. Dental Suction Valves, C. G. Knight and J. T. Ford, Southsea.
3406. Fastening for Sashes, F. Cox, London.
3407. Envelopes, M. P. Gosset, London
3408. Motor, J. Papiesz, London.
3409. Casting Metals, &c., F. R. Schweiger and C. F. Muhlmann, London.
3410. Deodorising Cocoa-nut Oil, A Smith, London.
3411. Actuating Pneumatic Brakes, J. F. Carpenter, London.
3412. Cakes, &c , J. C. Lunk, London.
3413. Locking Nuts, J. Mactear, London.
3414. Extinguisher Mechanism for Lamps, W. Snelgrove, London.
3415. Roofing Tiles, J. L. Wilson, London.
3416. Brushing Felt and other Hats, B. Herzberg, London.
3417. Type-writing Machines, H. H. Lake.—(*J. H. Currier, United States.*)
3418. Producing Gas from Hydrocarbons, J. A Marsh, United States.
3419. Indicating Speed, J. Thorne and E. B. Burr, London.

7th March, 1887.

3420. Rigging Screw, N. Arthur, Heaton.
3421. Railway Luggage, &c., Vans, R. Gray, Lincolnshire.
3422. Corset Busks, H. Vollmer.—(*The Actien-Gesellschaft fur Federstahl-Industrie, Germany.*)
3423. Steam Roundabouts, &c., F. J. Burrell, Thetford.
3424. Union Joints for Hose Pipes, G. Emens, Hettonle-hole.
3425. Smoke Shade, &c., T. Dineen, Leeds.
3426. Skin Rugs, &c., E. Wood, Halifax.
3427. Ships' Berths, C. J. Fox, Birkenhead.
3428. Portable Electric Warning, T. F. Remer, Liverpool.
3429. Triplet Escape Valves, J. Hodkinson and A. Middleton, Hyde.
3430. Wire Ropes, J. Westgarth, Manchester.
3431. Water-closets, J. Ducket, London.
3432. Water-closets, T. Gill, London.
3433. Holdfast, W. E. Copping, Anerley.
3434. Bottles, &c., H. M. Ashley, Ferrybridge.
3435. Fixing Blinds, H. Ough, London.
3436. Boilers for Heating Greenhouses, &c., J. H. Thomas, London.
3437. Connecting, &c., Medical Coils, R. Durling, London.
3438. Esclatine's Rollers, A. Esclatine, Paris.
3439. Washing Clothes, C. Campbell, London
3440. Extinction of Fire, J. C. Merryweather, London.
3441. Cock or Tap, W. Thomas, London.
3442. Flushing Sewers, W. Thomas, London.
3443. Disintegrator, E. Wilson, London.
3444. Pinning, Striking, &c., Leather, E. Wilson, London.
3445. Timber Structures for Mines, G. J. Goodhue, London.
3446. Corn Planters and Row Checkers, R. I. Skiles, London.
3447. Millinery Trimmings, A. Tompkin, London.
3448. Velocipedes, H. J. Howard, London.
3449. Hanging Pictures, &c., on Walls, H. Day, Tunbridge.
3450. Products of Combustion, J. J. and F. G. C. Lundy, and A. G. Christiansen, London.
3451. Rotary Wire Gigging Machines, A. J. Boult.—(*J. Hanson, United States.*)
3452. Lubricators, W. S. Chantrell, Liverpool.
3453. Fire-escapes, W. E. Heath, London.
3454. Horseshoes, T. D. Richardson, London.
3455. Spring and Pin for Solitaires, &c., J. Sadler, Northampton.
3456. Spanners, J. C. Martin, London.
3457. Forced Draught and Combustion, J. P. Wilson, Glasgow.
3458. "In and Out" Indicators, F. Sage, London.
3459. Door, &c., Stops, F. Sage, London.
3460. Bottles, &c., A. G. Collins, London.
3461. Purifying Water, G. Bischof, London.
3462. Seats for Organs, Pianos, &c., E. Greenhow, London.
3463. Adapting a Traction Engine for use as a Road Roller, S. Eddington and J. E. Steevenson, London.
3464. Traction Engines, &c., S. Eddington and J. E. Steevenson, London.
3465. Buttons, H. Morgan, London.
3466. Musical Hoop, P. Perry, London.
3467. Employers' Tell-tale, H. C. W. Emery, London.
3468. Combination Roller for Pens, &c., J. Spear, London.
3469. Electric Primers, C. A. McEvoy, London.
3470. Preventing Water Pipes from Bursting, W. H. Moore, London.
3471. Preserved Food, H. Köchert, London.
3472. Safety Valve and Pressure Regulator, E. Weerts, London.
3473. Platen Printing Presses, F. X. Hölzle and C. Spranger, London.
3474. Clip for Letters, &c., L. W. Stone, London.
3475. Chains, E. J. B. Augé, London.
3476. Match or Cigarette Light, E. L. Sheldon, London.
3477. Extracting Nails, H. B. Churchill-Longman, London.
3478. Arc Lamps, J. Kleissl and A. Duffek, London.
3479. Printing Machines, W. R. Lake.—(*P. F. A. Godchaux, France.*)

