BRITISH AND FOREIGN RAILWAY GOODS RATES.

Complaints against railway companies in respect to goods traffic for years have been numerous, and are now so frequent and loud that some change in the system upon which they are based is imperative. The charges against the companies are :—That rates in excess of the authorised maximum are often exacted. That on the same line higher rates are charged on some kinds of goods than on others, though the cost of the service is the same in both cases. That in many cases lower rates are charged on goods imported or for export, than on the same articles produced in this country. That preferential rates are granted to one class against another. That the difficulties in the way of obtaining redress by private individuals against railway companies for over-charge or illegal preference are almost insuperable. That through imperfect rate books and defective classification, it is almost impracticable to ascertain the particular class to which any article belongs, and the rates which the railway company is authorised to charge for its conveyance. A Committee of the House of Commons in 1882 examined these charges, and, while admitting that they were well founded, did not recommend any legislation on the subject beyond an extension of the powers of the Railway Commission. Since then several attempts have been made to arrive at a settlement of the question, both by the Government, private members, and some of the railway companies, but with no result; and in the next session of Parliament another attempt will be made. Among recent contributions to our knowledge of the question is a report to the Associated Chambers of Commerce by Sir B. Samuelson, M.P., on the railway goods traffic of Holland, Belgium, and Germany compared with that of this country. It gives a full description of the principles upon which the classification and rates are fixed, and also a series of tables showing the rates charged for some thirty-five articles, such as are of common use in trade and manufactures, for nearly 200 typical distances in this country, compared with what would be charged in Belgium, Germany, and Holland. The tables are not very well arranged for showing the extent of the difference in rates. No mileage is given, and to those unfamiliar with the localities the arrangement is rather confusing. The report shows that in Holland, Belgium, and Germany the rates are fixed on some definite principle, and that they are considerably lower than here. The Dutch railway rates are the lowest in Europe, being about three-fifths; the Belgian are the next, about two-thirds; and the German the highest, about seven-tenths of the British rates. The rates for different kinds of goods vary considerably, some kinds being charged more in one country than other. The following table shows the ratios of the rates for different kinds of goods in each country:—

	Dutch.	Belgian.	German.	British
Minerals	— ...	1·000 ...	1·163 ...	1·082
Iron	1·000 ...	·967 ...	1·273 ...	1·956
Cutlery	1·000 ...	1·416 ...	1·144 ...	2·436
Saws and tools	1·000 ...	1·411 ...	1·144 ...	1·544
Hardware and machinery	1·000 ...	1·088 ...	1·248 ...	2·308
Cotton, wool, manufactures, &c.	1·000 ...	1·155 ...	1·216 ...	2·125
Food	1·000 ...	1·013 ...	1·230 ...	1·684

From this it appears that there is very little difference between the British and Continental rates for minerals, and that excluding these the greatest difference is in manufactured articles, and the next in foods and provisions. We give further on a description of the various tariffs, together with the tables, so arranged as to show the rates in the different countries with their ratios to each other. For cutlery, hardware, iron, minerals, saws, and tools, the rates are given in detail, and for the remaining articles the average of the several distances is taken. The railways of Holland and Belgium, amounting to not more than a fourth of those of England and Scotland, cannot be individually compared with the latter. The British railways must, as far as distance is concerned, be compared rather with those of Germany. The comparison in the report is confined to such distances as do not exceed the length of Holland or Belgium, and consequently do not, with a few exceptions, exceed 184 miles. It is to be regretted that more examples of longer German distances were not given, as there are complaints in that country of the mileage charges for long distances being very heavy, and that it is evaded by the use of special rates. In the case of goods in lots of less than five tons, the charges for long distances are high, being 2·10d. and 3·15d. a mile, according to space occupied. At this rate the carriage of goods under five tons from London to Edinburgh would be £3 15s. and £5 5s. a ton respectively.

In any comparison of the British and continental railways it must be clearly kept in view that the British railways are independent bodies, having no interests but that of their shareholders, under no obligations to the public or State, and in a legal view, though not a practical view, owners of a highway which all can use, and they are not compelled to carry goods or passengers. On the Continent the railways generally either belong to the State, or are so subject to its control that they can be worked as a whole, and any deficiency in one part balanced by the gain in another.

The Belgian railways are nearly 3000 miles in length; of this amount about three-fourths are in the hands of the State and the remainder worked by private companies. It is difficult to ascertain the amount of capital expended on the State railways, but so far from there having been a loss on their construction and working, after deducting from the receipts interest on money expended and payments to a sinking fund from the commencement, there is a balance of profit amounting to nearly four millions. The private lines, like nearly all on the Continent, revert to the State at the expiration of their concession. The proportion of expenses to receipts is on the State railway 60 per cent. and on the private lines 54½ per cent.

General merchandise, except that forwarded by passenger or van trains, is classed under four heads, and the traffic is composed of a terminal charge, which is generally 9·60 per ton, and a kilometric charge diminishing with the distance; five kilometres, or 3·16 miles, being charged in classes 1, 2, and 3 as a minimum. Class 1 consists of bale goods, china, fresh provisions, leather, machinery, and sugar. Class 2 consists of beer in barrels, cast steel, earthenware, glass, ornamental iron, wool and zinc. Class 3 consists of flour, forage, grain, lead ore, rolled steel, and zinc ore. Class 4 consists of coal, iron, manure, &c. The rates are:—Class 1: ·96d. per ton kilometre or ·621 mile for the first 75 kilometres, or 46·6 miles, diminishing gradually to ·384 per ton kilometre for distances over 124 miles. Class 2: ·768d. per ton, descending gradually to ·192d. per ton for distances over 124 miles. Class 3: ·576d. per ton as above, gradually diminishing to ·096d. per ton for distances over 78 miles. Class 4: ·576 per ton, descending to ·096d. per ton, but more rapidly than in Class 3; the terminal charge for the shorter distance in this class is 4·8d., or half that of the others. Goods belonging to the second and third classes, if in lots of less than five tons, are charged first-class rates, goods of the fourth class in lots of less than ten tons are charged the third-class rate.

For general merchandise a charge is made of 5d. per ton for loading and 5d. per ton for unloading where the work is done by the railway servants; the only other charges are 2d. per consignment for booking and 1d. for advice of arrival. There are numerous exceptions to the foregoing tariff, such as for coal and iron for export, and for the importation of certain minerals, but all are charged at mileage rates.

The Dutch railways are in length between 1300 and 1400 miles, and belong partly to the State, partly to private companies. All of them are worked by private companies, those belonging to the State being worked under an agreement by which the companies pay all the cost of the traffic and hand over a definite proportion of the receipts —usually 20 per cent.—to the State. The dividends received by the State and companies under this arrangement are 1·18 and 4·56 per cent. respectively. When the lines fail in the dividend received by the State will be greatly increased. The classification and charges in respect to goods is similar to that of Belgium. The rates are compounded of a terminal rate of about 1s. 4d. a ton, and a mileage rate diminishing with the distance. The only charges in addition are for loading and unloading goods in lots of five tons and upwards. The tariff is not to be relied on, the competition between the railways themselves as well as with water carriage leading to special bargains. The law compelling the companies to put all traders on the same footing appears to be evaded on the plea of conditions being unequal. There are some very low exceptional tariffs, chiefly for large quantities of goods carried in conjunction with the German railways. Competition between railway and water carriage in Holland is very severe, the length of navigable rivers being within 200 miles of that of the railways, and the length of canals a similar amount in excess of them.

The French railways, including those in course of construction, are about 24,000 miles in length. The entire system is very complicated; some lines are built by the State entirely, and others partially. In some cases the lines are built by private enterprise, and the State repays the money expended in annual instalments; but under whatever conditions made and worked, every railway becomes the property of the State in a certain number of years after completion. Thus the position of the companies is that they make what they can out of the roads, receive their capital back in instalments, so calculated that at the time their term of occupation ends they will have recovered their original capital with interest. The greater part of the French railways are in the hands of six or seven great companies, which work their traffic at different rates and on different principles. The trading classes are very discontented. Some think that the rates are unfair and unequal, others that they are too high, others that they press unfairly on local centres. An agitation has resulted in two of the companies revising their charges, and these new charges, being in some cases higher and in others lower than the old ones, have not given satisfaction. The tariffs are, the maximum beyond which the companies cannot go; the tariffs originally established below the maximum; the general tariffs and the special tariffs at cheaper figures. By a subtle combination of all these, the charges are raised to the maximum where there is no competition, and lowered where there is, the result being a complete chaos, in which it is impossible to discern the cause of difference between the charges of ·384d., ·576d., and ·748d. per ton and kilometre for the same articles on different sections of a net of lines. The same complaints are made as to differential rates, favouring foreign produce, terminals, &c., as in Britain. The rates, as far as they can be ascertained, are higher than those of Belgium, and probably higher than those of Germany. At the end of March a debate took place in the French Chamber of Deputies, which, except for the different circumstances of the two countries, was identical with that on the Railway and Canal Traffic Bill of the late Government. After a debate of fourteen days, the subject was referred to a Commission. This appears to mark a new departure in French railway legislation, so far as it transfers the chief responsibility to a Parliamentary Committee invested with the right to propose legislative measures on its own initiative.

The German railways are about 23,000 miles in length, nine-tenths of which belong to the States, and the remainder to private companies. The States constructed some of their lines and purchased others. The cost of the lines under State control was nearly £430,000,000. The net return on the cost of the construction of the railways in the hands of the State was 4·65 per cent. on the average, reaching in Prussia 5·09 per cent. After paying the guaranteed amounts to the shareholders of the purchased lines, and setting aside a small amount to a sinking fund, there is a clear profit to the State of 1 per cent. on the capital invested. The proportion of expenses to receipts is 56·11 per cent. The railways of Germany are nominally under the control of an Imperial Railway Board, but practically are subject to the laws and regulations of the different States. In Prussia the railways are under the Minister of Public Works. The Minister is advised by a Council of forty members, two of whom he nominates himself; eight are nominated by the Ministers of Agriculture, Commerce, and Finance, and thirty by the various cities and provinces of the kingdom—all holding office for three years. The Minister, assisted by this Council, decides on the general application and policy of tariffs, and the principles upon which differential and exceptional rates may be granted.

The actual direction of the railways is entrusted to eleven provincial Railway Boards, nominated by the Minister. These Boards are charged with the supply of rolling stock, all matters relating to conveyance and the regulation of local tariffs, claims for damages, and the superintendence of the railway servants. Each Railway Board is advised on questions of traffic by a district Council, composed of representatives of agriculture, commerce, forestry, and manufactures. The members of this Council are elected by the Chambers of Agriculture and Commerce, and hold office for three years. The Railway Board must consult the Council on all important questions affecting the traffic of the district, and especially on those relating to tariffs. These district Councils are acknowledged to be of great utility in adjusting tariffs, and preventing friction between the public and the railway authorities.

There is no special tribunal for deciding questions between the public and the railways; both are amenable to the ordinary courts. All complaints as to rates as well as damages are ordinarily referred to, and generally satisfactorily settled by the district Railway Boards, but complaints of this nature are few. A general tariff is now in force for the whole of Germany, and the rates can only be increased by a law of the Empire. All the railways are by law common carriers, and cannot refuse to carry any articles tendered them, except such as explosives, &c. The whole of the general tariff and of the regulations respecting goods traffic is contained in an octavo pamphlet of seventy-six pages. Alterations in the tariff are published in the local papers. All exceptional tariffs must be published in a handy form. No increase in an exceptional tariff can take place until after six weeks' notice of the change has been given.

Railways are obliged to forward goods from any station to any other station in Germany at through rates. Foreign produce is not carried between the same points at lower rates than native. The railways do not reduce their rates so as to compete with coasting steamers. The general tariff is founded on a compromise between the systems of Northern and Southern Germany. In the former the rates were fixed in reference to the value of the goods conveyed. In the latter the charge was proportionate to the space occupied by the articles and the mileage traversed. Goods are divided into seven classes. Numbers 4, 5, 6, and 7 comprise goods relatively low in value, and ordinarily carried in large quantities, and they include the bulk of the traffic. Classes 1, 2, and 3 differ from each other chiefly in weight.

There is a uniform charge in Class 1, of 2·10d. per ton mile for goods of every description in lots of less than 5 tons, subject to an increase of 50 per cent. for certain articles which occupy considerable space; Class 2, of 1·80d. per ton mile, for 5 ton loads of all goods not included in classes 5, 6, and 7; Class 3, of 1·16d. per ton mile for similar goods carried in 10 ton loads; Class 4, of 0·96 of a penny per ton mile for 5 ton loads of goods in classes 5, 6, and 7; Class 5, of 0·87 of a penny per ton mile for 10 ton loads of cotton, wool, articles of copper flour, glues, grain, hardware, machinery, tools, lead, paper, soda, various woods, zinc plates, &c.; Class 6, of 0·68 of a penny per ton mile for 10 ton loads of asphalte, earthenware, hewn stone, cotton, linseed cake, colours, iron and steel plates, pipes, rails, lead ores, flax, timber, vegetables, &c.; Class 7, of 0·50 of a penny per ton mile up to 62¾ miles, and of 0·43 of a penny per ton mile for greater distances both for 10 ton loads of food of the cheapest kinds, as potatoes, salt, manures, cattle food, raw materials used in manufacture, such as clay, staves, rough timber, esparto grass, straw, fuel—except in large quantities—building materials, iron, ores—partly manufactured, and pig, raw products, and waste animal products—as bones, charcoal, hoofs, &c.

Goods forwarded by passenger or van trains, if in quantities of less than 5 tons, are charged double the rate of No. 1; if in quantities of 5 tons, double No. 2; if in quantities of 10 tons, double No. 3. Perishable articles are forwarded by passenger and van trains, and charged No. 1 rate. The relatively high rates under tariffs 1, 2, and 4, are generally avoided by the intervention of forwarding agents who collect goods in small quantities, and make up 5 or 10 ton loads, and charge the consigner a little more than the 5 or 10 ton rate. In the mileage rates under classes 1 and 7 there is added a terminal charge varying from 1s. 2d. to 2s. 4d. a ton. All goods under Class 1 are loaded and unloaded by the railways free of charge. If the railways load and unload goods under classes 2 to 7 they charge 6d. a ton for each operation. Except the preceding there are no terminal charges whatever. Cartage is undertaken by the railways at published rates, varying in different localities; but the work can generally be done by carters at rates below those charged by the railways. In addition to the above there are certain exceptional tariffs, mainly for minerals in large quantities, at low mileage rates, but in some cases a uniform rate is charged between groups of places of production and consumption. There are also contract rates between Westphalia and Holland for coals, coke, and patent fuel, in quantities of not less than 200 tons a week. From collieries in Westphalia goods are conveyed for export, a distance of 226 miles, for 5s. 6d. per ton, or at the rate of ·292 of a penny per mile. This rate includes the charge for taking the wagons out of colliery sidings, which ordinarily is from 1·20d. per ton for the shortest distances, up to 3·60d. per ton for six miles. From Ruhrat to Kiel, 309 miles, pig iron is carried for 9s. 4d. a ton, or ·372 of a penny per mile. In all cases the tariff includes the use of trucks.

The principal conclusions arrived at are: "That the traffic in Belgium, Germany, and Holland is carried on under rates founded on intelligible principles. The charges for terminals are confined to loading and unloading, and a definite and very moderate addition, which is almost a corollary of the system of mileage rates. That in view of the close competition between this country and those of Northern Europe, our trade is in danger of suffering loss, unless our railway rates are promptly and thoroughly revised. That a more scientific base for railway charges may with advantage be adopted in this country. The present maximum tables may, to a certain extent, assist as a guide to classification, but would be misleading in all other respects. The construction of revised tariffs should be the subject of negotiation between the railway companies and the representatives of agriculture and trade, before being submitted to Parliament. That the Railway Commissioners should have and be bound to exercise greater control and direction over the railways than at present, for the protection of traders and the public."

With these recommendations all will agree. The railway companies acknowledge that the present system of goods rates is chaotic, unsatisfactory, and works injustice. The difficulty is, how to provide a remedy; and the longer the subject is delayed, the greater that difficulty becomes. The solution of the question seems to be either in the purchase by the State, or in amalgamating the companies into groups. But whatever settlement is arrived at, it is imperatively necessary that the railway companies be compelled to carry all goods tendered them, except such as are dangerous. To keep at each station a book showing the rates for all goods, from that station to every other that they book to, distinguishing between the amounts charged for conveyance and terminals. To be made to refund the amounts for over charges, and be liable for damages for the same. That the costs of legal proceedings be cheapened. Of these recommendations, the first is the most important. As long as the companies have power to refuse to carry, any amendment is hopeless and legislation useless.

Comparison for Equal Distances of Dutch, Belgian, German, and British Railway Goods Rates.[1]

Distances for Comparison.	Rates. Dutch.	Belgian.	German.	British.
Minerals—Coal.	d.	d.	d.	d.
Bestwood to Boston pr tn p. mile export	—	0·34	—	0·63
„ Lynn „ „	—	0·31	—	0·50
„ Boston „ „	0·76	0·75	0·69	1·21
„ Lynn „ „	0·60	0·55	0·59	0 79
„ Sleaford „ „	0 95	0·87	0·77	1 50
„ Grantham „	1·14	0·96	0 89	1·51
„ London „ „ (131 mls.)	0·47	0·36	0·52	0 52
„ Brighton „ „	0·44	0·31	0·49	0·40
South Yorkshire to Brighton „	0 44	0·32	0·49	0·39
„ to London „	0·48	0·37	0·51	0·51
Average	0·660	0·514	0·619	0 796
Ratio	1·000	·779	·938	1·206
	s. d.	s. d.	s. d.	s. d.
Plumptree Colliery to Wellingboro' pr ton	3 10	3 8	3 8	2 9
Shipley Colliery to Wellingborough „	3 10	3 8	3 7	2 7
Average	3 10	3 8	3 7½	2 8
Ratio	1·000	·957	·946	·696
Coal and coke—				
Adelaide Colliery to Newport in Cleveland .. .. per ton	—	2 0	1 8	1 5½
Etherley Colliery to ditto .. .. „	—	2 2	1 11	1 7¼
Copley Colliery to ditto .. .. „	—	2 5	2 1	1 10¼
Hedley Hope Colliery to ditto .. „	—	2 7½	2 4	2 0
Average	—	2 3½	2 0	1 8¾
Ratio	—	1·000	·873	·755
Coke—				
South Wales to Darlaston .. per ton	—	4 7	6 0	7 3
Hedley Hill Collieries to Frodingham „	—	4 4	5 6	6 10
Dodworth Colliery to Wellingboro' „	—	4 3	5 2	5 3
Thorncliffe Colliery to Wellingboro' „	—	4 1½	4 11	4 9
Howdon Colliery to Wellingboro' „	—	5 10	9 2	9 1½
Average	—	4 7½	6 2	6 7¾
Ratio	—	1·000	1 333	1·437
Iron ore—		d.	d.	d.
In the Cleveland district, average rate for transport for from 11-21 miles at per ton per mile	—	1·20	1·14	·71
		s. d.	s. d.	s. d.
Northamptonshire to Derby .. per ton	—	3 6	3 0	3 2
Ditto to Great Bridge (Stafford) „	—	3 8	3 3	3 2
Ditto to Sheffield.. .. .. .. „	—	4 0	3 11	3 9
Average	—	3 9	3 5	3 4½
Ratios	—	1·000	·911	·900
Limestone—				
Bishopley (Weardale) to Newport in Cleveland .. .. per ton	—	2 9	2 6	1 11¼
Baisley Hill to ditto .. .. .. „	—	1 10	1 8	1 4
Average	—	2 3½	2 1	1 7⅝
Ratio	—	1·000	·909	·718
Ratios for carriage of minerals	—	1·000	1·163	1·082
Iron, bar—	s. d.	s. d.	s. d.	s. d.
Brettel-lane to Liverpool (86 mls) per ton	8 3	6 8	8 8	11 0
„ Hull .. .. „	9 5	7 3	11 1	14 4
„ Paddington (143 mls) „	8 7	6 10	9 4	15 0
„ Manchester .. .. „	7 3	6 4	7 0	11 6
„ Nottingham .. „	6 6	6 1	6 2	10 0
„ Edinburgh .. „	—	—	18 8	20 0
North Staffordshire to Liverpool „	4 8	5 0	4 8	7 6
„ London „	8 8	6 4	9 10	13 4
Newcastle to Darlington (40 miles) „	3 4	3 10	3 1	3 9
Average	7 1	6 0½	8 9	11 10
Ratio	1·000	·853	1·235	1 671
Saws and tools—				
Sheffield to Hull, per ton, export..	6 0	8 9	6 7	13 0
„ Newcastle, „ „ ..	10 10	15 0	12 8	13 0
Average	8 5	11 10½	9 7½	13 0
Ratios	1·000	1·411	1·144	1·544
Hardware—				
Birmingham to Liverpool, per ton ..	10 4	12 9	10 0	19 4
„ London „ (113 mls)	11 3	13 11	11 4	23 6
„ Glasgow „	—	—	25 2	36 0
„ Edinburgh „	—	—	26 1	41 0
„ Manchester „	9 6	11 7	9 1	17 8
„ Plymouth „	15 3	19 10	20 1	37 8
„ Hull „ export	12 5	15 2	13 1	23 0
„ Newcastle „ „	14 10	18 11	18 7	25 6
„ Sunderland „ „	14 7	18 6	17 11	25 6
„ Hartlepool „ „	14 2	17 9	16 10	25 6
Average	12 9½	16 0½	16 10	27 5½
Ratios	1·000	1·254	1·316	2·146
Machinery—Agricultural:				
Banbury to London „ (78 mls.)	10 7½	10 8	11 10½	29 1
„ Lynn „	14 5½	14 5	17 5½	31 7
„ Shrewsbury „ (77 mls.)	11 8	11 8	13 1½	27 10
„ Liverpool „	16 6	15 8	20 6	39 6
„ Bridgwater „	15 7½	15 3	19 2½	37 5
„ Newcastle-on-Tyne ..	23 11	—	37 7½	58 3
Bedford to London „ (47 mls.)	7 5	7 9	8 6	20 4
„ Lynn „	9 7	9 3	11 11	24 11
„ Shrewsbury „	14 6	14 9	18 5½	36 2
„ Liverpool „	18 3	17 1	22 2	44 11
„ Bridgwater „	20 6	18 11	28 11	54 6
„ Newcastle „	22 0½	20 5	32 8	56 2
Average	15 5	14 2	20 2½	38 4½
Ratios	1·000	·919	1·311	2·489
Machinery—General:				
Leeds to Hull, per ton	5 6	6 8½	4 6	18 9
„ Newcastle „	8 8	9 8	10 1	12 10
Average	7 1	8 2¼	7 3½	15 9½
Ratios	1·000	1·156	1·029	2·229
Ratios of carriage for cutlery, hardware, &c.	1·000	1·193	1·220	2·209
Cotton, wool, manufactures, &c., china, and earthenware—	s. d.	s. d.	s. d.	s. d.
Average of five distances, per ton.. ..	6 3	8 0	8 3½	17 7
Ratios	1·000	1·280	1·326	2·813
Cotton—				
Liverpool to Manchester (31 miles), p. t.	4 2	4 6	4 2	7 2
Ratios	1·000	1·080	1·000	1·720
Cotton goods—				
Average of seven distances, per ton ..	10 11½	14 7	16 9	28 11
Ratios	1·000	1 331	1·529	2·639
Cotton yarns—				
Average of two distances, per ton.. ..	14 10	14 2	13 5	20 6
Ratios	1·000	·955	·905	1·382
Manure, including artificial manures, abroad—				
Average of six distances, per ton	2 2	2 2¾	2 1¾	3 1¼
Ratios	1·000	1·029	·990	1·433
Tallow—				
Liverpool to Manchester (31 miles), p.t.	3 11	4 6	5 4	7 11
Ratios	1·000	1·149	1·362	2·421
Wool—				
Liverpool to Manchester (31 miles), p.t.	4 2	4 11	4 2	9 2
Ratios	1 000	1·180	1·000	2·200
Woollen, worsted, and stuff goods—				
Average of eight distances, per ton ..	10 11½	14 7½	16 10	29 10
Ratios	1·000	1·338	1·537	2·722
Ratios for carriage of cotton manufactures, &c.	1 000	1 155	1·216	2·125
Food, &c.—Apples and pears—				
Average of six distances, per ton.. ..	8 0	11 4	13 8	16 1½
Ratios	1·000	1·417	1·708	2·016
Bacon and ham—				
Liverpool to Manchester (31 miles) p. ton	4 2	5 9	5 11	9 2
Ratios	1·000	1·380	1·420	2·200
Butter—				
Average of six distances, per ton.. ..	7 10	11 5	15 11	19 3½
Ratios	1·000	1·457	2 032	2·463
Cattle—				
Average of seven distances, per wagon	29 5	21 8	28 8	34 3
Ratios	1·000	·737	·974	1·164
Flour and grain—				
Average of ten distances, per ton.. ..	5 4	4 9	5 9	6 5½
Ratios	1·000	·891	1·078	1·211
Herrings—				
Edinburgh to Birmingham, per ton ..	—	—	24 10½	64 2
Ratios	—	—	1·000	2·579
Hops—				
Average of five distances (60 miles) p. ton	14 2	11 11	16 7½	31 10
Ratios	1·000	·841	1·174	2·247
Milk[2]—	d.	d.	d.	d.
Average of six distances, per gallon ..	·848	1·183	·570	·960
Ratios	1·000	1·395	·673	1·132
Oranges—	s. d.	s. d.	s. d.	s. d.
Liverpool to Manchester (31 miles) p. ton	3 11	5 9	6 6	9 2
Ratios	1·000	1·468	1·659	2·340
Oysters—				
Average of two distances, per ton ..	18 4	14 5	23 1½	30 6
Ratios	1·000	·786	1·261	1·664
Salmon—				
Average of two distances, per ton ..	—	—	1·000	1·317
Ratios	—	—	52 0	48 6
I on (pig)—				
Cleveland to Durham .. .. per ton	2 0	2 3	2 1	2 11
„ Leeds .. .. .. „	3 5	3 7	3 5	5 1
„ Manchester .. .. „	4 11	4 2	4 11	8 4
„ Birmingham .. „	6 11	6 2	7 10	11 3
Northampton to Sheffield .. „	4 2	3 11	4 5	7 2
„ Manchester.. .. „	5 0	4 3	5 2	8 9
Barrow to Birmingham .. .. „	5 8	4 7	6 1	10 9
„ Sheffield .. .. .. „	5 6	4 5	5 8	7 4
Kettering to Wolverhampton.. „	3 6	3 8	3 8	5 10
Wellingborough to „ .. .. „	3 8	3 9	3 11	5 10
Whitehaven to Tipton .. .. „	7 1	5 3	7 11	11 8
Barrow to „ .. .. „	6 1	4 9	6 7	10 6
Average	4 10	4 2¾	5 1¼	7 11½
Ratio	1·000	·875	1·060	1·645
Iron (wire)[3]—				
Birmingham to London, per ton (113 mls.)	8 2	8 11	9 7½	13 9
„ Liverpool „	7 9	8 6	8 7	15 6
„ Hull „	8 7	9 4	10 8½	21 3
„ Glasgow „	—	—	21 2¼	30 6
„ Manchester „	7 3	8 2	7 10½	13 6
„ Coventry „	3 3	3 6	3 1¼	6 10
Average	7 0	7 8¼	10 2¼	17 8¼
Ratios	1·000	1·498	1·446	2·529
Ratios for carriage iron.. ..	1·000	·967	1·273	1·9 6
Cutlery, hardware, machinery: Cutlery[4]—				
Sheffield to Newcastle, per ton, export.	14 10	15 1	12 8	20 6
„ Hull „ „	6 0	8 9	6 7	20 6
Average	8 5	11 11	9 7½	20 6
Ratios	1·000	1·416	1·144	2·436
Sugar—				
Average of seven distances, per ton ..	10 0¼	11 1¼	12 7½	14 0½
Ratios	1·000	1·108	1·258	1·401
Tea—				
Liverpool to Manchester (31 miles) p. ton	5 3	5 9	6 6	10 10
Ratios	1·000	1·095	1·238	2·063
Vegetables—				
Average of two distances, per ton ..	9 6½	10 2	13 3¾	19 5
Ratios	1·000	1·065	1·395	2·035
Ratios for carriage of food ..	1·000	1·013	1·230	1·684
SUMMARY.				
Ratios for carriage of minerals	—	1·000	1·163	1·082
„ iron	1·000	·967	1·273	1·956
„ cutlery, saws, and tools	1·000	1·413	1·144	1·990
„ hardware, machinery	1·000	1·088	1·248	2·308
„ cotton manufactures	1·000	1·155	1·216	2·125
„ food	1·000	1·013	1·230	1·684
Average ratios for all goods carried	1·000	1·100	1·200	1·725