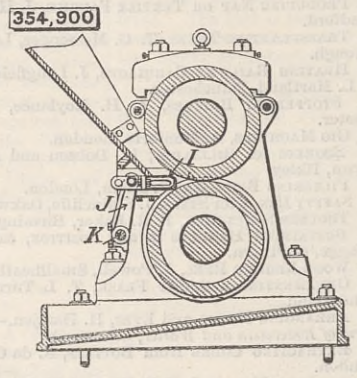
SELECTED AMERICAN PATENTS.

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

354,900. Feeder for Bagasse Roller Mills, *A. Haneberg, Koloa, Hawaii.—Filed June 19th*, 1886.

Claim.—(1) The combination, in a bagasse roller mill, of the feed hopper having a horizontal bottom plate, the rollers, a horizontally reciprocating feed bar interposed between the feed hopper and said bottom plate and in line with the entering space between the rollers, and means for operating said bar as set forth. (2) In a bagasse roller mill, the combination, with the feed hopper, the rollers, and spur wheels, of a reciprocating ball, a pawl having two points engaging with one of

354,900

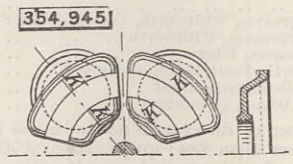


said spur wheels, and connections between said pawl and the feed bar, substantially as described. (3) In a bagasse roller mill, the combination, with the feed hopper and rollers, of the feed bar I, rock arms J, shaft, K, having crank L, pendulum lever M, having pawl N, with points n n^1, and spur wheel E, all substantially as and for the purpose set forth.

354,945. Dynamo-electric Machine, *E. A. Sperry, Chicago, Ill.—Filed October 31st*, 1884.

Claim.—(1) A field magnet for dynamo-electric machines, consisting of a core and concentric sector-like pole piece provided with an intervening circular groove to admit the revolving end of an annular armature, as described, that portion of the sectional area of the core standing opposite each pole piece being proportional to the sectional area or mass, respectively, of the pole pieces themselves, substantially as and for the purpose set forth. (2) In a dynamo-electric machine, a field magnet, the poles of which are arranged in equidistant pairs or parts within a circle, each part or pair of pole pieces being magnetised by a separate or distinct core, and divided to admit the end of a revolving annular armature, the

354,945

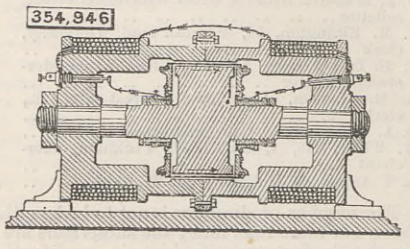


masses of the divisions of each pair or part being proportional, respectively, to the sectional area of the parts of the core opposite said divisions, substantially as described. (3) The combination of the back armature or yoke C, the cores J, projecting from said yoke, the divided sector-like pole pieces K K^1, bearing the specified relation to said cores J, and the annular armature E, playing between said pole pieces, substantially as described.

354,946. Dynamo-electric Machine, *E. A. Sperry, Chicago, Ill.—Filed March 21st*, 1884.