[1] Many of the Dutch rates are subject to considerable reduction by special contract for export.

[2] Dutch and Belgian rates by goods train are much lower.

[3] The British and German rates are the mean between packed and unpacked. In Belgium and Holland no distinction is made.

[4] For small quantities the German rate is about double.

ELECTRIC LIGHTING IN THE LIVERPOOL INTERNATIONAL EXHIBITION.

THE Executive Council, in order to avoid the inconveniences that frequently arise from divided responsibility, decided to place the whole of the electric lighting of the building and grounds, including the provision of the requisite engines and boilers, in the hands of one firm. A limited number of tenders were invited for the work, and the lighting was finally entrusted to the Liverpool Electric Supply Company, and the work has been carried out in accordance with the plans prepared by Messrs. Holmes and Vaudrey, the managing engineers of the company.

It was decided to light the whole of the floor space of the buildings by arc lamps, and to place at the disposal of exhibitors who might wish to increase the attractiveness of their stands a number of incandescent lamps at a small rental charge—a privilege of which the exhibitors have availed themselves to a large extent, with considerable advantage to the general appearance of the Exhibition in the evening.

The steam power consists of twelve engines, made by Messrs. Marshall, Sons, and Co., Britannia Works, Gainsborough, driving the dynamos direct from the fly-wheels without counter-shafting, and of the following types. Three 30-horse power compound and three 20-horse power compound stationary engines, with the working parts beneath the boilers. Two 40-horse power compound separate stationary engines. One 14-horse power vertical engine, with grooved fly-wheel for ropes. One 10-horse power vertical engine. One 8-horse power vertical engine; and one 4-horse power vertical engine. The latter six engines are supplied with steam from three 40-horse power locomotive multitubular boilers, placed side by side as shown on page 243, working at 140 lb. pressure. The three 30-horse power stationary compound engines are each provided with two 10ft. diameter fly-wheels for driving two dynamos, with a suitable distance left between the wheels for getting on the driving belts. The fly-wheel end of the shafts has an outer bearing. These engines are supplied with firing platforms for convenience in stoking, as shown on the drawings. The three 20-horse power compound stationary engines are each fitted with one fly-wheel, but they also have outer bearings. All the underneath compound engines are of Messrs. Marshall's well-known and standard types, in which have been embodied every recent improvement for economising steam and for obtaining perfectly regular running under varying loads. They have steam-jacketted cylinders, the drains of which are each connected to a steam trap, and Hartnell's governor and automatic valve gear is applied to the high-pressure cylinder. Circular crosshead guides are used in lieu of slide bars. The crank shaft carriages have filling in pieces extending across the engine, and bolted to the channel iron girders on each side, thus making a thoroughly rigid job at this end of the engine where the power is given off. The crank shafts, connecting rods, piston rods &c., are of steel. New type sight-feed lubricators are applied to the high-pressure cylinders. The fittings on the boilers in each case consist of a double spring safety valve—Ramsbottom's—a lock-up safety valve, a steam blast pipe, and two gauge glasses.

Every boiler is supplied with a duplicate feed arrangement, consisting of a Blake's steam pump and one of Gresham and Craven's new automatic self-starting injectors, both of which are supplied with steam from one steam pipe, and the delivery from each is connected to a double check valve, the whole of the piping for the pumps and the injectors being of copper. The boilers are made of steel, with Bowling iron fire-boxes, and stayed for a working pressure of 140 lb. The foundation girders for the large engines are built up, consisting of strong plates and angle irons top and bottom rivetted to them, the rivets being countersunk inside for planing. The smaller engines have channel iron girders of very heavy section. Each underneath engine is entirely self-contained and quite independent of the others as regards feed-water supply, &c.

In addition to the six stationary undertype compound engines just described there are two 40-horse power nominal separate stationary engines without boilers mounted upon strong channel girders. Each engine has two fly-wheels driving two dynamos direct, the long end of the crank shafts being provided with outer bearings. These engines are fixed in close proximity to three 40-horse power high-pressure boilers as shown on the plan. These two engines and three boilers are equipped in exactly the same style as the undertype engine; the boilers, however, in this case being fed by a Pearn's double-cylinder vertical feed pump and by Gresham and Craven's automatic injectors. The main steam pipe A is wrought iron, with strong tee pieces arranged for supplying steam to the two compound engines and the four vertical engines, the bent branch pipes B leading to the various engines being made of copper. The main steam pipe is carefully drained and supported overhead by suitable columns. The exhaust steam from the two compound engines is carried overhead to a large vertical exit pipe C as shown, while the exhaust steam from the four vertical engines is carried underground by the pipe D and led into the same large exit pipe C. The four vertical engines are of Messrs. Marshall, Sons, and Co.'s standard type, in which all their recent improvements have been embodied. Each engine drives a dynamo. The twelve engines and nine boilers will readily develope 1000-indicated horse power when all in work. The whole of the arrangement has been thoroughly and very neatly carried out. The lubrication of all working parts and the proper draining of all steam pipes, cylinders, steam chests, jackets, &c., has been effectively achieved. The dynamos with one exception are driven by Oldfield and Walton's link belting, the largest Crompton dynamo, as described below, being driven by ⅝in. diameter cotton rope.

The arc lamps are of the improved type, manufactured by the Anglo-American Brush Company, which has also supplied the dynamos for running them. This part of the installation consists of two 50-light machines with the new laminated wrought iron armature, and driven each by a 20-horse power engine, and six 35-light machines driven by three 30-horse power engines, two dynamos to each engine. In the interior of the buildings there are 240 arc lamps divided into six circuits, so arranged that each portion of the building is lighted by at least two circuits, so that no portion would be left in darkness by the temporary stoppage of any one dynamo or engine. In addition to the above lamps, which are arranged in series, there are also in the building forty arc lamps arranged to run in multiple series from the incandescent lamp circuits. This plan of running arc and incandescent lamps on the same mains was introduced into Liverpool by Messrs. Holmes and Vaudrey more than two years ago in the Central Station Works of the Liverpool Electric Supply Company, and has been in successful nightly operation ever since. The grounds are lighted by seventy arc lamps arranged on poles 40ft. high, two lamps on each pole, and forming part of two separate circuits, so as to guard against any inconvenience in the event of the breakdown of either dynamo.

The incandescent plant consists of one 700-light and four 600-light Victoria Brush dynamos, and four Crompton dynamos, capable of supplying respectively 300, 200, 100, and 50 incandescent lamps. Of the latter machines the largest size is driven by rope gear, and is exactly similar to four other machines recently supplied by the Liverpool Electric Supply Company to the White Star Line for the steamers Britannic and Celtic. The smallest Crompton machine is provided to supply the powerful arc lamp which surmounts the full-sized model of the Eddystone Lighthouse in the gardens. The four Victoria dynamos are

THE ELECTRIC LIGHT AT THE LIVERPOOL EXHIBITION.

(*For description see page 242.*)

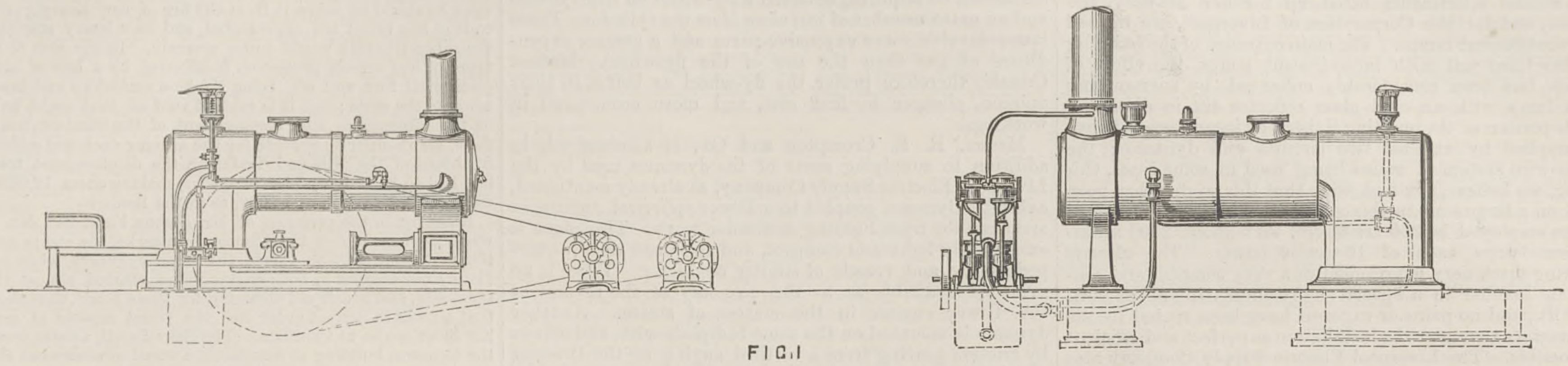


FIG. 1

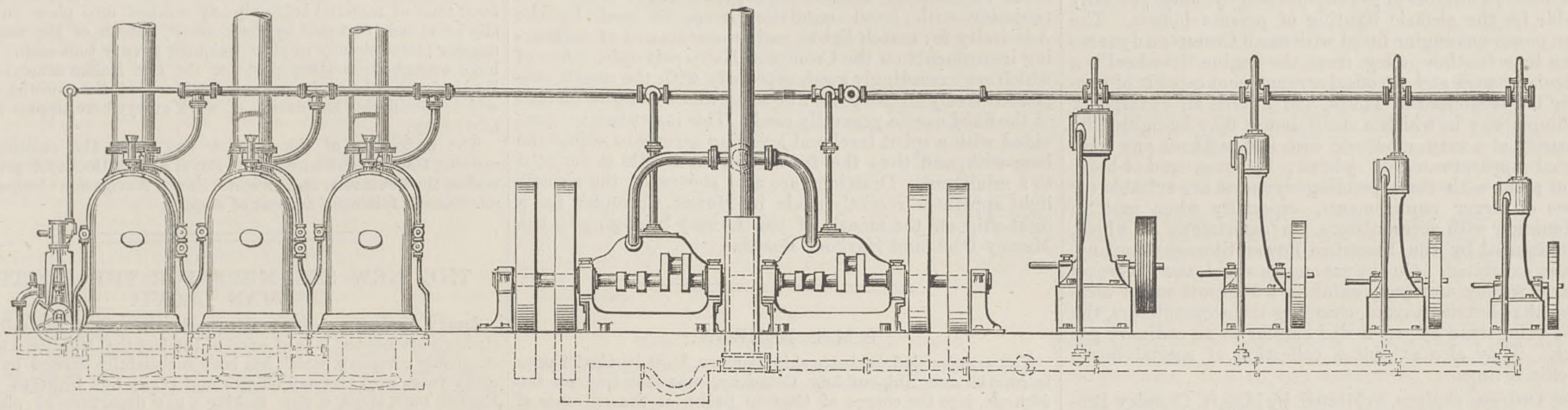


FIG. 2

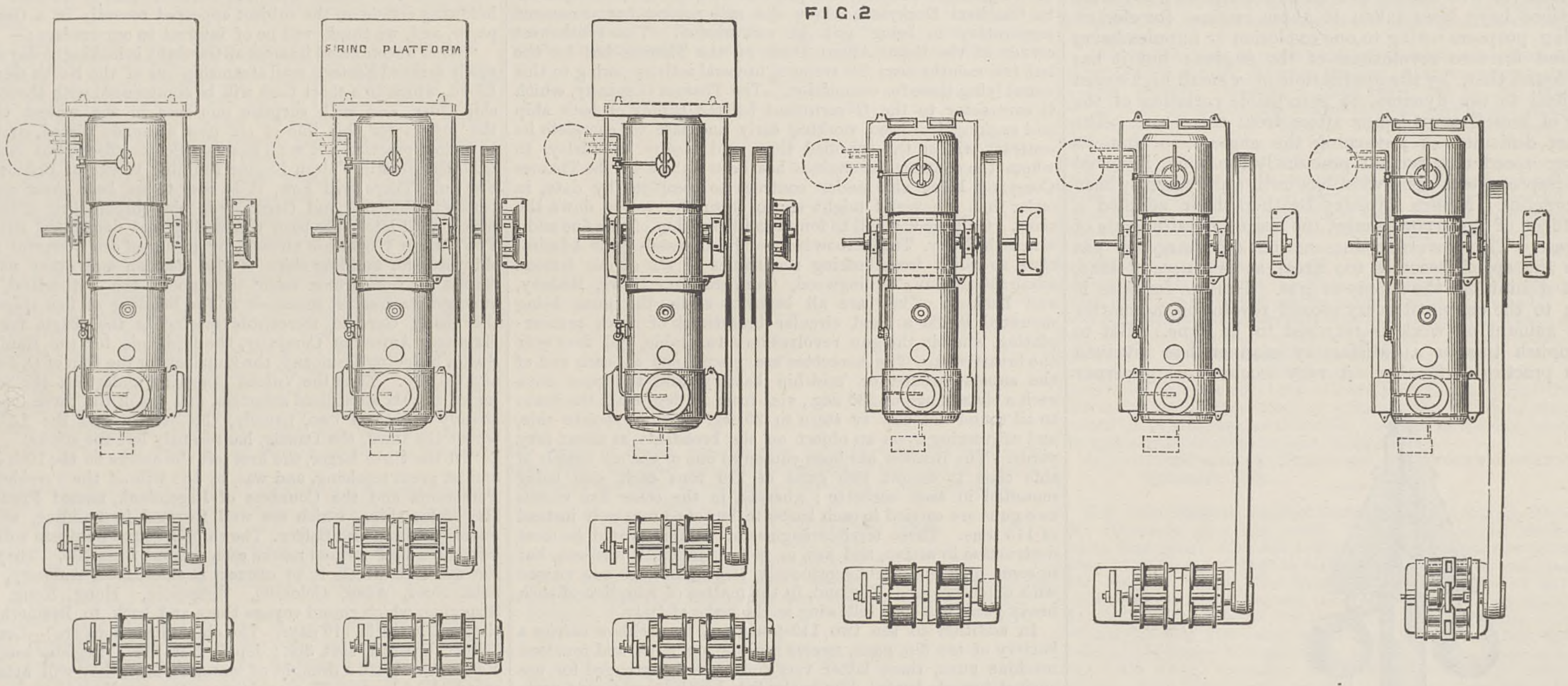
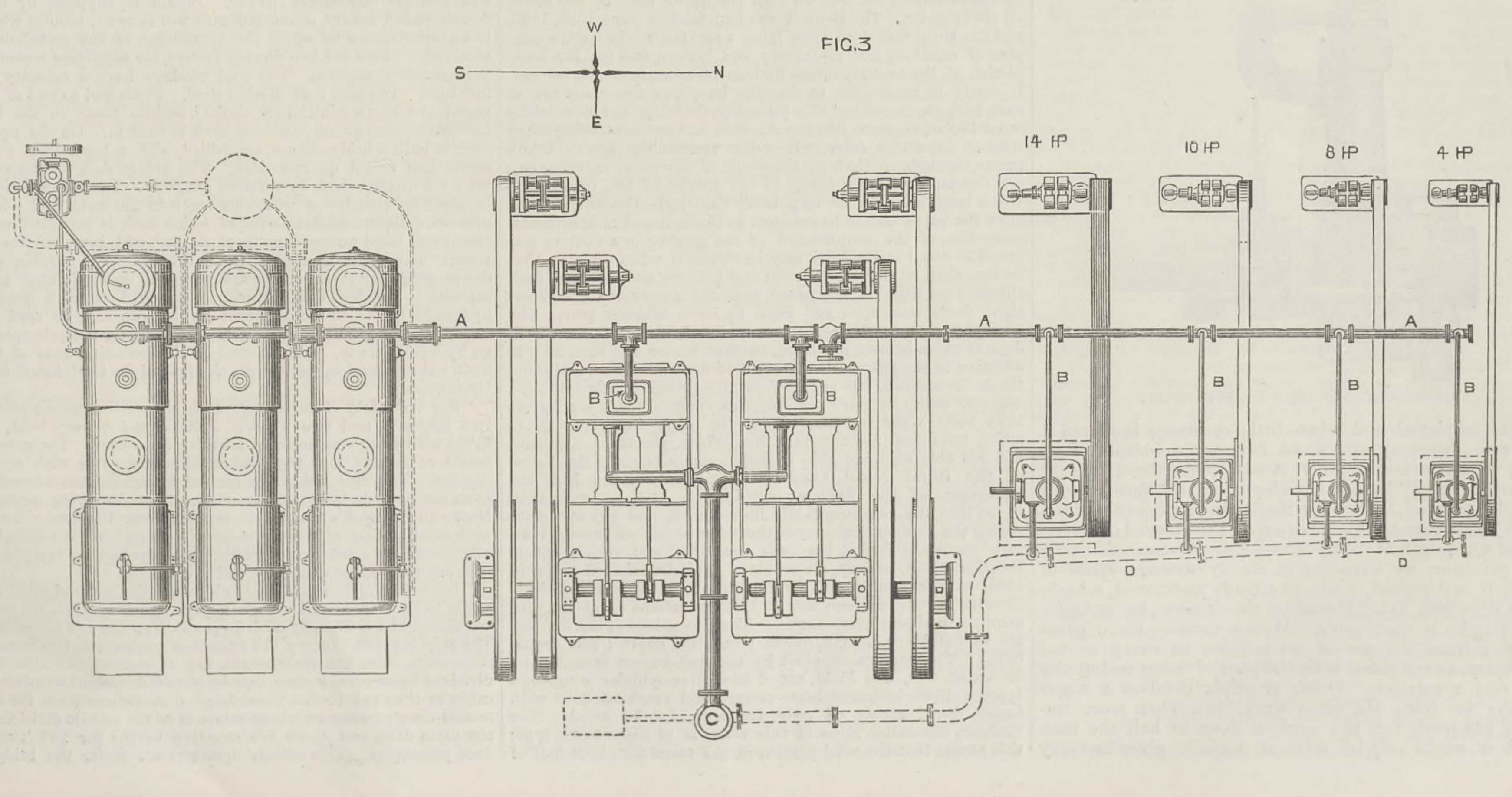


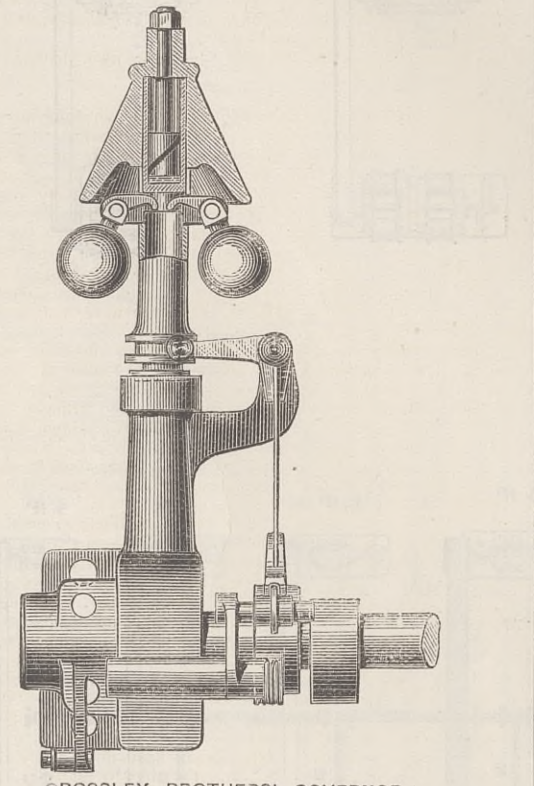
FIG. 3



driven by the two pairs of 40-horse power compound engines, the smaller machines being driven each by the vertical engines.