Claim.—In a dynamo-electric machine, the combination of the field magnet having a solid core-piece with shaft-shaped extensions, the conducting rings fitted

354,946

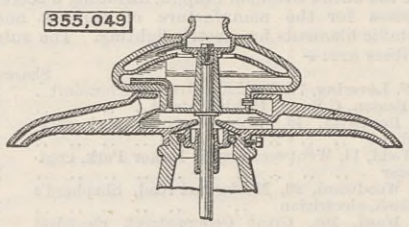


on said extensions and insulated therefrom, the antifriction balls serving as electrical conductors, and the drum-shaped armature supported upon said balls and rotating thereon, substantially as described.

355,049. Centrifugal Liquid-separator, *C. Axel, Backstrom, Trenton.—Filed July 24th*, 1886.

Claim.—(1) In a centrifugal machine, a separating vessel provided with an annular shelf, a radial partition above and below said shelf, an induction orifice arranged at one side of the upper part of said partition, and an induction orifice arranged at the opposite side of the lower part of said partition, substantially as specified. (2) In a centrifugal machine, a separating chamber having a series of annular shelves and a radial partition intersecting said shelves and extending above and below them, the shelves being imperforate except at alternately opposite sides of the said partition, substantially as specified. (3) In a centrifugal machine, a separating vessel provided with an annular

355,049

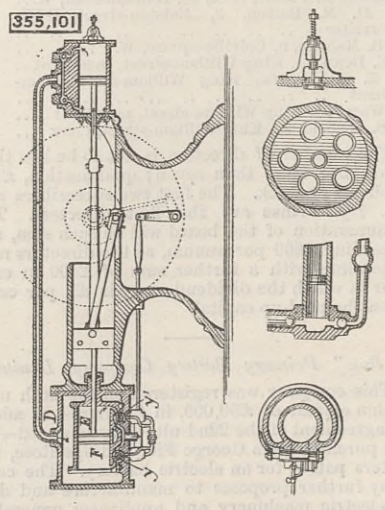


shelf, having an orifice near the inner periphery of the vessel, and having a radial partition adjacent to the orifice and extending above and below the shelf, and a central depressed neck, the latter having discharge orifices in relatively different horizontal planes, and a pipe leading from the lower of said orifices to and beneath the annular shelf, substantially as specified. (4) The combination of the separating chamber, an annular shelf provided with a single discharge port or orifice located near its outer edge, a radial partition arranged adjacent to said single discharge port and extending above and below said shelf, and the supply pipe arranged at a side of said partition opposite that at which said discharge port is located, substantially specified.

355,101. Gas-engine, *N. B. Randall, Philadelphia, Pa.—Filed June 3rd*, 1886.

Claim.—(1) The combinatlon, with the power cylinder E and air jacket D, surrounding the power cylinder, of valves for admitting air from the air jacket to opposite ends of the power cylinder in alternation, the gas compressor T, forcing gas under pressure into

355,101

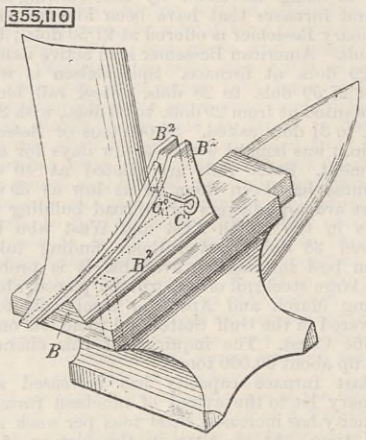


opposite end of the power cylinder in alternation, and means substantially as herein shown and described for igniting the explosive charge contained by the power cylinder and releasing the products of combustion. (2) The combination of the power cylinder E, provided with the piston F, the air jacket D, surrounding the power cylinder, the valves y y', provided with spindles a' a'' and arms b' b'', the cams c' c'', the layshaft S, carrying the cams and receiving motion from the crank shaft, the gas compressor T, link o', angled lever p'', connecting rod q'', excentric strap r', and excentric s', the air compressor, J, provided with the piston K, and valves g h'' h^3, the igniting ports u w', and the mechanism connecting the moving parts of the engine, substantially as herein shown and described.

355,110. Device for Welding Ploughshares and Landsides, *L. A. Weyburn, Rockford, Ill.—Filed May 22nd*, 1886.

Claim.—(1) In a short landside holder, a base, B, provided with upwardly projecting sides B^2, for holding a short landside in proper position while a ploughshare is being welded to said landside, substantially as described, and for the purpose specified. (2) A short

355,110

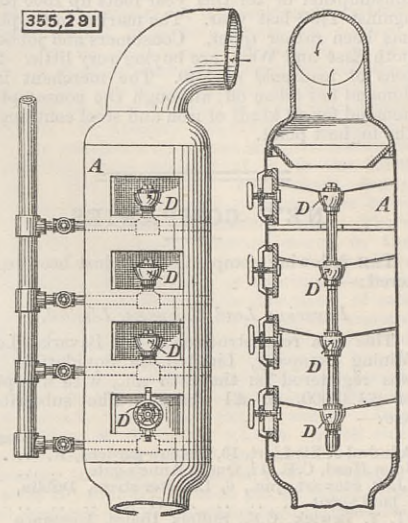


landside holder consisting of a base and sides B^2, the latter being provided with pin holes C, and having their upper surfaces inclined toward the end B^5 of the landside holder and furnished with a heel pin, C^1, bolt D, nut D^1, and washer D^2, substantially as set forth.

355,291. Steam Condenser, *V. D. Anderson, Cleveland, Ohio.—Filed August 23rd*, 1886.

Claim.—A condenser consisting of a case A, having one or more nozzles, D, arranged therein, with a pipe for supplying water thereto, the said nozzle or nozzles

355,291

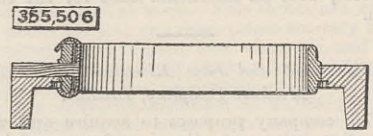


being constructed substantially as described, whereby a solid or unbroken sheet or diaphragm of water is produced within the case, as and for the purpose set forth.

355,506. Ring for Spinning Frames, *G. J. Carter, Clinton, Mass.—Filed July 21st*, 1886.

Claim.—The ring rail having an opening through it for the reception of an oil conductor, and a ring having an opening in or through it to coincide with

355,506

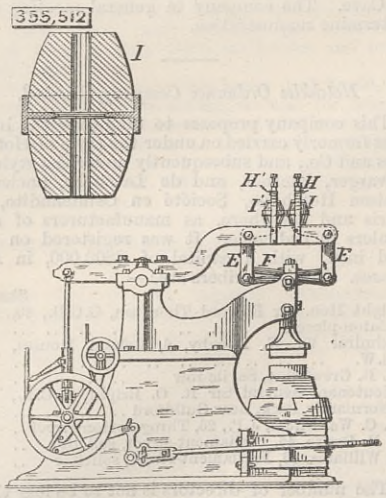


the opening in the rail, the said openings being adapted to receive within them an oil-conductor to supply oil slowly to the contracting surface of the traveller running upon the ring, substantially as described.

355,512. Power Hammer, *M. Deering, Syracuse, N. Y.—Filed October 16th*, 1886.

Claim.—(1) The combination, with the helve and the hammer head, of levers pivotted to the helve, and a flexible connection whereby said levers are connected with the hammer head, substantially as set forth. (2) The combination, with the helve and the hammer head of levers pivotted to the helve, a flexible connection whereby said levers are connected with the hammer head, and an elastic cushion applied to said levers, substantially as set forth. (3) The combination, with the helve and the hammer head, of levers pivotted to the helve, a flexible connection whereby said levers are connected with the hammer head, and adjusting devices whereby the levers are adjusted, substantially as set forth. (4) The combination, with the helve and

355,512



the hammer head, of levers pivotted to the helve, a flexible connection whereby said levers are connected with the hammer head, an elastic cushion applied to said levers, and adjusting devices whereby the levers and cushion are adjusted, substantially as set forth. (5) The combination, with the helve and the hammer head, of levers E E', pivotted to the helve, a flexible strap F, connecting the lower ends with the hammer springs I I', resting on the upper ends of said levers, and bridge pieces H H', secured to the helve and supportiug the upper ends of said springs substantially as set forth.