In addition to the exhibitors' stalls, the offices, refreshment-rooms, and interior courts of the building, including the special apartments fitted up for her Majesty the Queen, and for the Corporation of Liverpool, are lighted by incandescent lamps. The main entrance of the building is also lined out with incandescent lamps, the effect of which has been considerably enhanced by surrounding each lamp with an opal glass reflector 4in. in diameter. Each portion of the building lighted by incandescent lamps is supplied by at least two circuits and dynamos; the three-wire system of mains being used in some cases, this being, we believe, the first time that this system has been used on a large scale in this country. The total number of lamps employed is 350 arc lamps, and about 2000 incandescent lamps each of 16-candle power. The electric lighting machinery is arranged in a very compact and convenient manner in a special court measuring about 90ft. by 80ft., and no pains or expense have been spared by the contractors to render the installation as perfect and efficient as possible. The Liverpool Electric Supply Company also exhibits, in conjunction with Messrs. Crossley Brothers, of Manchester, a number of gas engines and dynamos specially suitable for the electric lighting of private houses. The 5-man power gas engine fitted with small Crompton dynamo driven by a friction pulley from the engine fly-wheel is a particularly neat and practical arrangement capable of supplying ten incandescent lamps, and affords an example of the simple way in which a small house may be lighted by electricity at a very moderate cost and without any complicated apparatus. The ½-horse, 1½-horse, and 4-horse sets of plant with corresponding dynamos are suitable for houses of larger requirements, especially when used in combination with accumulators, an assortment of which, manufactured by the Electrical Power Storage Company, are also exhibited. On the gas engine stand, the Liverpool Electric Supply Company exhibits a Ferranti meter measuring the electric current charging the accumulators, the result being read off on a dial similar to an ordinary gas meter. They also exhibit a collection of special house and ship fittings.

The Otto gas engines, exhibited by Messrs. Crossley Brothers, are too well known to require description; but some objections have been taken to these engines for electric lighting purposes owing to one explosion or impulse being required for two revolutions of the engine; but it has been found that, by the application of a small high-speed fly-wheel to the dynamo, no perceptible variation of the light of incandescent lamps arises from this cause. The further difficulty of governing the engine, so that its average speed may remain practically the same, involved some improvement upon what has until quite recently been the practice. Messrs. Crossley Brothers have adopted a new form of governor to meet the special requirements of the case. This governor does not cut off charges of gas when the speed becomes too great, as is generally done, but it diminishes the supply of gas. Thus an impulse is given to the engine at every second revolution, no matter what amount of work is required to be done. But to accomplish this in a satisfactory manner has involved much practical difficulty. A very isochronous governor



CROSSLEY BROTHERS' GOVERNOR.

must be employed, and when little resistance is offered it is apt to dance up and down from top to bottom of its range in an erratic manner, thus altering the charges at the wrong time. Messrs. Crossley have therefore applied a small oil cataract, as shown in the accompanying engraving, which has overcome this tendency. The stepped or sloped cam of Otto's patent being introduced in connection with this governor, an exceedingly steady average speed of engine is maintained, while, as already mentioned, a high-speed fly-wheel being placed on the dynamo, no variation in the light is discernible. Messrs. Crossley claim great economy from the use of an impulse in every second revolution, as compared with the plan of using an impulse for every revolution. Otto's principle involves a larger cylinder for doing the same work than when more impulses are used, but the work is done in half the time which it would require were an impulse given to every revolution; less heat escapes through the walls of the cylinder, the surface of the cylinder being less in proportion to its volume than would necessarily be the case if a smaller cylinder were used and an impulse given at each revolution. The choice therefore appears to be, if perfect steadiness be required, between a fly-wheel on the dynamo and an extra number of impulses from the cylinder. These latter involve more expensive parts and a greater expenditure of gas than the use of the fly-wheel. Messrs. Crossley therefore prefer the fly-wheel as being, in their opinion, cheaper in first cost, and more economical in working.

Messrs. R. E. Crompton and Co, of Chelmsford, in addition to supplying some of the dynamos used by the Liverpool Electric Supply Company, as already mentioned, exhibit a dynamo coupled to a Tower spherical engine, as arranged for train lighting or similar work. This plant is exceedingly light and compact, and has been used for torpedo boats and vessels of similar character. There is no evidence available as to the economy or the reverse of the Tower engine in the matter of steam. Another dynamo is mounted on the same bed-plate with, and driven by friction gearing from a vertical engine of the Browett and Lindley type, suitable for ship lighting. Among the other exhibits on Messrs. Crompton's stand there is a projector with hand regulator lamp, as used by the Admiralty for search lights, and an assortment of measuring instruments on the Crompton-Kapp principle, some of which are exceedingly good, especially with the needle suspended freely on one point like a mariner's compass instead of the fixed needle generally used. This instrument is provided with a spirit level and levelling screws to adjust the base with, and thus the friction on the needle is reduced to a minimum. Drawings are also shown of the electric light apparatus recently made by Messrs. Crompton for a light-ship off the mouth of the Mersey belonging to the Mersey Dock and Harbour Board.

H.M.S. BENBOW.

The armour-clad barbette ship Benbow, built by the Thames Ironworks and Shipbuilding Company, was delivered on the 26th ult. into the charge of Captain Buller at the entrance of the Royal Albert Docks, and proceeded in charge of that officer to Chatham Dockyard, where she will receive her armament preparatory to being put in commission. The south-west corner of the Royal Albert Dock, on the Thames, has for the last few months been the scene of unusual activity owing to this vessel lying there for completion. The Thames Company, which is contractor to the Government for the supply of both ship and engines, has been working early and late to complete its contract within the specified time, and Messrs. Maudslay, to whom the contract for engines has been sublet by the Thames Company, being also under contract to complete by date, in order that the vessel might steam from the works down the river. On page 250 will be found an illustration of this fine addition to the Navy. The Benbow is one of the six vessels of the Admiral class, so called from bearing the names of six of our famous admirals—Anson, Collingwood, Camperdown, Howe, Rodney, and Benbow. They are all barbette ships, the guns being mounted inside a fixed circular breastwork of thick armour-plating, wherein the gun revolves on a turntable, and fires over the breastwork. The barbettes are placed one at each end of the superstructure, or 'midship battery, and the guns have each a clear range of 230 deg., viz., from 25 deg. abaft the beam to all round the bow or stern to 25 deg. on the opposite side, and converging upon an object on the broadside at about fifty yards. The Benbow has been chosen as one of the six vessels of this class to mount two guns of 110 tons each, one being mounted in each barbette; whereas, in the other five vessels two guns are carried in each barbette, but of 63 tons only instead of 110 tons. These terrible engines of warfare would be most destructive in action, and are, in fact, formidable weapons, but in some quarters such enormously large guns are not viewed with much favour. England, in the matter of adoption of such heavy guns, has been following in the wake of Italy.

In addition to the two 110-ton guns, the Benbow carries a battery of ten 6in. guns, twelve rapid-firing guns, and fourteen machine guns, these latter very conveniently arranged for use against torpedo boats. She is also fitted with four torpedo ports on the broadside and one through the upper part of the stern, all above water. The Benbow was launched on June 15th, 1885, and has since that date been lying near the works for the purpose of receiving her machinery and boilers, and for the completion of the multitudinous fittings of a modern ship-of-war. It would be impossible to describe on paper the character of such fittings, including the pumping, draining, and ventilating some 180 separate compartments, each compartment being fitted with an automatic valve, where the ventilating pipe or trunk passes through, so that in the event of the water entering any one compartment, and rising to the height of the trunk—the trunk being assumed to be possibly damaged—the water would close the valve, and so be confined to the damaged compartment. Some idea of the complication of the gearing in a modern war vessel as fitted in England may be obtained when we state that no less than eighty-three water-tight doors and armour deck shutters are fitted in this vessel, in addition to eighty-five water-tight doors that open and close by hand without gear. The deck plates, to which indicators are fitted, showing when each door or valve is open or closed, amount to no less than 250, in addition to the automatic valves above named. Then, including the main engines, fan engines, pumping engines, electric-light engines, steam steering and capstan engines, there are no less than forty separate sets, all to be kept in proper going order, requiring all the care Mr. White, the chief engineer, and his able staff are able to bestow upon them. Mr. Yates, of the Royal Naval Corps of Constructors, has had the inspection of the Benbow, aided by a staff of assistants, to see that the company fulfils its contract, and any one comparing the Benbow with any of the sister vessels will see that the full "pound of flesh" has been demanded and readily given, the Thames Company, ever since it built the Warrior in 1861, having maintained its reputation as builders of first-class naval constructions, and to this day retains its oldest connections in almost every nation. The dimensions of the Benbow are as follows:—Length, 330ft.; breadth, 68½ft.; and depth, 37ft. The engines supplied by the well-known firm Messrs. Maudslay, Son, and Field, are of the three-cylinder compound type, of 7500 indicated horse-power, and reaching 9000 with forced draft, giving an estimated speed of 16 knots. The Benbow, like other ships of this class, is of the citadel type; this means that the vital portion of the vessel for about half of her length is protected by being included in an iron box armoured with 18in. plates on the side, the top of which at full draft is 2¼ft. above and 5ft. below water, giving a total depth of 7¼ft. The athwartship bulkheads forming the two ends of the citadel are 16in. thick; before and abaft these there is an armour deck of 3in. steel-plating. Except for this steel deck, which is calculated to shield all below it from the fire of very heavy guns, the ends of the vessel are unprotected, and in a heavy engagement the superstructure would suffer severely. In the case of other types of war vessels protection is afforded by a belt of armour plating all fore and aft, being thickest amidships and tapering towards the ends; but it is evident that all that could be done on the dimensions and displacement of the Benbow has been done, for in order to provide for the armour deck and additional freeboard of the Nile and Trafalgar, the displacement tonnage has had to be increased by 2000 tons, making them 12,000 tons displacement instead of 10,000, as in the Benbow.

Recently, in the presence of Mr. Joshua Field and Mr. Hayward, the manager of the Thames Ironworks, the steam was for the first time admitted into the huge cylinders, when immediately the engines in both engine-rooms started almost simultaneously, and continued steaming for three hours, thus showing that all was in perfect order and the vessel capable of making her short cruise to Chatham. The Sans Pareil, a sister vessel to the Renown, building at Newcastle, a vessel of somewhat similar dimensions to the Benbow, is making rapid progress at these works, and is to be launched in the spring of next year; some 3000 tons of material being already worked into place on the slip previously occupied by the Benbow, sixteen of the massive armour plates already in place weighing twenty tons each. The huge wrought iron stern post for the new Italian armour-clad Re Umberto is being forged and machined at these works also, which, considering the dearth of work everywhere, appear to be fairly busy.

The undocking of the Benbow was made the occasion of opening the new entrance to the Royal Albert Docks for general traffic, the Peninsular and Oriental Steam Navigation Company's s.s. Massilia following her out of dock.

THE NEW STEAMERS FOR THE NORTH GERMAN LLOYD.

If any further warning to our workmen against the folly of strikes were needed it is at hand in the fact that this well-known steamship company, which has been successfully carried on for many years with German officers and crew, but hitherto with English built ships, is now making a new departure by placing its orders for vessels with the German firms at Stettin. The following article on the subject appeared recently in a German paper, and, we think, will be of interest to our readers:—

"With unconcealed interest all Germany is looking to-day at the newly arrayed Eastern mail steamship line of the North German Lloyd, which in a short time will be commenced with the steamship Oder, and with surprise one sees in the widest circles the orders for this line of six new steamers placed, contrary to former practice, not with English (Scotch) firms, but ordered from the Stettin Vulcan Engine Building Works of Bredow-by-Stettin. There will now, it is easy to see, be a great rivalry between England and Germany in the shipbuilding industry, which until lately has been the undisputed domain of Britain. The Vulcan Works has already, by means of its powerful navy shipyards for building ships of the German and other navies, earned an honourable name throughout the Fatherland, and amongst its greatest successes is the building of fine ships for the rising German mercantile marine, as the Rugia for the Hamburg-American Company, the Iphigenia for the Hamburg Steam Shipping Company, the Zanzibar for the firm of O. Swatel and Co., &c. Thus the Vulcan Company undertook the building of the six subsidised steamers, and has of the three smallest already delivered two, namely, the Stettin and the Lubeck, whilst the third, the Danzig, has recently left the stocks.

"Of the three larger, the first left the stocks on the 10th July, amidst great rejoicing, and was, by the wife of the President of Pomerania and the Countess of Regendank, named Preussen. Her sister ships, which are well forward in building, will be named Sachsen and Baiern. The ships in round numbers will cost two and a-half million marks each—about £125,000. They are for the line which is to connect Bremerhaven, Antwerp, Port Said, Suez, Aden, Colombo, Singapore, Hong Kong, and Shanghai, which round voyage there and back to Bremerhaven they will make in 110 days. The chief dimensions are:—Length, 390ft.; breadth, 45ft. 3in.; depth, 33ft. 6in. Register tonnage, 4000 tons. With a draught of water of 20ft. they will attain a speed of 14 knots. The engines are three cylinder, compound, and indicate 3500-horse power. Steam is supplied by four double-ended boilers, connected with two funnels, around which is an outer casing by which the ventilation of the stokehole is attained. There are two donkey boilers for supplying steam to the auxiliary engines. The coal bunkers have a capacity for 900 tons. The hull is of Martin steel. From end to end of the vessel are three continuous decks; besides these, in the two forward compartments, an orlop deck is built in. On the upper deck is built a bridge house amidships, with a top-gallant forecastle and raised quarter deck. The bridge deck is connected with the quarter deck by a raised gangway. The ship is divided by eight bulkheads—of which six reach to the main deck—into nine watertight compartments, of which each is provided with steam and hand pumps capable of dealing with large volumes of water. Cargo will be carried in four holds. For loading and discharging four steam cranes are provided, each of three tons capacity; besides these there is attached to each part a hydraulic hoist—Brown's patent—which can also be used for cargo. This appliance, which acts somewhat on the principle of an hydraulic crane, is also fitted to the reversing gear of the main engines, and is, we believe, the first of its kind fitted in a German ship.

"For the safety of passengers each ship will carry six patent iron lifeboats, and two wooden cutters, and a jolly boat, all fitted with Brun's patent boat-lowering apparatus. The ground tackle consists of four powerful anchors and cable with steam capstan. The side lights are carried in lighthouses accessible from the spar deck in bad weather. Steam steering gear, on Muir and Caldwell's patent, is worked from the bridge-house with mortice gear wheels to deaden the vibration. We question whether this is a safe arrangement, unless springs are introduced between the rudder quadrant, and the chains.

"Between the forecastle and bridge are the covered stalls for cattle to be slaughtered on the voyage; beside which are well-ventilated and artificially cooled provision rooms and ice cellars. The ship is fitted to carry 118 first-class passengers, two in each state-room, and the state-rooms are so constructed that the divisions between any two can be removed and a large family cabin be thus provided. There is good accommodation for the second-class passengers, whose saloon is in the middle division of the main deck, and there are standing berths for 200 'tween deck passengers. The officers' quarters are under the bridge-house, where also the galley, bakery, and engineers' mess-room is situated. Besides the principal galley where food for 300 persons can be prepared, there is under the forecastle deck a steam galley and kitchen; twelve bath-rooms, and four lavatories are provided for passengers, and for the ventilation of cabins and saloons exhaust ventilators are fitted, in addition to which there is a ventilating fan in the engine-room which supplies fresh air to the whole ship through pipes; 340 incandescent lights illuminate the cabins and entire ship, and oil lamps are also provided as a stand by. In a deck-house on the bridge-deck are a smoking saloon and ladies' saloon, between which are the companion stairs to the main saloon.

"The whole of the fittings and decorations of the saloons and cabins is being done by the Vulcan Company, after designs by J. G. Poppe, of Bremen, the materials being supplied by the same firm who fitted the North German steamers, Travi and Aller, recently built on the Clyde. The vessels are being rigged with four yards on fore and main masts; the fore yards are fitted with Pinkney and Collings' patent reefing attachments. Each mast is fitted with lightning conductors with platinum point and gilded dog vane, and copper wire cable leads."

From the foregoing description it is evident that it is the intention of the management to leave no important improvement untouched, and in every way to be equal to the best practice in ship construction and equipment."

WEST GLOUCESTERSHIRE WATERWORKS.

On Saturday last these waterworks were opened for the supply of the district over which the West Gloucestershire Water Company has obtained Parliamentary powers. This district comprises several populous parishes in the southern and western portions of the county of Gloucester, together with a large urban area forming part of the northern and eastern suburbs of the city of Bristol, and the whole of the Bristol coalfield lying to the north of the river Avon, in which large additional discoveries of coal have recently been made, and which is now in course of active development. The present population is between 35,000 and 40,000 people, which is rapidly increasing, especially in the neighbourhood of Kingswood Hill, a district which for the most part lies compactly and well suited for economic supply, and has hitherto suffered very acutely from a chronic state of water famine during the summer months of each year.

The source of supply is a deep-seated spring situate on property acquired by the company at Frampton Cotterell, a populous village situate about ten miles to the north of Bristol. This spring is practically inexhaustible, its yield having been proved some years since to be no less than three million gallons a-day, and the quality of the water is pronounced by Dr. Frankland, F.R.S., to be "very excellent for all dietetic and domestic purposes."

The water is raised from a well situated on the company's property at Frampton Cotterell, by a waterworks pumping engine, constructed by Messrs. Gimson, of Leicester. The water is in the first place lifted from the well into a surface reservoir over an aërating waterfall, which, when the engine is at work, forms a noticeable and very attractive object, and it is forced thence through a line of 10in. main pipe, about six miles in length, into a tank fixed on the top of a water tower on elevated land belonging to the company at Kingswood Hill, near Bristol. The overflow level of this tank is 270ft. above the surface of the ground at Frampton Cotterell, where the pumping engine is situate, and is of sufficient elevation to supply the whole of the company's district and other surrounding places by gravitation. The tower is an ornamental erection of red and blue brick, and is between 50ft. and 60ft. in height, and octagonal in shape, and is roofed over with a timber and slate roof, finished with an ornamental finial. The tank is of wrought iron, and is capable of holding about 25,000 gallons, and is fitted with a self-acting check valve, which, when the tank is full, closes automatically, and warns the man in charge at the pumping engine at Frampton Cotterell, six miles away from the tank, by raising a relief valve over the well in the engine-house, that the tank is full.

The engine—which it is proposed shortly to duplicate—works with great smoothness, and is capable of delivering between 500,000 and 600,000 gallons a day; and, as showing the immense quantity of water which the company has at its command, it should be stated that when the engine is pumping at the above-named rate the water is only lowered 15ft. out of a total depth of 360ft. in the well.

The works have been carried out in a satisfactory and substantial manner, and at a moderate cost, by the contractors, Messrs. John Howard and Co., of Basinghall-street, London, from the drawings and specifications, and under the superintendence of Mr. Henry J. Marten, M. Inst. C.E., Westminster, the engineer to the company. The pipes were made for the most part by Messrs. J. and S. Roberts, of West Bromwich, and although in some parts of the line of main pipe they are subject to a pressure equal to a column of water 350ft. high, only five pipes gave way out of the 4000 pipes composing the main, and notwithstanding the great pressure to which they are subject, they have been so carefully laid that there has not been a single leaky joint.

The work of laying the branch and subsidiary mains is now proceeding rapidly, so that in the course of a few weeks the directors of the company, of whom Major Rasch, M.P., is chairman, hope to be supplying water to a large number of the inhabitants.

The opening of the works was the occasion of great rejoicing at Kingswood Hill, where the dearth of water has been very great, and much interest was shown when a jet of water was thrown from a hose and nozzle clear over the adjoining houses.

LETTERS TO THE EDITOR.

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

A NEW ILLUMINANT.

SIR,—I am much interested, as indeed must be many of your readers, in the extract or *résumé* you give of Mr. J. R. Wigham's paper, "A New Illuminant for Lighthouses." It states that gas after being enriched by some solid hydrocarbon is "made to produce intensely white light by compressed oxygen," and that this oxygen is used at a pressure of about 1000 lb. to the square inch. Further, that the cost of this new illuminant is but little over that of ordinary gaslight, for the application of oxygen is only made on the occurrence of fog." Now, this is certainly the funniest reasoning I ever heard of. As well might one say that the cost of Chateau Margaux is but little over that of ordinary claret, because it is only drunk on the occurrence of a dinner-party! I do not for an instant suggest that the expense may not be warranted, but it will not be arrived at by estimating that "there are not on an average many hours of fog in the year." It would be instructive to be told what consumption of oxygen would be applied to the 429-candle power consuming 50ft. of gas per hour, and what additional candle-power results. Then we require to know what is the cost of the oxygen per 1000ft., and the cost and means of applying it at a pressure of 1000 lb. on the square inch; also what is done with the heat generated by an oxygen blow-pipe of such enormous power. It seems, however, as if we should read that the compression is simply for economy of transport and storage, in which case it may be assumed that the oxygen arrives at the point of combustion at about the same pressure as the gas burnt with its aid. Used thus, and in proper proportion to the combustible gas, there is no doubt that a very considerable increase in lighting power can be obtained, but what increase and at what cost are the points that need elucidation. The recent wreck of a pleasure steamer in a fog on this coast lends an additional interest to the subject, and I trust that we may be favoured with the information I have asked for in your columns. PRACTICE.

Bournemouth, September 18th.

SUSPENSION RAILWAYS.

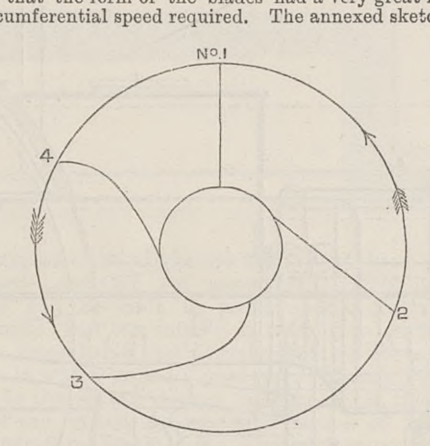
SIR,—In asking you to publish the following notes on the history of suspension railways, I trust that I shall not be understood to impugn the ingenuity shown in the design of the Lartigue railway, nor the novelty of any of the details.

As far back as the year 1821 a patent for a railway upon this principle was granted to Mr. Henry Robinson Palmer, and the inventor published a pamphlet describing the system in 1823, a second edition appearing in the following year. In 1825 an experimental line, nearly a mile in length, was erected at Cheshunt, in Hertfordshire, for the purpose of conveying bricks to the river Lea. An account of the railway may be found in the *Mechanics' Magazine*, vol. iv.—1825—287, 340. In 1829 the subject was taken up by a Mr. Maxwell Dick, a bookseller, of Irvine, N.B., who also obtained a patent, and in the following year he published a further explanation of his invention in a pamphlet, some extracts from which appeared in the *Mechanics' Magazine*, vol. xiii., pp. 257, 299. I am not aware that the idea went any further than a model, which was exhibited in a room near Charing-cross in the year 1830. The subject seems to have attracted attention in America, and in 1834 an article was published in the American *Railroad Journal*, quoted in the *Mech. Mag.*, vol. xx., p. 369, claiming priority over Palmer for Henry Sargent, of Boston, but without giving dates. The writer states that two or three experimental lines had been put up, and that one on a larger scale was then in course of construction at East Boston. A few years later Uri Emmons took out a patent in America for some improvements in the details of Palmer's railway, and the specification may be found in the *Mech. Mag.* for 1837, vol. xxvii., p. 393. HISTORICUS.

London, September 17th.

THE EFFICIENCY OF CENTRIFUGAL PUMPS.

SIR,—The reason given by your correspondent in No. 1602 of the reason why the circumferential velocity of centrifugal pumps does not need to attain the value $\sqrt{2gh}$ may be one reason, but not the only one. About 1856 I carried out a series of experiments to determine the best forms and proportions of centrifugal pumps, and found that the form of the blades had a very great influence on the circumferential speed required. The annexed sketch shows



the forms of blades experimented on; the total lift was in all cases 45ft.; the inner and outer diameters of the discs as 1 and 3.

To hold the water at this height but without any discharge.

No. 1 required just $\sqrt{2gh}$.
No. 2 ,, considerably more.
No. 3 ,, still more.
No. 4 ,, $0{\cdot}82 \times \sqrt{2gh}$.

No. 4 form was the best in every respect, and I continue to use it from the time the experiments were made to the present day.

Pozzuoli, September 17th. C. BROWN.

AN OPTICAL PROBLEM.

SIR,—In the Liverpool Exhibition are certain silvered glass reflectors for search lights. These are not parabolic, but segments of a very large sphere. The reflectors are about 2ft. in diameter.

Standing about 10ft. from one of these, I see my own image slightly reduced projected in front of the mirror, and standing half-way between me and the mirror.

In the ordinary plain mirror the image always appears to be behind the mirror at the same distance that the individual stands in front of it. With the search light reflectors the case is reversed. At almost all distances the image appears suspended in the air half-way between the observer and the mirror.

Can any of your readers kindly explain the cause of this phenomena? I have failed to find any reference to it in two or three treatises on light and optics which I have consulted.

Liverpool, September 14th. LUX.

MIXED TRAINS.

SIR,—Mr. Stretton knows a great deal about railways, but he does not know everything. If he did he would not have written what he did last week.

He contends that passenger coaches in mixed trains ought to go next the engine, for one principal reason because automatic brakes can be used. If Mr. Stretton had any experience in mixed trains he would know that there are seldom more than three, more often only two, passenger coaches, and all the brakes can if necessary be applied to the coaches by a single guard. Mr. Stretton also thinks that passenger coaches are run with coal trains. This is an error; but let us suppose that Mr. Stretton is right. We have a train of an engine and tender, three passenger coaches, a guards' compartment being in one of them, and behind these twenty loaded coal trucks and a brake van. Does Mr. Stretton seriously mean to assert that any driver dare use his automatic brakes in such a train? Fancy such a train coming down an incline at thirty miles an hour, and the brakes put on. The passenger coaches have yet to be built that would stand the resulting shock. Even without the automatic brake at all, the squeezing which the coaches would get between the coal trucks and the engine is something serious to contemplate.

Mr. Stretton must have a very exalted idea of the value of automatic brakes if he fancies that two passenger coaches braked more or less would have any value worth mentioning in a coal train weighing 300 or 400 tons.

The concluding paragraph of Mr. Stretton's letter is delicious. He might just as well have said that the passengers would have been quite safe if they had stopped at home. In this particular accident there was only one passenger coach. Will Mr. Stretton venture to affirm that this coach would have been safer next the tender than it was at the other end of the train? Does he know that Major Marindin in his report makes no suggestion that the passenger coach was in the wrong place?

The contention that wheels and axles are more likely to come off and get in the way of the passenger coaches at the back instead of at the front is beyond me.

It is very easy for Mr. Stretton to say that mixed trains ought not to be run. This is another illustration of his ignorance of the entire subject. Mixed trains are run because the companies running them cannot afford to run separate trains; and the general public are quite content with the result. I may mention one line, of about thirty-six miles long. Over this there are run every day two passenger trains each way, and one goods train. The passenger trains run in the morning and evening, about ten hours apart. The goods train runs in the middle of the day, and to it are attached one third-class coach with a guard's compartment, and one first and second-class composite. The passenger trains stop at all stations, and take an hour and a-half to make the trip. The goods train occupies two hours, and the addition of the passenger coaches has been regarded as a great boon, and the coaches are well filled. If Mr. Stretton had his way, there would be only two passenger trains each way in the day.

Traffic managers may be allowed to know their business quite as well as the officers of the Board of Trade. C. R. I.

London, September 21st.

WATER-SOFTENING—COST OF MAIGNEN'S PROCESS.

SIR,—I regret to see that Mr. Maignen in no way replies to my letter in your issue of 3rd September, but takes a great deal of trouble about affairs which do not concern him. Your estimable paper, Sir, is not, I presume, intended to discuss matters of law relating to agreements, and I decline for obvious reasons to enter into the discussion of a question which has not been raised by the parties interested. The competence of Mr. Maignen is much more limited than I anticipated, and I most decidedly object to be taught by him on matters relating to engineering or water-softening, and before offering any criticism on my letter, he should get some one to read it correctly for him. His remarks about corroded and choked up pipes prove his knowledge of chemistry and mechanics to be very limited; in any case this remark does not apply to my process.

My patent specification was drawn by Mr. Aston, Q.C., and I leave your readers to judge whether he or Mr. Maignen is the most competent authority. Anyone endowed with ordinary intelligence can see by examining my process that the principle is entirely different from all others. If Mr. Maignen considers himself competent, let him read your article on my apparatus in your issue of 21st May last. Mr. Maignen thinks that by throwing some of his anti-calcaire powder into the eyes of your readers that they will be satisfied that his process stands alone for excellency, efficacy, and cheapness. It is all very well for him to offer "all information" to those who may call at his office, but he should have considered this before throwing himself into print, and saying his process will cost one-half of any other in existence. He has defied all of us publicly, and he must now prove publicly that he is right, or apologise.

As THE ENGINEER is much read on the Continent, I considered it my duty to ask Mr. Maignen the cost of his process, which I did, I hope, politely, expecting a polite reply; but no, Mr. Maignen seems to be differently constituted to most people, and refuses to give the information of which he boasted so much. Such being the case, we can only turn to his circular, where we find a 6d. tin softens 300 gallons—that is to say, Maignen's anti-calcaire powder softens 1000 gallons of water at an expense of 1s. 8d., as compared with something under 1d. by my process. This fancy-named anti-calcaire is nothing else than lime, soda, and alum; if bought at the market prices the cost per 1000 gallons would not be more than one penny. Mr. Maignen, however, no doubt on account of the fancy name, adds 1s. 7d. for every 1000 gallons of water softened. Mr. Maignen again says, "Why choke up the drains with what I have proved can be utilised with advantage?" This is what I asked him in the first instance; prove to us what you can do, it is not sufficient to say so; give us the expense per 1000 gallons of water softened by your process, certified to by some competent authority. I don't agree with Mr. Maignen. I think your valuable space could not be more profitably employed than by discussing the cheapest mode of softening and purifying water for steam boiler purposes, as this is the question of the day, and must be specially interesting to your readers.

46, Boulevard Anspach, Brussels, ANDREW HOWATSON.
September 18th.

SIR,—Mr. Maignen does not seem to have the courage for which Mr. Howatson gave him credit. His letter does him much more harm than good; if he has really confidence in his new patent, it must be to his advantage to make it as widely known as possible. Mr. Maignen should also be careful not to contradict any one unless he himself is beyond contradiction. I have tested the Lambeth water, and I find it as Mr. Howatson says, 14 deg.—Wanklyn's soap test—and by adding 8 per cent. of lime water, I reduced the degree of hardness to 4½ deg. If Mr. Maignen makes the Lille water, according to Clark's scale, 21 deg. instead of 30 deg., what degree is the purified water which, according to Mr. Howatson, is 4 deg?

Do I understand Mr. Maignen to say—taking the Lille water as an example, as we leave the analysis before and after the purification by Mr. Howatson's machine—that he can by his new patent soften the Lille water from 30 deg. to 4 deg., by utilising the precipitate or deposit found in the bottom of Mr. Howatson's machine? If this is so, will he explain the chemical reactions which take place? In order to test the expense of the anti-calcaire, will Mr. Maignen say how much I must employ to reduce the Lambeth water from 14 deg. to 4½ deg.?

I can now see the expense of lime and soda for the softening of water is very very little, and the reason some system is not universally adopted is because the patentees are too exorbitant for their machines. Lime is cheap enough and can be got everywhere, and if Mr. Maignen can purify and soften water by the impurities contained in such water, this is certainly a cheaper and easier process; but if Mr. Maignen puts on a profit in the same proportion as he does for his anti-calcaire, it will again be out of the reach of the public. Dr. Clark forty years ago invented a process of softening water by lime. Mr. Maignen to-day sells anti-calcaire, which is little else than the process of Dr. Clark. So long as patentees are so greedy, the public will not patronise them.

Dr. Clark's process may be taken as the basis of all the softening processes in existence, and we all know that by adding a certain quantity of lime to the water we precipitate the lime in solution and produce a soft water, but to do this in large and continual quantities an enormous space is necessary, as the water being treated must be kept quiet in order that the clarification may take place and the precipitate fall to the bottom. If a simple, cheap, and efficient machine is put in the market to overcome the above difficulties, it is the interest of all steam boiler owners, dyers, and others, to soften and purify the water before use; but they must see their way to recoup the expense of plant, and have a substantial profit. I enclose my card. AN ENGINEER.

Clapham, September 20th.

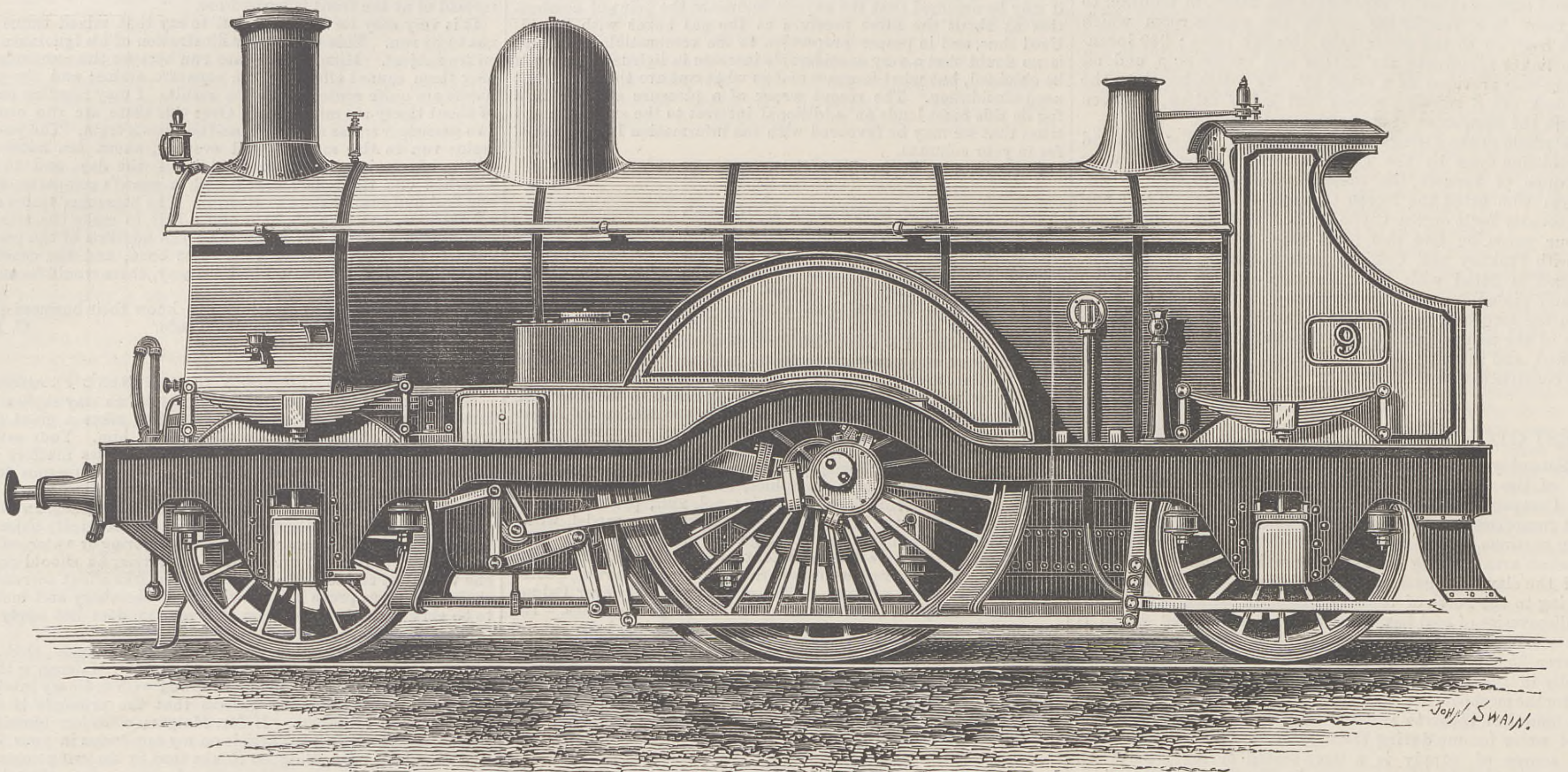
SIR,—Mr. P. A. Maignen's letter in your last issue may lead readers to suppose that this company is merely the agent of Messrs. Gaillet and Huet, of Lille. This is not so. The company is sole owner of the original Gaillet and Huet patent, and of those for the subsequent improvements which have brought the Stanhope water softener and purifier to its present perfection.

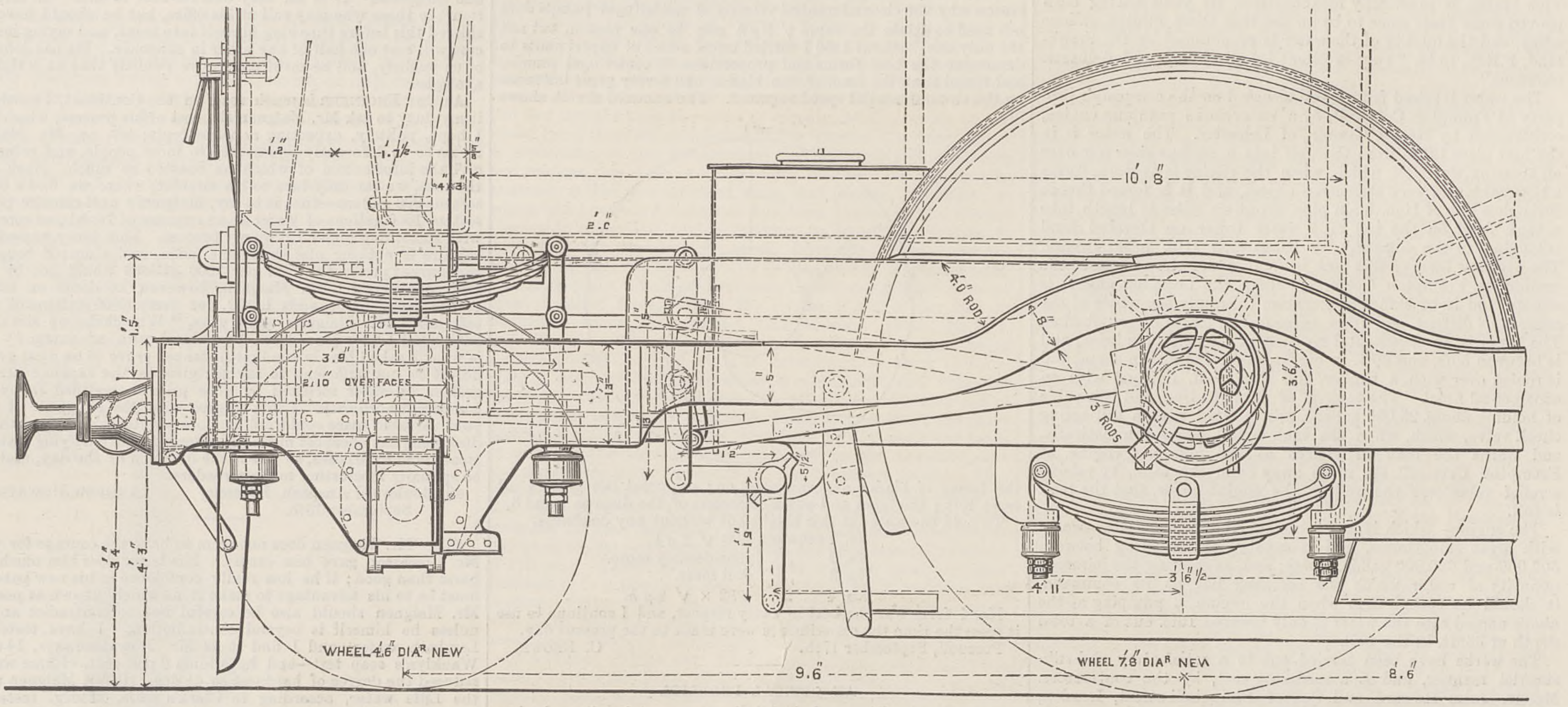
The Stanhope Company, Limited,
Formerly Cordner, Allen, and Company, Limited.
JOHN S. SAUVAY, Director.

20, Bucklersbury, London, September 21st.

EXPRESS ENGINE WITH OUTSIDE VALVE GEAR, GREAT WESTERN RAILWAY.

MR W. DEAN, SWINDON, ENGINEER.





EXPRESS ENGINE, GREAT WESTERN RAILWAY.

MR. WILLIAM DEAN, locomotive superintendent of the Great Western Railway, has built an express engine with the excentrics outside, which we illustrate. Our views give an external elevation of the whole engine and a detailed view of the leading end. The arrangement is intended to get rid of the excessive cramping up of the valve gear necessary when large cylinders have the valve chests placed between them. It will be seen that in this case the valves lie on top of the cylinders, and are driven by rocking shafts, the excentrics being, as we have said, placed outside the wheels instead of inside. This gives more room for bearings, permits a longer crank pin to be used, and gives several other advantages, against which is only to be set the use of rocking shafts, concerning which little can really be urged. The engine is giving, we understand, complete satisfaction Mr. Dean, to whom we are indebted for the drawings we reproduce, has courteously added the following particulars as to the dimensions of the engine:—

Great Western Railway Engine No. 9.

Cylinders, diameter	1ft. 6in., stroke, 2ft. 2in.
Boiler barrel, ...	10ft. 8in. long.
,, ,, ...	4ft. 3in. outside diameter.
Outside fire-box	6ft. 2in. by 4ft.
Inside do.	5ft. $5\frac{1}{16}$in. by 3ft. 6in. by 6ft. $2\frac{1}{2}$in. high.
Tubes, 241	$1\frac{5}{8}$in. by 10ft. $11\frac{1}{4}$in. long.
Wheels, leading	4ft. 6in. diameter.
Wheels, driving	7ft. 8in. diameter.
Wheels, trailing	4ft. 6in. diameter.
Wheel-base, L. to D.	9ft. 6in.
Wheel-base, D. to T.	8ft. 6in.
Total	18ft. 0in.
Heating surface—tubes	1120 square feet.
Fire-box	130 square feet.
Total	1250 square feet.
Working pressure	150 lb. per square inch.
Fire-grate area	19·23 square feet.

HYDRAULIC WAREHOUSE CRANE.

THE engraving on the next page shows an hydraulic crane just erected for Messrs. Holland and Sherry's new warehouse in Golden-square, by Mr. Stannah. It is fixed just within the doorway, so that when not in use it is entirely enclosed in the building. It consists of a wrought iron jib with a movable spear S, and is operated on by two rams, one, A, to raise the spear, and the other, B, the goods. Its mode of action is apparent. When taking goods out of the warehouse, the goods are raised sufficiently off the ground by means of the left-hand ram B, acting on a return block C which moves vertically in guides between the upright frames. The spear S is then forced out by the other ram A to its extreme limit S^1, and the goods are over the van in the street when the goods are lowered out. The crane raises 12 cwt. at a working pressure of 700 lb., is working very satisfactorily. and is the only one of its kind.

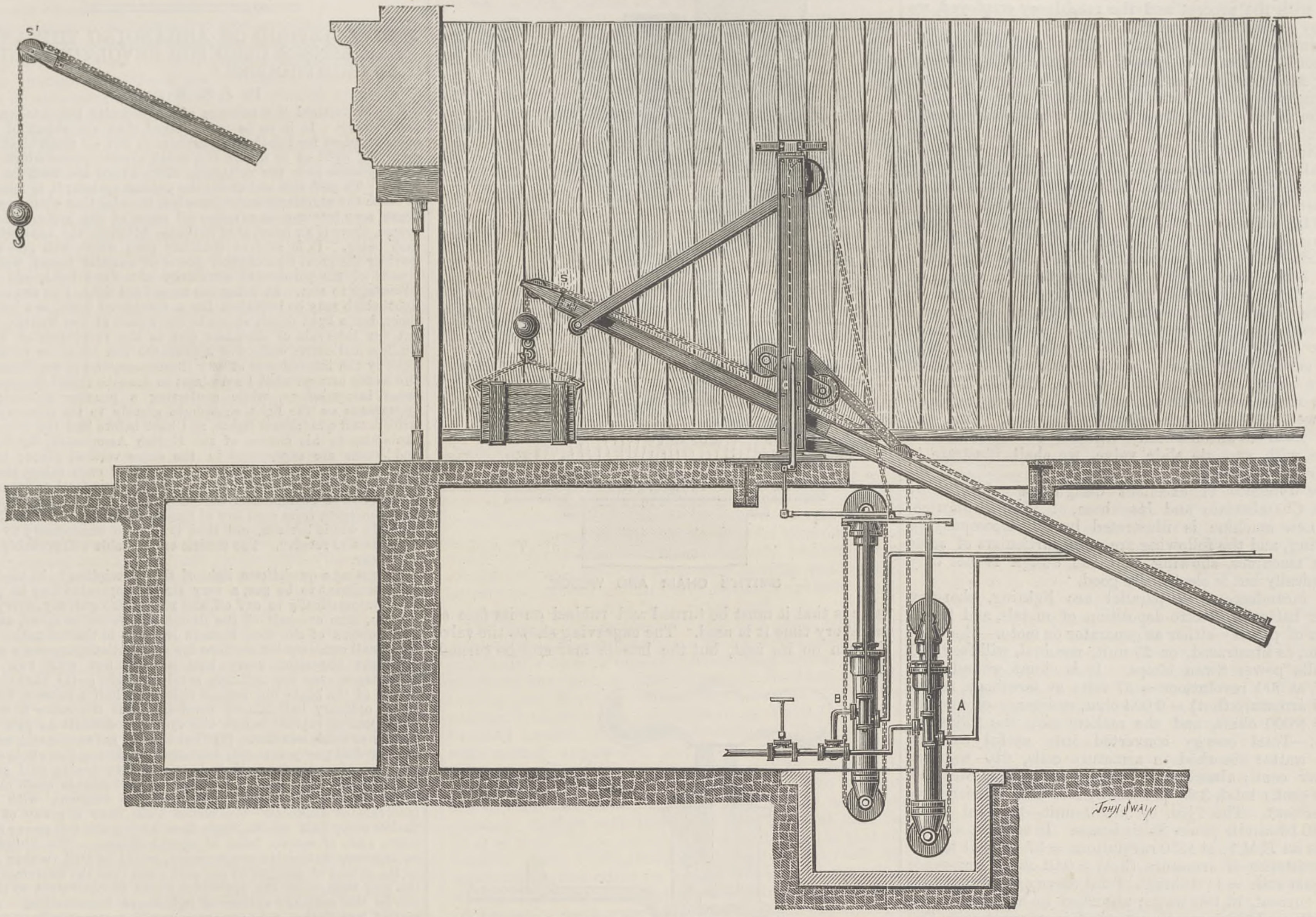
RAILWAYS IN CHINA.

THE *North China Daily News* contains some interesting information concerning railways in China. A correspondent writing from Tientsin says: "When H.I.H. Prince Ch'un was on a visit here, one of the improvements discussed between him and H. E. Li Hung Chang was the best way of introducing railroads into the Empire. It was at last agreed that as there were already a few miles of rail laid down from Kaiping to Hsü Ko Chong, the best plan was to extend the line, and thus have a road worthy of its name without exciting the opposition of the anti-railroad men in Peking. A scheme was formed to raise the capital for the work, on a public shareholding basis. This has been going on for some time, and no doubt at no distant date we shall see the first railroad built in this country, constructed in the North, under Imperial sanction. I believe that as Kaiping is not an important place, the traffic on the road between that town and Lutai, a length of about twenty-six miles, at which it terminates, will not be great, and the new company will not reap a heavy percentage from the capital they invest; but its chief importance lies in its being a precedent, and the mother of railroads in the Empire. The hope is that a further "extension" will soon be made, which will join Kaiping, Taku, and this place. Lutai is situated on the Pai Tung River, and steamers of moderate draft can easily come and go with cargoes of coal. Thus, by steam carriages and steamships, Kaiping will be connected with the world outside, and the C. E. and M. Company will be able to send their coals abroad at a much cheaper rate of transport. The cost is estimated at Tls. 250,000, the country through which it passes is level, and everything is plain sailing. Both Lutai and Kaiping are places on the highway from this port to the famous pass in the Great Wall, between China Proper and Manchuria, called "San Hai Kwan," or "the Pass of Hill and Sea." Through this pass the Tartar re-enters his old homestead from the land of his conquest, as it was through this that he first entered China 300 years ago. It is stated that H. E. Li Hung Chang has in view besides, that this line should run along the northern, or rather the southern coast of this province from here to San Hai Kwan, connecting all the forts, to strengthen and defend the capital of Peking from the Russian or Japanese who may have views of paying that city a military visit. We are glad to state that Mr. C. W. Kinder, the Engineer-in-Chief of the Kaiping Colliery, of whose engineering ability there can be no question, and whose integrity, uprightness and sterling worth has been acknowledged by the Chinese, has been selected by the Government to superintend the new railroad. Without doubt they have luckily chosen the right man in the right place, as his long stay in Kaiping has peculiarly fitted him by his experience and knowledge of the country and people for the undertaking. They could find no better man qualified in the world. Messrs. Ng Choy and Woo Nan Kow (the latter the Resident Manager of the Kaiping Colliery) are the present chief directors of the new company, and offers for tenders for the supply of material for the constructing of the road are given to all the syndicates at present in Tientsin as well as the world."

The preceding was written on the 3rd of July. The same writer says on the 13th of July: "The tenders have been opened for the supply of rails for the Kaiping extension railway, and the German firm of Krupp and Co. has obtained the contract. The French, as well as some English syndicates, also competed, but the Prussian offers were the lowest, so they were accepted. The terms of Krupp were so low that it has occasioned much surprise. It behoves the British merchant to work with great caution and care. The great monopoly of trade of the present day is very different from that of the olden time, and our German cousins are also seeing the importance, and taking mighty strides in the commerce of the 'Far East,' and unless steps are taken to secure some of the iron trade in the next undertaking, we fear that the future railroads of China will be built of other than English rails. The Chinese as a nation are excessively fond of running in beaten tracks, and attach much importance to precedents; this first contract therefore going to a German firm is a bad omen for Englishmen, especially as this was an open competition."

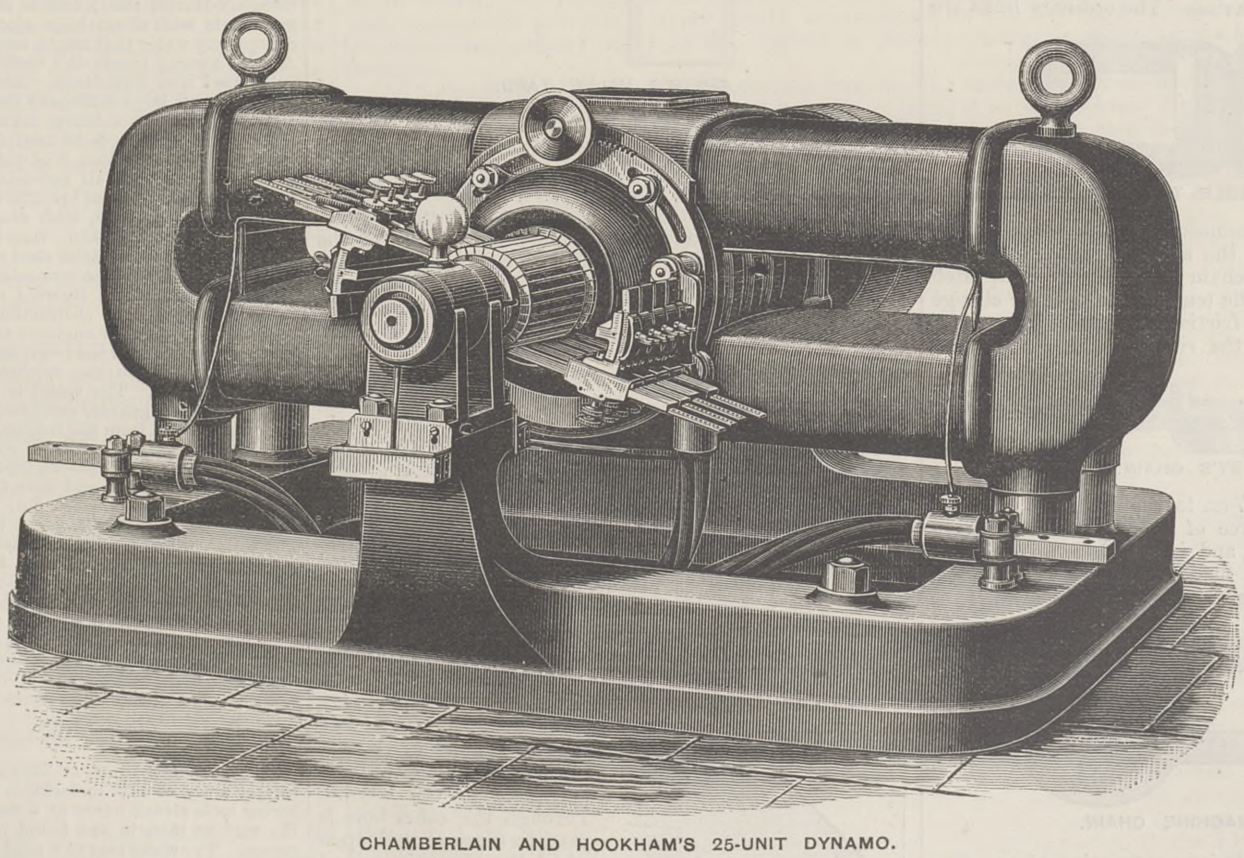
HYDRAULIC WAREHOUSE CRANE.

MR. J. STANNAH, ENGINEER, SOUTHWARK BRIDGE-ROAD



THE BIRMINGHAM EXHIBITION.

In continuing our notice of this Exhibition and observations on the manufactures of the district it must be remarked that Birmingham is not any more than any other town, a system which is awake at every point. It has amongst its manufacturers many who, whatever they might have been years ago, are not now so ready to see the necessity of the best and of plenty of tools—and especially of machine tools—to carry out new and cheaper modes of production. Neither is Birmingham, any more than other industrial centres in general, as ready as it should be to make wants as well as to meet them. The enormous variety of its manufactures gives it an air of being, as the motto of the town-arms declares, ever "forward," and ready at any time to make anything which invention makes necessary. This is not, however, really the case, for a difficulty is often experienced in getting an article manufactured in the Birmingham district until a maker can be discovered who has been previously engaged upon something of the kind. There are plenty of reasons why this should be so, for demand may not repay time and expenses; but when a demand actually exists for an article differing somewhat from that which has been long the regulation thing, as happens every now and then, it is remarkable that adherence to old patterns and modes of manufacture should cause the demand to be satisfied elsewhere. Even in Birmingham this can happen.



CHAMBERLAIN AND HOOKHAM'S 25-UNIT DYNAMO.

Amongst the processes of manufacture carried on in the Exhibition is that of pen making by Messrs. Perry and Co., so far as concerns the formation of pens, that is to say punching the blanks from sheet steel by one fly-punch; piercing them with the necessary and ornamental holes by another press; raising them, that is, bending them into the finished form by another; and finally splitting them by another press, the sheet steel and the pens being fed in under the cutters or dies, in each case by hand. The processes of ornamenting by tempering and plating, &c., are not shown, and the above are what have been seen by most people, and are not remarkable, except as showing what can be done by punches and cutters accurately made and mounted; but it does strike any visitor as remarkable that Birmingham seems to be the last place in which to find a good pen. Messrs. Perry and Co. gave to the visitors during the evening of the conversazione of the British Association a sample of their pens, and another firm did the same. The assortment of Messrs. Perry did contain about 20 per cent. of useful kinds, for writing, etching, mapping, or printing. The rest were like those of the other makers, all supposed to be writing pens; but inasmuch as very few people like writing with needles, they are useless except to the few. In the assortments there were of course the inevitable J pen, but these, although having a point suitable to the greater number of writers, will not hold enough ink, and most people like a pen that will hold enough ink to write at least half a two-syllable word without having to dip it more than twice. Probably nearly all the pens that are obtainable in London are made in Birmingham; yet as a specimen of pen manufacture very few of those shown in the Exhibition would satisfy one out of ten of those who know what a good writing pen may be. Most of the fancy forms are poor things. They are thin, scratchy, needle-pointed, and weak, and hold very little ink. The best sort of pen is one which very nearly resembles in its simple but capacious form, a good-size quill pen, but with a point not very fine and resembling the form of the J pen. Such pens are to be had in London, but their prices, as compared with the prices of the ornamental and fine-pointed pens we have spoken of, though no more costly to make, are shamefully high.

Cutting files by hand is an industry represented by a cutter working on various kinds. Here, again, we have an industry which in a few years will support only a limited number of men, and as the machine-cut file for general purposes is now admittedly at least as good as the hand-made file, in spite of the confident assertions of not more than four or five years ago, it is to be hoped that file-cutters will recognise the real cause of a fall in demand for their labour except for special work, and will in good time turn their attention to the most suitable change they can make. Some kinds of files will be made by hand for years, but the rank and file of the trade will, like candle-snuffer makers, find their trade declining to the vanishing point.

It is within the recollection of many, or of most engineers, that years ago ball and roller bearings in various forms were used a little, but went out of use. The saving which results from their use when in order is undoubted, and may be very large; but as designed a quarter of a century ago, wear rapidly caused them to run very loose, and there were no satisfactory means of adjustment. For all light work the difficulty in this respect has been overcome by the bicycle and tricycle makers, and in a year or two we shall probably see ball or roller bearings in use in various kinds of machinery, and for carrying shafting.

A remarkable new system of producing copper tubes has been adopted by Messrs. Ralph Heaton and Sons, of Birmingham, and one which has cost a very large sum to develope. Specimens of tubes and swelled ingots illustrating the process are exhibited, but as we shall deal at length with the process and the machinery employed, we need say no more concerning it here.

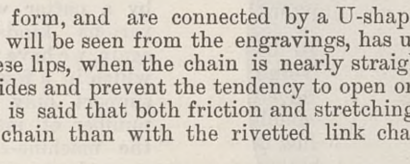
Specimens of large welded tubes and barrels are exhibited by Messrs. J. Russell and Co., of Wednesbury, and by Messrs. Lloyd and Lloyd. The former show some very fine weld work, including a hollow ram, like those made for the Mersey Railway passenger lifts, with screwed joints, the ram being made from Siemens' plate 60in. by 11ft. 6in. and 0·75in. thickness, the finished thickness being about ½in. Messrs. Lloyd show barrels about 4ft. in diameter and ⅜in. thick, and Messrs. Russell 5ft. in diameter. They also show steam pipes with screwed joints up to 14in. diameter. All this, and the welded saltpetre and sugar pans exhibited by Messrs. T. Piggot and Co., and made by apparatus described by us in our impression of the 10th instant, show rapid growth of a system of construction which will probably tend as much to centralise large hollow-ware industries, as to become of general adoption by boiler and other plate workers. Messrs. F. Lloyd and Co. show samples of what they term "crome" steel, a kind which is probably that asked for by a correspondent a little time ago. Messrs. Tangyes exhibit a fine new double vertical fly-wheel pump amongst other well-made and well-finished machinery. This, and a new form of automatically variable cut-off for steam engines with a single slide valve, we shall illustrate in another impression.

Some dynamos of excellent design are exhibited by Messrs. Chamberlain and Hookham, of West Bromwich. Their new machine is illustrated by the accompanying engraving, and the following are some particulars of some of the machines, showing that the design is not only mechanically but is electrically good.

For incandescent or parallel arc lighting, charging storage batteries, electro-deposition of metals, and transmission of power—either as generator or motor—the 10in. by 13in., as illustrated, or 25 unit, nominal, will feed 400 16-candle power Swan lamps. It is shunt wound, and E.M.F. at 900 revolutions = 57 volts at terminals, resistance of armature (hot) = 0·003 ohm, resistance of magnet coils = 8·000 ohms, and the makers give the following figures:—Total energy converted into useful current, 26,635 watts; absorbed in armature coils, 610 watts = 2·28 per cent.; absorbed in magnet coils, 375 watts = 1·4 per cent.; total, 3·68 per cent.; electrical efficiency = 96·3 per cent. The 7¼in. by 9in. 9 unit—nominal—is to feed 150 16-candle power Swan lamps. It is shunt wound, and has an E.M.F. at 1250 revolutions = 57 volts at terminals, resistance of armature (hot) = 0·01 ohm ; resistance of magnet coils = 11·6 ohms. Total energy converted into useful current, 10,180 watts; absorbed in armature coils, 282 watts = 2·75 per cent.; absorbed in magnet coils, 280 watts = 2·75 per cent.; total, 5·5 per cent.; electrical efficiency = 94·5 per cent.

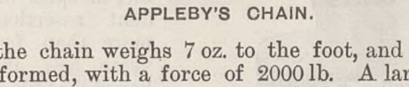
The same firm exhibit some very neat new small switches, and some electroliers and other fittings of very pretty and neat designs; designs not slavish copies of gas fittings, nor ugly results of attempts to avoid copying them. They also show a good and cheap factory fitting to carry an incandescent lamp, movable in any direction and extensible.

A new tricycle chain, applicable generally for light machinery, is exhibited by Messrs. Perry and Co., and is shown by the annexed engraving. The ordinary links are



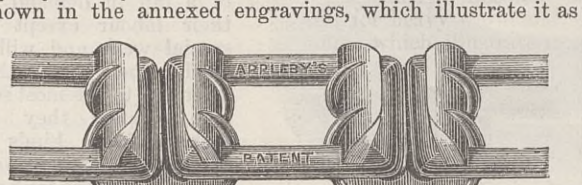
APPLEBY'S ADJUSTABLE TRICYCLE CHAIN.

of square form, and are connected by a U-shaped piece, which, as will be seen from the engravings, has under-cut lips. These lips, when the chain is nearly straight, catch the link sides and prevent the tendency to open or change form. It is said that both friction and stretching are less with this chain than with the rivetted link chain. For



APPLEBY'S CHAIN.

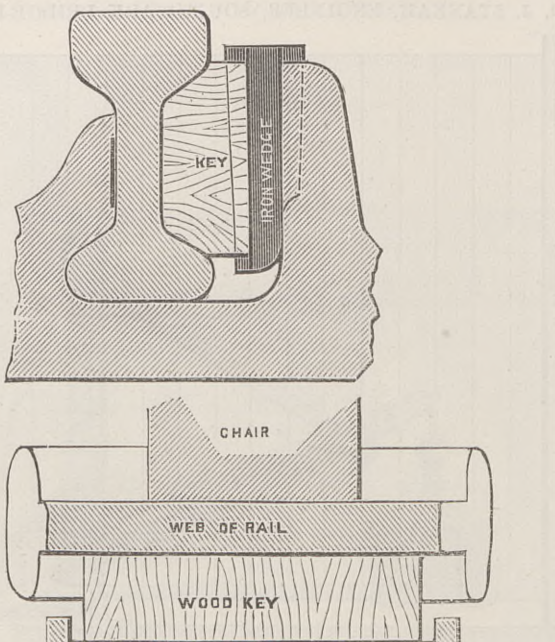
tricycles the chain weighs 7 oz. to the foot, and is tested, we are informed, with a force of 2000 lb. A larger form of the same kind of chain, and in which a link may be equally readily removed, is made for heavy work, and is shown in the annexed engravings, which illustrate it as



APPLEBY'S MACHINE CHAIN.

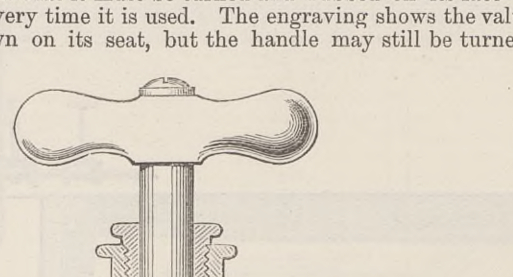
made with a strong malleable iron connecting piece. The adjustable link is of cylindrical shape, strengthened at the bottom on the inside, and with two ribs on the outside. The 3in. pitch chain is, we are informed, capable of withstanding a pull of upwards of three tons without breaking.

Mr. David Smith, of Dudley-road, Birmingham, exhibits, amongst other things, the iron and wood wedge and key for railway rails illustrated by the annexed engraving. The wedge is of wrought iron, and the key is of wood with the grain endways, the object being to use the wood so that the pressure is in the direction in which shrinkage is very slight. The wedge is, as will be seen, made so that the key or itself cannot come out. The same exhibitor shows some well-made and simple taps, made as shown in the annexed engraving. The feature in the



SMITH'S CHAIR AND WEDGE.

valve is that it must be turned and rubbed on its face or seal every time it is used. The engraving shows the valve V down on its seat, but the handle may still be turned,



SMITH'S VALVE TAPS.

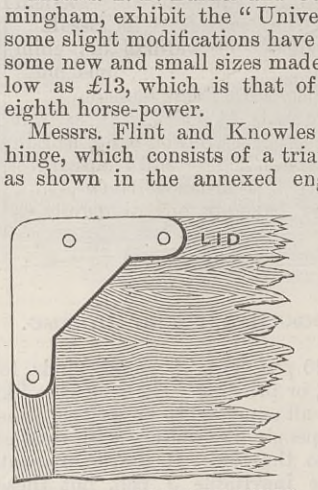
because the slot S and space P permit its further descent. The handle cannot therefore be turned without turning the valve on its seat, and thus the tendency is always to grind the valve a little, and so keep it tight.

One of the largest tool-making firms in Birmingham—Messrs. J. Archdale and Co.—and makers of some of the largest shaping, slotting, and drilling machines ever made, and of small-arms and ammunition, is represented only by a small, well-finished amateur's lathe. A considerable number of the British Association members interested in machine tools visited Messrs. Archdale and Co.'s works.

Messrs. W. and J. Player exhibit some of the latest forms of their Lingworth power hammers for forging, welding, and planishing. These are exceedingly handy tools, and are made with the tup moving in a guide, which gives an air cushion at the top of its stroke, which greatly increases the efficiency of the hammer.

Messrs. T. B. Barker and Co., of Scholefield-street, Birmingham, exhibit the "Universal" gas engine, in which some slight modifications have lately been introduced, and some new and small sizes made, the prices commencing as low as £13, which is that of an engine nominally one-eighth horse-power.

Messrs. Flint and Knowles show a new form of box hinge, which consists of a triangular piece of brass plate, as shown in the annexed engraving. In the plate are three holes, through two of which nails or screws are passed, fixing the corner piece to the box-lid. Through the other hole is passed a screw or nail, upon which the piece pivots, and thus constitutes a simple hinge suitable for a great many purposes.



FLINT AND KNOWLES' HINGE.

Messrs. Shirlaw and Co., Birmingham, exhibit the spiral petroleum engine, which we shall illustrate shortly. Amongst the numerous and very interesting exhibits of early engines, as shown by original models of Watt and others, is a model of the drawing rollers used in spinning, which is shown with the first hank of yarn ever spun in that way. It is exhibited by Messrs. Platt Brothers, of Oldham, at the suggestion of Mr. R. B. Prosser, of the Patent-office, who is well known as taking great interest in all that concerns the development and history of inventions.

A NEW METHOD OF ARRANGING THE ANNULAR LENSES USED FOR REVOLVING LIGHTS AT LIGHTHOUSES.[1]

By J. R. WIGHAM.

By this method the rotation of the annular lenses is rendered unnecessary. It is to be remembered that the object of using annular lenses for lighthouse purposes is not so much to obtain a revolving light as to obtain the much greater power which these lenses possess over the refracting belts which are used for fixed lights. To gain this end under the present system, it is necessary to cause the annular lenses to revolve, in order that their powerful beams may traverse in rotation all parts of the horizon; and, of course, there is an interval of darkness between the recurrence of each beam. It is evident that any plan which will give to the mariner the great illuminating power of annular lenses, with the benefit of the permanent continuity of a fixed light, will be an advantage to him. In using the term fixed light, I do not mean a light which may be mistaken for a mast-head light, or a lamp on shore, but a light which shows to every part of the horizon, without the intervals of darkness due to the revolution of lenses. Endless distinctive variety of appearance can be given to such a light by the intermission of the illuminant, and in the illuminant and in the arrangement I am about to describe it will be seen that these intermissions, while conferring a peculiar characteristic appearance on the light, contribute greatly to its economy. In triform and quadriform lights, as I have before had the honour of explaining to this section of the British Association, the burners and lenses are superposed in the same vertical plane; but if, instead of placing the lenses vertically over each other, they are placed obliquely to each other, but kept in their focal position with regard to the illuminants, the effect will be that the beams of light emerging from each tier of lenses will overlap, so as to illuminate the whole horizon, and thus it will be unnecessary to cause the lenses to revolve. The models on the table will probably make this clear.

Supposing a quadriform light of this description to be used, and the illuminant to be gas, a very simple apparatus may be placed so as automatically to cut off and relight the gas, say, every half minute, thus one-half of the illuminant would be saved, and the consumption of the four burners reduced to that of two. With this small consumption we have for all practical purposes a revolving light appearing every half minute, but with two great advantages over the ordinary revolving light:—(1) That the full power of the beam will remain visible for half a minute, whereas in an ordinary half-minute revolving light the beam is a mere flash passing rapidly before the eye, and difficult to pick up in stormy or thick weather. (2) That there is no waxing and waning, but the full power is shown continuously during the whole of the half minute. Further, if it be desired to confer still greater individuality upon the light, the great half-minute beam may be broken into flashes of, say, two seconds duration, with equal intervals of darkness. We would then have a group of eight flashes every half minute, each flash having the full power of the lense, and, of course, being of equal brilliancy. The illuminant, by this very distinctive arrangement, would be still further saved to the extent of another 50 per cent., and thus the consumption of the four burners in the apparatus would be equivalent to that of one in the ordinary system of lighthouse illumination. As to cost of installation, this apparatus would be practically about the same as an ordinary revolving light, for the cost of the extra lenses would be about equivalent to the saving effected by dispensing with rotating machinery.

STERN WHEEL STEAMER.

MESSRS. FORRESTT AND SON, of Britannia Yard, Millwall, E., and Norway Yard, Limehouse, London, E., have lately constructed for an African river a stern wheel steamer of the following dimensions:—Length over all, 75ft.; breadth, 13ft. 6in.; depth, 3ft., with a draft of only 15in. with six tons of cargo, fuel, and equipment on board. The hull is built entirely of galvanised Siemen's-Martin steel, and is divided into five watertight compartments with steam bilge ejectors to each compartment to discharge any water that might accumulate from leak or otherwise. A wood awning covers the vessel completely, and is supported on galvanised iron stanchions. Accommodation for officials is provided for in a large mahogany deckhouse on main deck forward of boiler space. The cabin is luxuriously fitted up with cushioned seats, broad enough to be used as sleeping berths when required; the rest of the furniture is of polished mahogany. The pantry is at the fore end with all necessary conveniences; the sides of the house are fitted up with venetians instead of glass, to give as much ventilation as possible, with sun blinds outside. There are also curtains all round the vessel to be used at night time. The main deck is of light steel covered with linoleum. The two balanced rudders aft are connected by an iron rod and worked from a steering gear placed forward of the deck-house, the steersman being clear of all deck obstructions, and by means of a gong can communicate with the engineer aft at will. There are three cargo hatches—one to each hold—giving every facility for working cargo. The windlass is on the ratchet principle, with hand lever for working anchors. The vessel is fitted all round with galvanised steel wire arrow guards, extending from deck to awning, to protect officers and crew from the frequent attacks of hostile natives. A very compact galley is situated on main deck aft.

The engines are of the high-pressure type; cylinders 11in. diameter by 30in. stroke, and work direct on the stern paddle-wheels. The paddle-wheels are 8ft. 6in. diameter, and so arranged that they may be raised or lowered to suit different drafts of water. The boiler, which is placed amidships, is of the Field vertical type, working pressure 120 lb., and having large heating and grate surface for burning wood fuel. The machinery is capable of indicating 75-horse power, and the speed of vessel, with cargo and equipment on board, ten miles per hour. The vessel was built, machinery fixed on board to the entire satisfaction of the owners and their engineer, taken to pieces and packed in cases of not more than 60 lb. each, with the exception of a few parts of the machinery, and delivered within seven weeks from date of order.

THE ARTESIAN WELL AT BELLEPLAINE, IA, is still spouting. The correct story of this remarkable well is about as follows:—The boring tools struck water at a depth of 193ft., about 40ft. nearer the surface than it was found in several other wells in the same region. The water rose in a solid stream, in a 2in. hole, 12ft. above the surface, and the whole rapidly increased in size. A 3in. casing was then forced down 120ft., but the flow outside the casing soon became unmanageable, and the well contractor abandoned his job. Within three days the hole was a yard wide at the surface, and the water was rising 4ft. above the surface, thick with sand. A 15in. casing tube was next driven down about 80ft., but the water still came up outside this tube. By this time all the other wells in the town had ceased flowing. Finally a 2in. tube was sunk 210ft. as a guide, and a cone, 30in. in upper diameter and weighing over a ton, was sunk to a depth of 62ft. But the flow is still as great as ever, and the street has been transformed into the bed of a stream to prevent overflow on adjoining property

[1] British Association, Section G.

to form sulphate of soda. The oxidising effect is also exhibited by the decomposition of the copper sulphide, which would appear to be converted partly into sulphate and partly into oxide. Double decomposition also occurs between the cupric sulphate and the sodic chloride, with the productions of the chloride of copper.

The next step is to subject the calcined mixture in lixiviating vats, provided with false bottoms, to the action of hot water and of the acid fluids collected during the above process. In these the calcined product receives eight or nine successive washings. If gold in appreciable quantity be found present in the washings, this metal, we understand, is precipitated by the addition to the fluid of a certain proportion of a protosalt of iron in solution. We may observe, however, that Mr. J. Rae, the manager of the works, very properly exhibited a certain amount of reticence in regard to some of the operations which it might be to the interest of the company not to make known. The washings from the ores treated, invariably contain a sufficient proportion of silver, in the condition of chloride held in solution by the excess of sodic chloride, to allow of the profitable separation of this metal. The silver is precipitated by the ingenious and economical process devised by Claudet. A solution of zincic iodide is added to the washings; the proportion of the iodide being determined by a previous estimation of the quantity of silver present in the liquors to be operated upon. Insoluble argentic iodide—usually accompanied by subsalts of copper and insoluble salts of lead—is thus produced by the following reaction:—

$$2\ Ag.\ Cl. + Zn\ I_2 = 2\ Ag.\ I + Zn\ Cl_2.$$

The argentic iodide thus obtained, after treatment with dilute hydrochloric acid to remove cuprous salts, is treated with metallic zinc, by which means the silver is obtained in the metallic state, whilst zincic iodide is regenerated. To obtain the copper the filtered washings now pass to the precipitating tanks, which are partly filled with scrap iron or waste tin-plate. Chloride of iron is produced whilst metallic copper is precipitated. By washing, the precipitated copper is freed, as far as possible, from the iron in admixture with it; but it is in this portion of the process that the need for improvement is most strikingly evident. To the electro-chemist the separation of metallic copper in a condition of almost absolute purity, from a filtered solution of this metal containing no substances electro-negative to it, should present but little difficulty. But, even after careful washing, the product obtained by the method of precipitating the copper upon scrap iron never contains, we believe, more than from 70 to 80 per cent. of the former metal. Hence the necessity for a tedious and expensive process of refining. The impure product is either smelted for blister copper, or is melted with fine metal and afterwards refined.

Here, then, there appears to be an excellent opportunity for the introduction of the dynamo machine for obtaining the copper in a state of comparative purity from its solution as obtained in the above process. It is well known that a current of about 381 ampères will deposit 1 lb. avoirdupois of copper in one hour, and that with suitable arrangements the electro-motive force required in this operation is very small, so that a number of depositing tanks may conveniently be connected in series. So long as a year or two ago the copper refining works at Selby Oak, near Birmingham, were producing per week ten tons of pure copper deposited by means of the Wilde machine. Recently we have heard of a dynamo machine in America which will supply a current of 122,500 ampères. Such a machine would be capable of depositing 321 lb. of copper per hour in a single depositing tank. The dynamo machine devised by Professor George Forbes is said to be admirably adapted for such work as this. Experiments which have been made upon the successive deposition of metals, according to their position, as electro-negatives, in the electro-chemical scale, would appear to indicate the possibility even of dispensing with the Claudet reaction in the above process, and of obtaining in a preliminary operation a deposit containing gold and silver, with a certain proportion, no doubt, of copper. It is for electricians to see what can be done in this direction, and there is but little doubt that their endeavours will be welcomed, since there is a tolerably clear *primâ facie* case in regard to the economical question which manufacturers have to maintain constantly in view.

THE ORDNANCE COMMITTEE'S REPORT ON THE COLLINGWOOD'S GUN.

As our readers are aware, the Ordnance Committee, with special associated members, were directed to investigate and report on the case of the 43-ton breech-loading gun which burst on board H.M.S. Collingwood at Portsmouth on May 4th, 1886. This gun had been fired with a scaling charge of 73¾ lb. of brown prismatic powder, and on firing its first round with a three-quarter charge of 221¼ lb. of brown prismatic powder and a common shell filled with water, weighing 714 lb., it gave way at 8ft. from the muzzle—that is to say, the muzzle end of the gun, which consisted of a single steel tube, broke up for a length of about 8ft., leaving intact the portion which was reinforced by an outer cylinder, termed the 3 B coil. Six fragments were recovered; among them one piece of the muzzle swell, and one piece from a point about 2ft. back from the muzzle, which fell on board.

The Committee consisted of Lieutenant-General Sir M. A. S. Biddulph, Rear-Admiral T. le Hunte Ward, Major-General Fraser and Colonel Baylay, R.A., Captains Jenkings and Hammill, R.N., Lieutenant-Colonel Davies, R.E., Major Colquhoun, R.A., as well as Mr. W. H. Barlow, and Sir F. Bramwell. The associated members were Sir W. Armstrong and Captain Noble, of Elswick; Sir F. Abel; Colonel Maitland, superintendent Royal Gun Factories; and Mr. M. Glendhill, of Whitworth's.

The same Committee and associated members, with one or two exceptions, had been before assembled, on February 3rd, 1885, to consider the question of the behaviour of the new-type guns under the action of modern charges of powder, which are very large in quantity and slow in action. This step had been brought about by the bursting of certain guns, especially a 6in. breech-loading gun on board H.M.S. Active.

The general position of affairs may be explained in a few words. The success of a gun is generally estimated by the total energy it is able to impart to a projectile in proportion to its weight. Thus, the Gun Factory 63-ton gun, in 1884, was estimated to give a total energy to its projectile of 36,415 foot-tons, while the projectile of the 9·2in. wire gun had only 16,730 foot-tons; but if these be divided by the weights of the guns—that is 63 tons and 19 tons respectively—the larger gun has only 569 foot-tons per ton of gun and the wire gun 880 foot-tons, showing that the latter is a more efficient discharging machine weight for weight. This system of estimation was, we think, first put forward by Krupp. Its value, of course, depends on the assumption that each maker has given to his gun the same margin of strength to insure safety. There are more points involved in such an assumption than appear at first. The pressure in the bore is registered by means of pressure gauges, and these, even supposing that they are absolutely trustworthy, give only the maximum pressure, which occurs near the bottom of the bore. Consequently a slow-burning powder, which gives a lower maximum but keeps it up longer, is registered lower, and appears at a great advantage. Yet of course it is possible that such a powder may keep up its pressure, low as it is, out of proportion to the tapering of the gun, so as to strain the forward portion of the piece. In short, a manufacturer must not be tempted by the register of a low maximum to keep up the pressure of his powder out of proportion to the taper and rate of decrease of strength of the gun. Some time ago this would have been regarded as an improbable contingency, because it is very difficult to keep up the gas pressure in the bore for obvious reasons which cannot here be discussed. Latterly, however, great success has been achieved with slow-burning powder, and latterly in England and on the Continent, guns have shown a disposition to burst in the forward part.

The Special Committee in 1885 laid down what were considered sufficient provisions to meet the case. They provided for each pattern of gun—among others, for that which we have now to consider, namely, the 43-ton breech-loading gun, Mark II., which may be called the earliest pattern, inasmuch as it only differs from Mark I., which is for land service, in having no trunnions. These patterns were already superseded, and the case of the few that existed was thought to be sufficiently met by limiting the firing charge to 295 lb. of cocoa powder. We mention this to show that these guns were at this time not above question, though undoubtedly it was believed that the limit of their charge rendered them quite safe, so that the bursting of the Collingwood gun caused considerable disappointment, and called for a reinvestigation of the whole matter. The cases of the Active and Collingwood guns were very similar; each piece had borne its proof without signs of weakness, and each gave way some months afterwards on the first shotted round which was fired, although in each case the charge was a reduced one. The fractures in both cases were forward, and very similar in general character.

The accompanying engraving from a photograph shows the fractured end of the gun. The Committee was to report on the following specific points:—(*a*) The cause of the accident; (*b*) the steps to be taken to prevent such an occurrence with guns of similar pattern; (*c*) whether the breech of this pattern is sufficiently strong; (*d*) whether in view of this accident the recommendations previously made should be reviewed. Question *c* was specially urged by the Director of Naval Ordnance.

The information laid before the Committee was chiefly on the following points:—(1) Detail of the nine rounds fired by the gun in question—Mark II., No. 16; (2) the mechanical and chemical tests of the metal; (3) results of experiments made with a 9·2in. breech-loading gun—No. 446—to ascertain pressures in different parts of the bore; (4) a telegram from Messrs. Firth to the effect that the ingot of which the tube burst was made weighed originally 30 tons, of which 20 tons 5 cwt. were used. This was followed up by a long examination of Mr. Hoyle, of Messrs. Firth's firm. (5) List of accidents with ordnance; (6) report of examination of gun in question before and after proof.

The metal of the burst tube was found to be harder in character than intended, and specimens taken from different parts varied considerably in quality and in the quantity of carbon contained. In connection with the possibilities disclosed by this fact, we understand that Colonel Maitland has made some investigations with remarkable results, which it is to be hoped may be published at some future time. Probably those who understand steel will think that the fracture shown in the cut suggests greater hardness than is desirable. Whitworth's steel is generally softer than Firth's. It contains more manganese, and while it suffers more from scoring, it is probably more certain in its quality. The report does not give the list of accidents submitted to the Committee. It is desirable that it should be clearly understood that England is not peculiar in having suffered from guns bursting, but is rather peculiar in having all accidents published and emphasised. Among other foreign accidents may be mentioned an 11in. gun at Fort Heppens in October, 1884, and a remarkably similar burst to the Collingwood gun, which occurred in May, 1885, in France, to a 42 c.m. (16·5in.) gun, weighing 75 tons, when the muzzle end of a tube blew away down to the front edge of the first strengthening hoop, an accident which was attributed to the abrupt termination of the support of the strengthening hoop. It was then found that a sister gun showed signs of yielding in the same way; consequently both were shortened to the edge of the supporting hoop, and future guns ordered to be chase hooped to the muzzle.

The Committee reported as follows on the case of the Collingwood gun, and others of the Mark I. and II. patterns:—(1) That the chases of these guns are strong enough if the steel be of good and uniform quality, and not subjected to any abnormal conditions. They do not think that abnormal pressure of any practical importance could have prevailed in the chase of the Collingwood gun. This opinion was confirmed by experiments made with a 9·2in. gun (No. 446), in which the projectile was moved a short distance up the bore, and charges fired when in this condition.

The Committee note the following facts:—(1) That the steel tube was irregular in its character and specially liable to set up internal strains during forging or oil hardening. (2) Annealing had not been adopted at the time of manufacture, which would have mitigated the evil. (3) The chase had been tried severely by charges of 340 lb. C*, a description of powder which was subsequently found to be capricious in its action and withdrawn from the service. (4) The gun was not fired for eighteen months after proof, when it fractured under fire with a reduced charge. (5) The gun burst violently with a much lower strain than it had already borne without apparent injury.

Under these circumstances the Committee concluded that the fracture of the gun was due to the following causes:—(*a*) Want of uniformity in the metal. (*β*) To absence of annealing after forging and oil hardening. (*γ*) To intensification of strains developed by proof rounds and subsequent interval of rest before firing. (*δ*) To absence of hooping on the chase. It should be explained that the process of annnealing which has been adopted since the manufacture of this gun consists in boiling the tube in oil and allowing it to cool very slowly in the oil.

As to the remaining guns of the same pattern, the reports furnished show that 378 rounds have as yet been fired from thirteen guns, one piece having fired 108 rounds and another 74 rounds, while the Collingwood gun fired but 9; consequently the latter must have been an exceptional piece. They recommended, however, that all 12in. breech-loading guns of Pat. I. and II. should be chase hooped to the muzzle after removing the 3 B coil. Also they recommended that they should be lined in the chamber to a diameter of 14⅝in. and proved with two charges of prismatic brown powder giving not less than 17 tons pressure per square inch in the chamber with a 714 lb. projectile. Afterwards five rounds should be fired with a service charge with pressure not exceeding 15 tons per square inch. Most of the guns of more recent patterns may be left unaltered, they having already chase hoops or double tubes. They would recommend alteration in the tests for steel, and they think that as the manufacture is perfected in a greater degree, the tests should be further altered. A copy of these tests recommended is here subjoined.

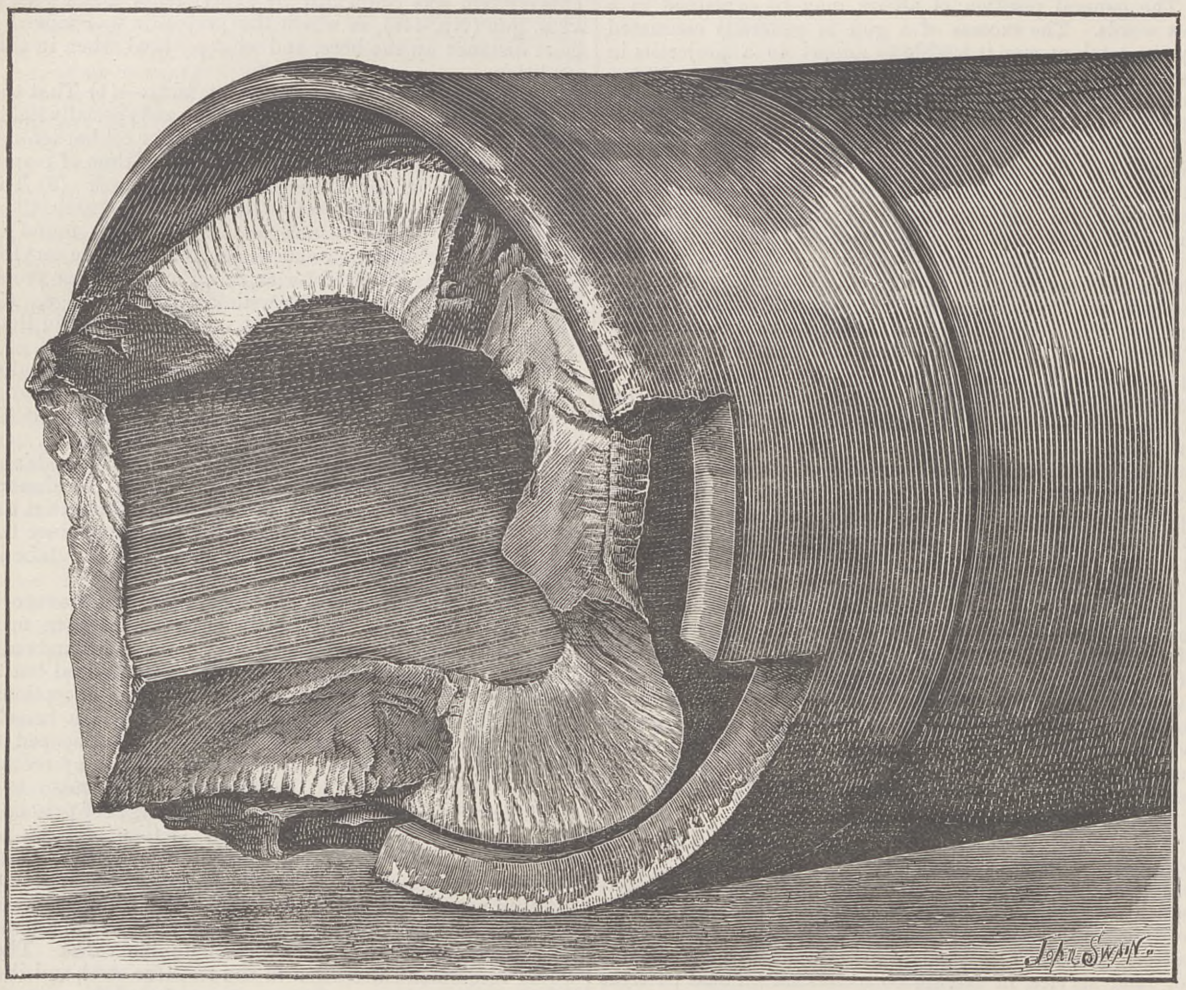
It may appear almost impertinent to comment on the judgment thus recorded by the highest authorities on gun steel in the country. There is, however, no doubt that the Government report is too guarded and colourless to tell us all we could wish to know. This must necessarily be the case in a united verdict of this character. Some remarks are therefore naturally called for.

First, as to the evil existing. As noticed above, whether the public believe it or not, the fact remains the same, that England is not suffering more than other nations. We have mentioned above the 10in. gun burst at Heppens, a 16·5in. gun with the muzzle blown off, and last week the daily papers reported one man killed and eleven wounded by the bursting of a 32 cm.—12·6in.—gun in Italy. This gun, we learn from Sir H. Bramwell's address to the Birmingham and Midland Institute on September 20th, consisted of a cast iron body reinforced by steel hoops of German manufacture. It was therefore a feeble gun, but it was only firing a 760 lb. projectile with the low charge of 170 lb. Sir F. Bramwell, however, quotes the cases of other guns, which he would have been wiser to have left alone. We must point out in common fairness that it was an outrageous mistake to quote the threadbare instance of an old obsolete 9in. Krupp gun which burst on board the training ship Renown in 1879, and even a Turkish gun burst in 1877, and to omit all reference to the much larger and more modern 100-ton gun, and the 38-ton gun which burst on board H.M.S. Thunderer in 1879, especially as it was in his work in connection with this last accident that Sir F. Bramwell principally became known as an authority on guns. We cannot refrain from calling attention to a treatment of the subject which is calculated to shake confidence rather than restore it. We have here only quoted some cases of recent guns, which are sufficient to show that Germany, France, and Italy, have suffered lately, even if we totally discredit the reports of the Krupp guns bursting in the Dardanelles. The fact is that, with all its great powers, steel is a most "kittle" material. The competition as to energy per ton of gun has caused the race to be pushed hard in all quarters. England waited, and allowed others to develope certain features in construction before she changed her old-type armament; but she could not obtain a knowledge of the actual working of gun steel except by experience, and having decided on the pattern late, it was necessary to push on rapidly, and some failures were inevitable. When they occur, it is almost always possible to find a fault, and to suggest improvements.

In the case before us various opinions are expressed, and we believe that individual members of the Committee would be found to differ if they proceeded beyond the general lines expressed in their report. As to the cause of fracture, some authorities think, with our foreign rivals, that much is to be attributed to the effect of tight hooping for a portion only of the barrel. The obvious bell form imparted to the 3 B coil accords with this supposition. The tendency, undoubtedly, is for the entire single tube to break up as far as the edge of the supporting hoop. On the other hand, there is another strongly expressed opinion that the barrel did not tear open tangentially, but pulled asunder longitudinally; that this effect was caused by the metal being too brittle to resist a very sudden shock. The tests bear out the opinion of the metal thus expressed, but it seems, on the other hand, that the limit of fracture in four cases coinciding with the front edge of the supporting coil or hoop, the action of the latter must have some share in checking or determining fracture. Were it

H.M.S. COLLINGWOOD'S GUN.

(*From a Photograph.*)



a case of simple longitudinal yielding under sudden strain, the recommendation of the Committee to chase hoop to the end would help matters very little indeed.

Probably the condition of the steel is itself the main cause of ruptures. It does not follow that there is much blame on this account, for the manufacture of large gun tubes is most difficult, and we believe subject to more influences than are yet recognised. The opinion that appears to have carried most weight is that the unequally carbonised condition of the metal caused it to yield unequally, the softer parts passing their limit of elasticity during proof, consequently there was a tendency for lines of weakness to be developed by molecular action during the time the gun rested. Variations in temperature in summer and winter, and other causes, assisted this action. Eventually the gun yielded at a point not far from the muzzle, so that rupture acted backwards until it was checked by the 3 B coil. The muzzle fragments thrown back on board ship support this, and the bell opening of the 3 B coil might be expected to occur on this supposition, as well as that adopted by the French in the case of their guns. Considering how the difficulties both of manufacture and examination increase with the thickness of the tube, it follows that it is undesirable ever to have a large gun with a single tube for the chase. We can hardly state the principle that we think should govern the manufacture of steel guns more clearly than by quoting our article advocating the introduction of steel for guns in THE ENGINEER of July 30th, 1880:—"Absolute certainty may not be attainable; but supposing that under ordinary circumstances a steel gun possesses even 20 per cent. more strength than one of wrought iron, and it is built up of separate cylinders, each one of which has been subject to working and processes of inspection that make the existence of a large flaw impossible, and that of a small one immaterial, then the time has come for its introduction." New difficulties have unquestionably presented themselves, but speaking generally they are best overcome by the employment of successive layers of metal. That we have much to learn we may own freely, but that we are now behind in England in the matter of guns, and especially heavy guns, we altogether deny. As an illustration, at the present moment while Krupp's 119-ton guns, only professing to give, so far as we can learn, under 50,000 foot-tons energy are awaiting delivery in Italy, we have two 110½-ton guns from Elswick professing to give 61,200 foot-tons energy now awaiting proof in Woolwich Gun Factories.

To make the system of testing clear to our readers, we give the following explanations concerning official practice. Each end of forgings for tubes is to be made so much longer than is needed for the length of the finished tube as to afford sufficient metal to give from the annulus between the outside of the forging and the bore of the tube (or the bore of the chamber, as the case may be), the four specimens mentioned below, and also two spare specimens of similar dimensions, being six in all. The specimens, if cut longitudinally, are to be so situated that their insides will be in line with the circumference of the bore, or of the chamber, as the case may be, and, if cut transversely, to be so situated that the middle of the length of each specimen shall be a tangent to the bore, or to the chamber, as the case may be.

The end of the jacket or breech-piece which was nearest to the upper end of the original ingot is to be made so much longer than is needed for the length of the finished breech-piece or jacket as to afford sufficient metal to give from the annulus between the outside of the forging and the bore of the breech-piece or jacket the four specimens required for the testing, and also two spare specimens of similar dimensions, being six in all; the specimens to be cut in the manner laid down for those from tubes. Hoops are to be tested in the same manner as breech-pieces or jackets, except that the specimens are to be cut transversely only, but in cases where several hoops have been forged from one ingot, it will be only necessary to cut a ring from one end of one of the hoops, such ring being taken from the upper end of that hoop which was nearest to the upper part of the ingot.

Two tensile specimens are to be tested "tempered." Each specimen is to be cut in a parallel cylindrical form, 1in. in diameter and 4½in. long, is then to be heated to between 1350 and 1550 deg. Fah. (a record of the actual temperature employed being kept for future information), and plunged into a bath of rape oil having an initial temperature of 65 deg. Fah. When cold the specimen is to be turned to testing size. The operative part of each specimen is to have, for a length of 2in., a uniform diameter of 0·533in. The enlarged ends of specimens are to be made of a form to suit the holders of the testing machine, and are to be united to the operative part by easy curves.

Two bending specimens are to be tested "tempered." Each specimen is to be cut to a width of 1·2in. by a thickness of 0·825in. It should be tempered as above described for the tensile specimens, and be reduced to testing size when cold. Each specimen is to be 4½in. long by ⅞in. wide by ⅝in. thick. The whole of the tests are to be conducted cold, subject to clauses 1 and 2; the tensile specimens are to bear the following tests:—

Yielding points, tons per square inch.			Breaking strain, tons per square inch.			Elongation, not less than per cent.
Not less than		Not more than	Not less than		Not more than	
22	to	33	35	to	45	17

The bending specimens are to be pressed flatways with a semicircular ended presser through one or more suitable apertures, furnished or not furnished with anti-friction rollers, at the option of the contractors. This test is to be borne without the steel exhibiting any indication of fracture.

Diameter of presser.	Width of aperture.
1½in.	2⅜in.

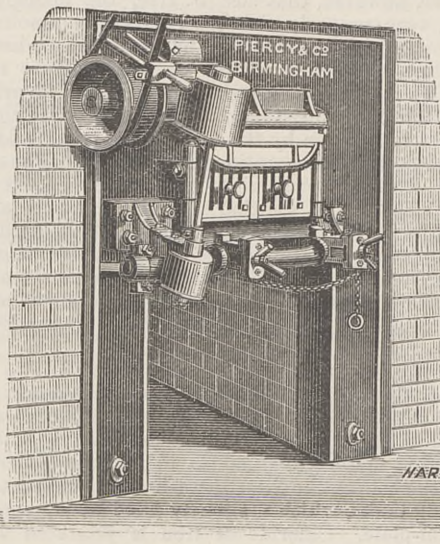
(1) In cases where the forging fails to bear the required tests at either or both ends after tempering (also with the allowance given by Clause 2) at a temperature between the limits laid down in the specification, a fresh set of samples may be taken from such end or ends of the forging and be tempered at a temperature to be selected by the maker but not lower than 1350 deg., nor higher than 1550 deg., all the samples comprised in one set from one end of the forging being tempered at one temperature. If the fresh set of samples fulfil the conditions, the forging may be considered to have passed the tests. The particulars of the first and second tempering should be recorded for guidance in tempering the metal for the gun. (2) In cases where the samples from a forging have satisfied the tests for bending, elongation, and breaking, but exceed the superior limit of the yielding tests, the forging may be considered as having passed the tests. (3) The foregoing tests being made for the benefit of the Government, and not for that of the contractors, shall not relieve them from any responsibility they would be under in the absence of such tests, and shall not prevent the rejection of the steel should it be otherwise unsatisfactory.

THE mechanical engineers and draughtsmen of Pittsburg, Pa., it is said, are preparing for the organisation of a protective association. The movement grows out of the action taken by a convention of representatives from all the leading bridge companies and other manufacturers who employ large corps of draughtsmen or engineers, held at Pittsburg about a year ago.

VISITS IN THE PROVINCES.

PIERCY AND CO.'S ENGINE WORKS, BIRMINGHAM.

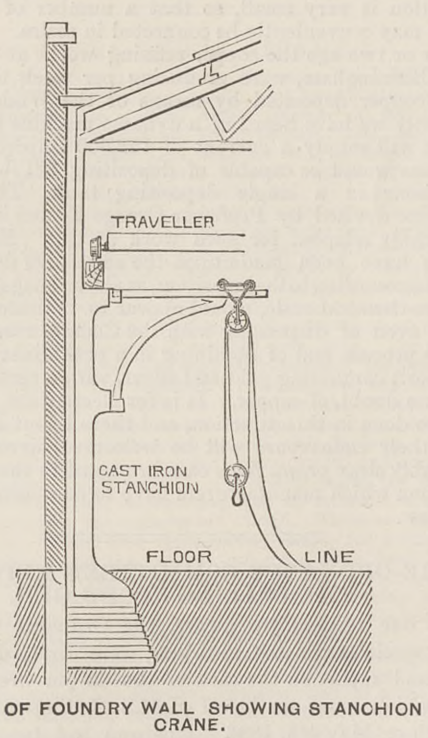
A FULL abstract was given in THE ENGINEER of Mr. Henry J. T. Piercy's report to the Birmingham Corporation on compressed air for motive power. He also sent in a report to the same body on the best method of dealing with town refuse, which resulted in the erection of furnaces whereby 50,000 tons of such refuse are consumed yearly, the heat being utilised in firing 650-horse power boilers for reducing to a dry state the excreta collected on the pan system, to be used as manure, at a total average cost of only 4d. per ton. The annexed cut shows the front of



SELF-CLEANING FURNACE.

these furnaces, which constitute an adaptation of Henderson's mechanical stoker, the reciprocating bars being, however, modified so as to deal with town refuse, which it has been found impossible to consume in any other kind of furnace. By means of the belt, pulley, shafts, and mitre gear, shown, and a series of cams under the bars, the clinker is carried automatically to the back of the furnace, where it remains until cool, and whence it is removed without opening the doors.

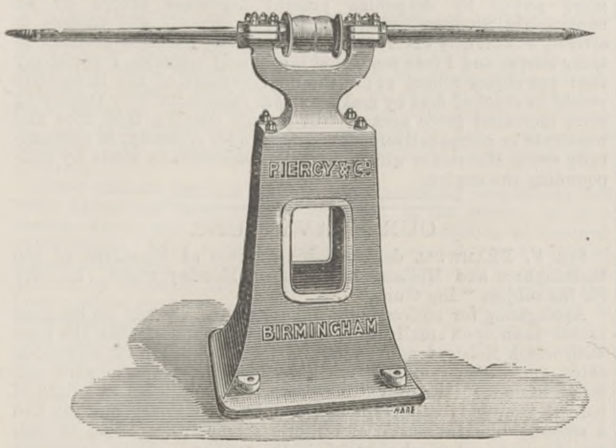
These furnaces, of which 3000 are now in use, are made at the Broad-street Engine Works by the firm of Piercy and Co., who are also the sole makers of Henderson's stoker. The works are small, but compact and well-arranged, containing excellent machine tools well adapted for turning out any special machine required in the Birmingham industries. Half the tools are driven by a horizontal engine, with nickel-plated rods, governor, &c., placed in the window of the show-room, on an encaustic tile pavement, to give occular proof that a steam engine need not be a cause of dirt while running.



SECTION OF FOUNDRY WALL SHOWING STANCHION AND CRANE.

The annexed sketch shows a section of the foundry wall, with specially designed cast iron stanchions, which carry the light iron roof, support the rails of the overhead traveller, and also provide top and bottom bearings for small jib cranes underneath. By this arrangement—commanding every inch of the foundry—the usual unwieldy jib cranes, which take up a great deal of room and obstruct the light, are entirely dispensed with. There are two cupolas, the larger of which is placed at one end of the main building, so that the metal may be conveyed to the moulds by the traveller, and the smaller in the trimming shop, for hand ladles when the larger cupola is not required. During our visit some remarkably sharp and smooth lamp-posts and street name-plates were being turned out of green sand moulds for the Corporation. The only precautions taken to secure smooth castings are to grind the sand very fine and to mould carefully. At the entrance is a large weighbridge, to take horse as well as cart, thus avoiding any inaccuracy due to propping up the shafts to take the weight off the horse's back.

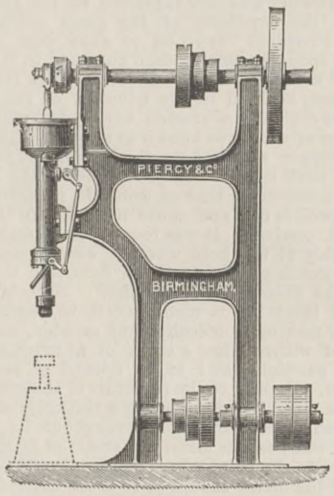
While passing through the shops we noticed a machine in progress for stamping buttons, and another for screwing the spokes of bicycles and tricycles, by which a boy, by merely turning a handle, can quickly cut a thread in the wire, instantaneously but securely clamped by an excentric. We illustrate two appliances that are, next perhaps to the stamp and screw press, among the most extensively used in Birmingham works. The improved "polishing head" consists of a cast iron standard, which may be used as a bed for emery wheels, &c., supporting a bracket carrying the bearings of a



IMPROVED POLISHING HEAD.

fast-running spindle, having screwed conical ends. The latter are so formed for readily receiving, by running in the reverse direction, the various appliances, such as "bobs," "buffs," and "mops," that are used for polishing small metal work. The "bob" is a wood disc having the periphery covered with leather, on which emery powder is strewn; and the "buff" is a similar disc covered with soft leather. The "mop" consists of several thicknesses of the material known as "swan's-down twill," clamped between metal discs with a lead bush, and made circular by being caused to revolve rapidly against the ragged edge of a piece of sheet iron. The remarkably soft edge thus produced, sprinkled with rouge powder, gives a high polish to metal articles, the yielding substance permitting of recesses and the depressions in ornament being reached.

The best piece of planishing seen at the Birmingham Exhibition was executed by the pneumatic hammer, of



PNEUMATIC HAMMER.

which Piercy and Co. are the sole makers, shown by the side elevation appended. According to the speed of the shaft, any number of blows may be given up to 350 a minute; and the length of stroke may be altered in a few seconds, by adjusting the throw of the crank, by means of a screw. British Association visitors saw one of these hammers at work planishing tin-plates, at Messrs. Hopkins' tin and iron plate works, described the week before last, and they are in use at all the Royal Dockyards. The action of this tool, which is the only one driven by belt which exactly reproduces the elastic effect of the hand hammer. In the most usual size, the upper portion of the barrel is 10¼in. in diameter, and that of the smaller part 3in., these proportions being observed in the other sizes. The larger piston, packed with Ramsbottom rings, alternately compresses and rarefies the air below it at each stroke, thus raising and forcing downwards the smaller and independent piston, with its rod and hammer head, giving a succession of smart elastic blows, just such as exert the best effect in planishing copper or tin plate. The hammer may be stopped, while the belt continues running, by raising the handle, seen below the barrel, thus opening a cock in the larger portion and causing the large piston to drawn air from outside and expel it freely at each stroke, without exerting any effect upon the smaller piston. A cam is keyed on to the short horizontal shaft for serving as a brake to hold up the hammer head clear of the work when required.

Mr. Piercy has been appointed by the Birmingham Corporation inspector of the extensive steam tramways in the town and suburbs, which we propose to deal with in a future article.

PLANT AND GREEN'S WARSTONE BUTTON WORKS, BIRMINGHAM.

As button-making is one of the special trades of Birmingham, where more buttons are made than anywhere else, a visit to the factory of a representative button-maker was arranged for the members of the British Association during their Birmingham meeting. Very little is generally known about the stages through which the button passes before its full development, we therefore made a point of following the various processes at the works in question, but were rather dismayed, on leaving, to be met with the formal request not to publish what we had seen, because the firm executes orders entirely for wholesale houses, and desires to avoid publicity, so as not to have the air of seeking an independent market. It would evidently be base ingratitude to disregard such a request; but, on the other hand, to write about Birmingham industries and say not a word on buttons would be very like the play of "Hamlet" with the part of Hamlet left out. In this dilemma we applied to Messrs. Plant and Green, of the Warstone Button Works, who are at the head of progress in this direction; and, after due consideration, they most obligingly showed us through their works. The staple of their manufacture is known as the "linen" button, that is to say, the linen-covered button with metal basis.

Carrying our remembrance back not so very many years ago, we can recall the then usual fastening of under garments and nocturnal habiliments. Its groundwork was a wire ring, and its superstructure a series of threads from the centre to the circumference, very symmetrical when new, but presenting a far different appearance after a few washings, when the exposed wire ring generally hung from the threads all gathered together. This was superseded by a button made of two cloth or linen discs, which were gripped between the edges of a trough-shaped metal ring closed over them. These buttons had the disadvantage of requiring the thread for attaching them to be spread over a large area in order to give them sufficient hold; and this in turn prevented that flexibility which is necessary for easy fastening or unfastening. To obviate this difficulty Mr. Edward Green formed the cloth-covered button with a front shell of metal, perforated in the centre and covered with fine linen also perforated in the centre, and closed at the back by a metal ring, covered with a stout linen fabric and made to firmly nip and hold the edges of the covering fabric all round. The annexed sketches, showing sections of this button during its several stages, give a good idea of the linen button manufacture generally. Fig. 1 is the front shell flanged and eyeletted; Fig. 2, the same with the eyelet closed over the front linen cover; Fig. 3, the back ring suitably flanged to receive its linen disc cover; Fig. 4, the ring closed over the back cover; and Fig. 5, the finished button with the flange of the front shell closed over the linen-covered back ring. This button is attached only by its stout back fabric, the needle passing through the eyeletted hole.

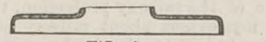


FIG 1

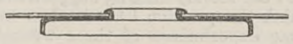


FIG 2

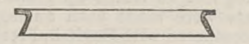


FIG 3

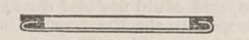


FIG 4

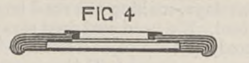


FIG 5

Similar buttons are also made with two small eyelet holes in the front shell, the thread passing over the narrow neck of metal in attaching them. They have, however, the disadvantage of the exposed metal discolouring the cloth. Accordingly, about a year and a-half ago, Mr. J. R. Green patented some improvements in sewn-through linen buttons which obviate this difficulty, while increased

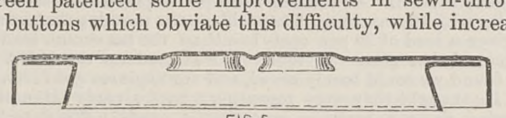


FIG. 6.

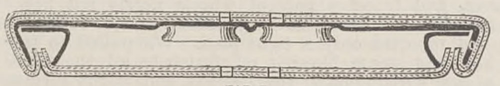
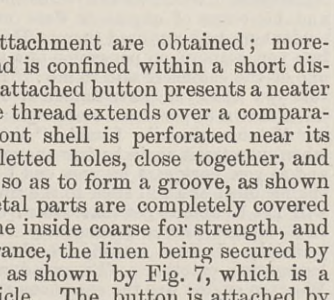


FIG. 7.

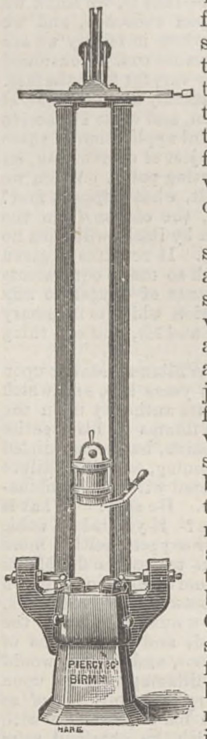
security and facility in attachment are obtained; moreover, as the sewing thread is confined within a short distance from the centre, the attached button presents a neater appearance than when the thread extends over a comparatively large area. The front shell is perforated near its middle by a couple of eyeletted holes, close together, and the back ring is flanged so as to form a groove, as shown by Fig. 6. Both these metal parts are completely covered by two linen discs each, the inside coarse for strength, and the outside fine for appearance, the linen being secured by a closing in of the flanges, as shown by Fig. 7, which is a section of the finished article. The button is attached by being sewn through both the cloth coverings and over the neck between the holes. To indicate the positions of the perforations, both back and front coverings are pierced with small holes during the process of manufacture.

The variety of cloth-covered buttons is endless, but the operations performed in producing them are very similar. The universal tool for stamping the discs and rings, flanging them, and subsequently closing one over another, is the single-side screw press, or such a one as that illustrated by the annexed sketch of the form made by Messrs. Piercy and Co., whose engine works are described on p. 254. The discs are punched out of sheet metal, brass, or zinc, very regularly, so as to leave a minimum of waste, and yet rapidly, without a gauge or fence, generally by girls. The zinc sheet is often passed over a gas flame just in front of the press, as it may be stamped more easily, and with less chance of cracking, when heated. The discs are flanged in one, two or more operations, according to the softness of the metal and the degree to which the edge has to be turned over, the holes being often eyeletted in the same operation or operations. The linen discs are stamped out also in the screw press, by punches like those for gun wads. Where two thicknesses of cloth are used they are stamped together, with a rapidity suggestive of automatic machinery. In closing the edges of the discs and rings over their linen coverings, all the parts are put into a cylindrical box having dies corresponding with those in the press, and also a spring for cushioning the thrust and probably releasing the parts easily. In some cases the box is divided into two parts horizontally, for receiving the various portions in their due relative position; and in such a case it is fed partly by the operator and partly by a second hand. The operator generally works the press with



one hand while feeding a second box for the next pressing operation, quite mechanically with the other.

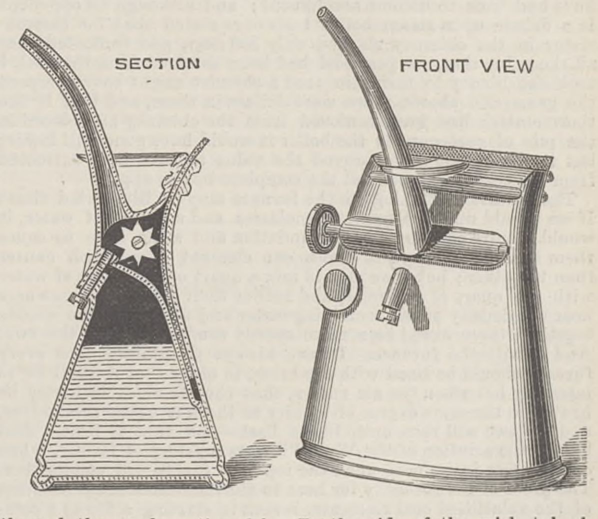
Mr. Green has invented a machine for performing all the operations to his patent buttons from the flanged metal and the linen discs. Four boxes are brought automatically under the press, just as the chambers of a revolver are presented to the barrel; and thus four successive pressings complete the button, which is blown off the last box by a small pair of bellows worked off the press. The new machine is driven by a treadle so as to obtain sufficient power; an attempt to work it directly by links, instead of by a screw as usual, not giving a sufficiently strong blow even when worked by a man. Now that a treadle is used in conjunction with the screw, it is found that a girl can exert the requisite amount of force, viz., that necessary to overcome the inertia and friction of the screw. In this new form of button the edges of the linen covering are all turned in; but in some of the older forms stray threads often hang out, which are cut off by scissors or flared off in a gas flame.



Metal buttons are stamped between steel dies under drops—such as that also of Messrs. Piercy's manufacture, shown by the accompanying cut—with successive stampings, so as to avoid cracking the metal. They are afterwards polished, and then tinned, japanned, or silvered. Silvering is performed, not by electro deposit, as that would require too much time and silver, but by simple washing. The buttons are cleaned in diluted acid, treated with cyanide of potassium to make the silver take, immersed in a solution of silver salts, washed, and then polished by being shaken in a bag with sawdust. Messrs. Plant and Green have lately brought out a new sleeve stud for ladies, with attachment for keeping the sleeve in its place while holding up the arm. The semi-automatic machinery which they have lately introduced has had the effect of reducing the number of hands to one-third for an equal if not greater production.

AN OIL CAN WITH WICK TUBE BESIDES A NOZZLE.

THE accompanying figures represent an oil can having a body of oblong form, provided with spring sides, and terminating in a wick tube for receiving a broad wick for applying oil to the surface of saws, for the purpose of lubrication, and for oiling metallic surfaces to prevent rust. This oiler has also a nozzle or spout, with a regulating valve for controlling the amount of oil escaping



through the nozzle or the wick. By the side of the wick tube is formed a chamber containing spur wheels placed on a spindle, extending logitudinally through the chamber and through the end of the can, the spur wheels engaging the wick, so that by turning the spindle the wick may be raised or lowered. This invention has been patented by Mr. Elijah Moat, corner of Third and Flower-streets, Los Angeles, Cal.—*Scientific American.*

SHIPBUILDING IN THE UNITED STATES.—Notwithstanding that the policy of Congress is to practically discourage shipbuilding in the United States, that industry is obviously at present in a more prosperous condition than it has been for two or three years past. In the construction of iron ships, it may, indeed, be said that the outlook is more promising than it has ever been. We noticed some weeks since the contract made by John Roach and Sons' Chester Works, with the Mallory Company for a large iron steamer for the New York and Galveston Line. At Wilmington it is understood that the local firms, Harlan, Hollingsworth, and Co., and others, are doing well, though rather in the direction of yachts and pleasure craft than of commercial constructions. The steam yacht building by Harlan, Hollingsworth and Co. for William K. Vanderbilt, is to be one of the largest, if not the largest, of its type in the world, and, though not especially designed for speed, is a sea-going vessel of the first class. At Philadelphia the shipbuilding yards on the Upper Delaware are all doing well, and that of William Cramp's Sons, employing 1800 men, has ten months' work ahead. Four steamers are very nearly ready for launching, a fifth, the Seminole, a large iron ship for W. P. Clyde and Co., having left the stocks on Saturday last. Besides this the keel of an iron steamer of considerable size for the Metropolitan Steamship Company, of New York, to be named the Herman Winter, after the consulting engineer of the line, was laid last week, and the El Monte, of the new Morgan Line, had a successful trial trip. The present week an iron vessel to ply between Tampa, Fla., and Havana has been laid down. These facts are exceedingly encouraging for the future, not only of the shipbuilding but the structural iron and plate-rolling industries, indicating, as they do, that American enterprise and skill have not yet lost the faculty of achievement, either in the way of design or execution. On the Pacific Coast a new vessel for Government service was launched last week at San Francisco, from the dock of the Union Iron Works. She is of steel, 125ft. long by 25ft. beam, and named the General McDowell.—*United States Army and Navy Journal.*

COMBUSTION, FIRE-BOXES, AND STEAM BOILERS.

By Mr. JOHN A. COLEMAN.[1]

I WAS rash enough some time ago to promise to prepare a paper for this occasion, the fulfilment of which prior engagements have absolutely prevented. For many years I was connected with steam engineering. I was once with the Corliss Steam Engine Company, and afterwards was the agent of Mr. Joseph Harrison, of Russian fame, for the introduction of his safety boilers. That brought me into contact with the heavy manufacturers throughout the Eastern States, and during that long experience I was particularly impressed with a peculiarity common to the mill-owners, which I believe it may be said with truth is equally common to those interested in locomotive engineering—namely, how much we overlook common, every-day facts. For instance, we burn coal—that is, we think we do—and boilers are put into mills and upon railroads, and we suppose we are burning coal under them, when in reality we are only partially doing so. We think that because coal is consumed it necessarily is burned; but such is frequently very far from the fact.

I wish upon the present occasion to make merely a sort of general statement of what I conceive to be combustion, and what I conceive to be a boiler, and then to try to make a useful application of these ideas to the locomotive. Treating first the subject of combustion, let us take the top of the grate-bars as our starting point. When we shovel coal upon the grate-bars and ignite it, what happens first? We separate the two constituents of coal, the carbon from the hydrogen. We make a gasworks. Carbon by itself will burn no more than a stone; neither will hydrogen. It requires a given number of equivalents of oxygen to mix with so many equivalents of carbon, and a given number of equivalents of oxygen to mix with so many of hydrogen, to form that union which is necessary to produce heat. This requires time, space, and air, and one thing more, viz., heat.

I presume most of you have read Charles Williams' treatise upon "Combustion," which was published many years ago, and which until recently was often quoted as an absolute authority upon the art of burning fuel under boilers. Mr. Williams in his treatise accurately describes the chemistry of combustion, but he has misled the world for fifty years by an error in reasoning, and the failure to discuss a certain mechanical fact connected with the combination of gases in the process of combustion. He said: "What is the use of heating the air put into a furnace? If you take a cubic foot of air, it contains just so many atoms of oxygen, neither more nor less. If the air be heated you cause it to assume double its volume; but you have not added a single atom of oxygen, and you will require twice the space for its passage between the grate-bars, and twice the space in the furnace—which is a nuisance; but if the air could be frozen, it would be condensed, and more atoms of oxygen could be crowded into the cubic foot, and the fire would receive a corresponding advantage." Mr. Williams proceeded upon this theory, and died without solving the perplexing mystery of as frequent failure as success which attended his experiments with steamship boilers. The only successes which he obtained were misleading, because they were made with boilers so badly proportioned for their work that almost any change would produce benefit.

Successful combustion requires something more than the necessary chemical elements of carbon, hydrogen, and oxygen, for it requires something to cook the elements, so to speak, and that is heat; and for this reason: When the coal is volatilised in the furnace, what would be a cubic foot of gas, if cold, is itself heated, and its volume increased to double its normal proportion. It is thin and attenuated. The cold air which is introduced to the furnace is denser than the gas. With the dampers wide open in the chimney, and the gases and air passing into the flues with a velocity of 40ft. per second, they strike the colder surface of the tubes, and are cooled below the point of combustion before they have had time to become assimilated; and although an opponent in a debate upon steam boiler tests once stated that his thermometer in the chimney showed only 250 deg., and indicated that all the value that was practical had been obtained from the coal, I took the liberty to maintain that a chemist might have analysed the gases and shown there were dollars in them, and that if the thermometer had been removed from the chimney and placed in the pile of coal outside the boiler it would have gone still lower; but it would not have proved the value to have been extracted from the coal, for it was not the complete test to apply.

The condition of things in the furnace may be illustrated thus: If we should mingle a quart of molasses and a gallon of water, it would require considerable manipulation and some time to cause them to unite. Why? Because one element is so much denser than the other; but if we should mix a quart of the gallon of water with the quart of molasses, and render their densities somewhere near the density of the remaining water and then pour the masses together, there would be a more speedy commingling of the two. And so with the furnace. I have always maintained that every furnace should be lined with fire-brick, in order that it shall be so intensely hot when the air enters, that the air shall instantly be heated to the same degree of tenuity as the hot gases themselves, and the two will then unite like a flash—and that is heat. And here is the solution of the Wye Williams mystery of failure, when cold air was introduced upon the top of a fire to aid combustion. The proof of the necessity for heat to aid the chemical assimilation of the volatilised coal elements, is seen in starting a fire in a common stove. At first there is only a blue flame, in which the hand may be held; but wait until the lining becomes white hot, and then throw on a little coal, and you will find a totally different result. It is also seen in the Siemens gas furnace, with which you are doubtless familiar. There is the introduction of gas with its necessary complement of air. Until the furnace and retorts become heated, the air and gas flutter through only partially united and do little good, but as soon as the retorts and furnaces become thoroughly hot the same gas and air will melt a fire-brick.

These are common phenomena which are familiar but apt to be unnoticed; but they logically point to the truth that no furnaces should present a cooling medium in contact with fuel which is undergoing this process of digestion, so to speak. It will be very evident I think from these facts that water-legs in direct contact with a fire are a mistake. They tend to check a fire as far as their influence extends as a thin sheet of ice upon the stomach after dinner would check digestion, and for the same reason, namely, the abstraction of heat from a chemical process. If fire-brick could be laid around a locomotive furnace, and the grate, of course, kept of the same area as before, it is my belief that a very important advantage would be at once apparent. An old-fashioned cast iron heater always produced a treacherous fire. It would grow dead around the outside next the cold iron; but put a fire-clay lining into it, and it was as good as any other stove.

If I have now made clear what I mean by making heat, we will next consider the steam boiler. What is a steam boiler? It is a thing to absorb heat. The bottom line of this science is the bottom of a pot over a fire, which is the best boiler surface in the world: there is water upon one side of a piece of iron and heat against the other. One square foot of the iron will transmit through it a given number of units of heat into the water at a given temperature in a given time; two square feet twice as many, and three, three times as many, and so on. Put a cover upon the pot and seal it tight, leave an orifice for the steam, and that is a steam boiler with all its mysteries.

The old-fashioned, plain cylinder boiler is a plain cylindrical pot over the fire. If enough plain cylinder boilers presenting the requisite number of square feet of absorbing surface are put into a cotton mill, experience has shown that they will make a yard of cotton cloth about as cheaply as tubular boilers. If this is so, why do not all put them in? Because it is the crudest and most expensive form of boiler when its enormous area of ground, brickwork, and its fittings are considered. Not all have the money or the room for them. To reduce space, the area is drawn in sidewise and lengthwise, but we must have the necessary amount of square feet of absorbing surface, consequently the boiler is doubled up, so to speak, and we have a "flue boiler." We draw in sidewise and lengthwise once more and double up the surface again, and that is a "tubular boiler." That includes all the "mystery" on that subject.

Now we find among the mills, just as I imagine we should upon the railroads, that the almost universal tendency is to put in too small boilers and furnaces. To skimp at boilers is to spend at the coal yard. Small boilers mean heavy and over deep fires, and rapid destruction of apparatus. In sugar houses you will see this frequently illustrated, and will find 16in. fires upon their grates. We have found that as we could persuade mill owners to put in more boilers and extend their furnaces, so that coal could be burned moderately and time for combustion afforded, we often saved as high as 1000 tons in a yearly consumption of 4000. Now, when the ordinary locomotive sends particles of coal into the cars in which I am riding, I do not think it would be unfair criticism to say that the process of combustion was not properly carried out. When we see dense volumes of gas emitted from the stack it is evident that a portion of the hard dollars which were paid for the coal are being uselessly thrown into the air; and it will be well to remember that only a little of the unburnt gas is visible to the eye. One point I wish to make is this. We find, as I have said, that as we spread out with boilers and furnaces in the mills, so that we can take matters deliberately, we save money.

Now, coming again to locomotives. I think if we examine the subject carefully the fact will strike us a little curiously. The first locomotive built in Philadelphia weighed about 14 tons. Judging from the cut I have seen, I should think her furnace might have been 30in. square. We have gone from that little 14-ton engine to machines of 50 and 60 tons, perhaps more. The engines have been increased over four times, but I will ask you if the furnace areas have been increased in proportion? Some of the furnaces of the engines are 6ft. by 3ft., but that is an increase of less than 3 to 1 of furnace, as against 4 to 1 of weight of engine. When my attention was first called to this matter, I had supposed, as most people do who are outside of the railway profession, that there was something subtle and mysterious about railway engineering that none but those brought up to the business could understand. Possibly it is so, and I am merely making suggestions for what they are worth, but I think the position I have taken in this matter was established by some experiments of three weeks' duration, which I conducted between Milan and Como, in Italy, for the Italian Government, in pulling freight trains up grades of 100ft. to the mile. The experiments were made with an engine built by the Reading Railroad. We competed with English, French, Belgian, and Austrian engines. These machines required the best fuel to perform the mountain service, and could use coal dust only when it was pressed into brick. We used in the Reading Railroad machine different fuels upon different days, making the road trip of 120 miles each day, with one kind of fuel. We used coal dust scraped up in the yards, also the best Cardiff coal, anthracite, and five kinds of Italian lignite, the best of which possesses about half the combustible value of coal. The results in drawing heavy freight trains were equally good with each fuel, the engine having at all times an abundance of steam on heavy grades, no smoke nor cinders, and no collection of cinders in the forward part of the engine. The fireman arranged his fires at a station, and did little or nothing except to smoke his pipe and enjoy the scenery until he reached the next station. An incident occurred to prove that we were not playing with the machine. They told me one morning that we should be given a load of 25 per cent. less than the maximum load of an engine of her class—30 tons. We started up the 100ft. grade and found we could barely crawl, and our engineer got furious over it. He thought they were repeating a trick already attempted by screwing down a brake in ascending a grade. We detected it, however, and found a pair of wheels nearly red hot. Upon this occasion we found nothing amiss, except full cars where they had reported only a light load. We pulled to the top of the hill, the steam blowing off furiously all the time. This was a new experience to the Italians, and might surprise some Americans. When we arrived at the station the inspector general and his corps of engineers were evidently amazed, and it was evident we had captured them. He said to me, "I can congratulate you, signore, on possession of a superb machine." Afterwards one of the engineers said to me: "Do not let it be known that I told you what you have hauled or I shall lose my place, but you have drawn 50 per cent. more than the maximum load of one of our 40-ton engines." I said: "You attempted to 'stall us, and when you try it again be fair enough to give me a flat of pig iron, and as you pack cars on one end I will pack pig iron upon the engine until she will stick to the track, but rest assured that you will not be able to get that steam down." The experience with that engine proves conclusively to my mind that the general principles of steam making are the same for both stationary and locomotive practice. The grand secret of the success of that Wootten engine was the enormous area of the grate surface, being, if I remember correctly, 7ft. by 9ft., permitting thin fires to be carried and complete combustion to be obtained before the gases reached the boiler tubes. An enormous crown sheet was presented, and that is where the bulk of the work of any boiler is done. Thin fires accomplish this. As already stated, a given amount of coal generates a given amount of gas, and this gas requires a given amount of air or oxygen. This air must be supplied through the grate bars and then pass through the interstices of the mass of heated coal. It requires about 10 cubic feet of air to consume 1 cubic foot of gas. In stationary boilers we find that if we use "pea" and "dust" coal, an extremely thin layer must be used, or the 10ft. of air per foot of gas cannot pass through it; if "chestnut" coal be used, the thickness may be increased somewhat; "stove size" allows a thickness of 6in., and "lump" much thicker, if any wise man could be found who would use that coarse, uneconomical size. Of course, I am speaking of anthracite coal. Opinions differ about "soft coal," but the same general principle applies as regards an unobstructed passage of air through the hot bed of coal.

Now, it will be agreed that the locomotive of the future must be improved to keep up with the times. Fierce competition requires increased efficiency and reduced expenses. I am told by you railroad gentlemen that the freight business of the country doubles every ten years. Trains follow close upon each other. What are you going to do? Are you to double, treble, or quadruple your tracks? It seems to me much remains yet to be done with the locomotive. We must burn a great deal less coal for the steam we make, and after we have made steam we must use that steam up more thoroughly. In the short cylinder required by locomotive service, the steam entering at the initial pressure pushes the piston to the opposite end, and it then rushes out of the exhaust strong enough to drive another piston. Of every 4 dols. worth of coal consumed, at least 2 dols. worth is absolutely thrown away. Or, of every 10,000 dols. spent for fuel 5000 dols. are absolutely wasted. How can we save this? It would seem obvious that if steam rushes from the exhaust of an engine strong enough to drive another engine, the common sense of the thing would be to put another engine 'longside and let the steam drive it, and we should get just so much more out of our 4 dols. worth of coal. It seems evident that we must follow the lead of the steamship men and compound the locomotive engine, as they have done with the marine engine.

Next we must attack the extravagant furnace and increase its area and reduce the depth of the bed of coal. The difficulty of making this change seemed to me to be removed, on examining an engine on the Providence and Bristol Railroad the other day. The machine was made at the Mason Works of Taunton. It was an engine and tender combined, the truck being at the rear end of the tender, and the drivers placed well in advance of the fire-box, so that the maximum weight of both engine and tender rested upon the drivers. In thus removing the drivers from the proximity of the fire-box, abundant facility is afforded for widening the fire-box so as to obtain a grate area as large as that of the Wootten engine, or of a stationary boiler. It seems to me the increase of grate area can be obtained only by widening; for a length of more than 6ft. or 7ft. is very hard upon the fireman. You certainly cannot get more power by deepening present fire-boxes except by an enormously increased waste of fuel, which all will concede is already sufficiently extravagant. In arriving at the conclusion of these hasty, and I fear somewhat incoherent remarks, I would say that the object aimed at for the improvement of the locomotive would be reached first by making steam economically by employing such increased grate area as will permit running thin fires and moderate or comparatively slow draft; and, secondly, in economically using the steam which has been economically made by compounding the engine.

[1] Address delivered before the Master Mechanics' Association.

OUR HEAVY GUNS.

SIR F. BRAMWELL delivered his address as President of the Birmingham and Midland Institute on Monday night. He took for his subject "Big Guns."

Apologising for addressing a Birmingham audience on big guns rather than upon small arms, the President stated that the guns with which Nelson fought successfully against unarmoured wooden ships, and which remained until the last thirty years, were cast iron muzzle-loaders rarely exceeding a calibre of 6·3in., a length of bore of 9ft., or 17 calibres, and a weight of 56 cwt. The gun had a smooth—unrifled—bore of uniform diameter from end to end, and fired a spherical shot of 32 lb. weight. After describing the defects of ordnance of this kind, and especially the disadvantages of the spherical ball, he said his audience would understand how it was that the cannon ball has, after so many years of use, disappeared from modern guns, and that its place is taken by an elongated projectile with a head in the form of a Gothic arch and having a total length of some 3 to $3\frac{5}{8}$ calibres. The alteration of the form of the projectile gives us the power of possessing so much of the initial velocity as was lost by the old spherical form, and also the greater power of attack per unit of area struck; but from the point of view of the duty of the gun in producing the muzzle velocity the change of form of the shot is a very grave matter. It is a matter involving no less than the change from smooth bore to rifle bore, the change in the length of the gun, the change in the nature and the quality of the powder, and eventually the change from the muzzle-loading to breech-loading. Obviously that which gives the velocity to the shot must be the pressure of the powder acting upon the area of the base of the shot throughout the travel in the gun; and if there are shots of equal weight and equal length of travel in the gun, it is clear that, whatever the form or whatever the area of the bore of the gun—*i.e.*, the base of the shot—the total average pressure must be the same. Having reminded his hearers that the whole of the energy of the powder was not expended on the shot, but a large proportion on the expulsion of the gases caused by its combustion, the President went on to show how the difficulties in loading and sponging long modern guns and in the requirements of "windage," that the projectile shall not stick fast in the operation of insertion, had led to the adoption of the breech-loading principle. The difficulty of erosion was endeavoured to be overcome by the use of what was known as a gas check, which consisted of a disc of copper attached to the base of the projectile and of such diameter that it could be passed down the bore from the muzzle, but so constructed that on firing the pressure of the powder gases should swell it out and cause it to fill up the bore and the rifle grooves themselves. It was found that though the gas check might thoroughly fit the bore when it was expanded, it did not steady the projectile as a driving band does, and thus the extreme accuracy of the shooting was impaired. Breech-loading is the remedy for all this; but it made enormous demands on the gun constructor in making a breech point capable, in the case of a 100-ton gun, of withstanding a strain of as much as 5800 tons, to be absolutely gas-tight, and to be opened or secured in a few seconds of time. Passing to the structure of the gun, the President dwelt upon the difficulty of producing a thickness of metal having at the firing an equal expansion throughout its thickness, and showed how it was possible under the strain of firing to extend the skin of the bore to the point where rupture would begin, while the outer layers of the metal should be so little expanded as to afford no sufficient aid to this skin. It is with the view of curing these defects that the system of putting an initial compressive strain on the inner metal by means of an initial tensile strain on the outer metal has been devised and adopted. But there is another construction of gun which admits of the theoretical calculations being much more nearly followed—namely, the system of coiling flat steel wire or ribbon around the tube, laying on these coils cold, and under predetermined tensions. There are many hopeful features about this system. Steel in the form of wire or ribbon is in a condition of very great tensile strength. The section of the material being so small it is very unlikely that there can be any concealed flaws. Moreover, if there are any, it is very unlikely that in the successive layers of ribbon such flaws would be aggregated in the same part of the winding, and thus there is hardly any chance of a considerable local weakness. Further, if there be a flaw it cannot go on spreading, as it may do through solid metal, but must be confined to its own layer. These are all important elements in favour of the use of steel wire or ribbon, and the President said he believed that if we had simply to consider the question of fortifying a cylinder to resist circumferential strain and nothing else, wire might unhesitatingly be adopted for the reinforcement. But in these days of machine guns and of quick-firing guns there is always a chance that a big gun may be struck by one of their bullets, and it might well be that a bullet which was too small to inflict serious injury to a gun reinforced by solid steel hoops would cut the wire coils to pieces, and would thus temporarily render the big gun unserviceable. This chance renders it necessary to enclose the wire in some kind of jacket that shall be sufficient to afford protection against bullets from such artillery. These difficulties have, however, in a great measure been already successfully grappled with in England, and there are now some four or five guns and howitzers under experiment, the largest being a gun of $10\frac{1}{4}$in. bore, having a length of about 29 calibres. Meanwhile, pending further experiments, we cannot afford to be without guns, and we must manufacture guns such as artillerists all over the world agree should be employed. After describing the method of casting and forging steel guns, and testing them when made, the President reviewed the progress that had been made in English ordnance in the last ten or twelve years. As regards dimensions of weapons, whereas in 1874 the 38-ton muzzle-loader was the largest gun we had ever made, we are now making 110-ton guns entirely of steel and breech-loading, having a shot travel of 25 calibres, a weight of projectile of 1800 lb., a muzzle velocity of 2106ft. per second, and a muzzle energy of 55,010 foot-tons. We have in the service or are making up to this time in all some 300 or 400 6in. guns. These have been made in successive lots, and on each occassion such improvements have been introduced as experience has dictated, so that there are as many as five marks or stages of development. Of these 6in. guns, from those already in the service thousands of rounds have been fired, including the proof rounds and a considerable proportion of other rounds with full charges. There is an old saying, "that bachelors' wives and old maids' children are perfect." Perfect likewise are the guns of the critics, and for the same reason—they have no existence. Therefore they have never been fired and therefore they have never failed. As regards the cost of tests of guns and experiments, the President mentioned that the expense attending the trial of sample projectiles out of an order for £10,000 or £15,000 worth exceeded £2000. He argued, however, that it was absolutely necessary, and that if we wished that the nation's means of defence should be kept up to cope with the means of offence of those who may covet this country or its possessions, we must be prepared to incur and even encourage a liberal expenditure on experiments.

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

(*From our own Correspondent.*)

The orders arriving at the mills and forges are required to be delivered in so short a time after their receipt that it is evident that buyers' stocks continue very low, and that they are only supplying early necessities. This state of things would greatly operate to makers' advantage if a revival were suddenly to make its appearance. At present, however, indications are not in favour of any such improvement, and ironmasters have to remain satisfied with a continuance of the existing somewhat slow demand.

Sheet makers are in a measure congratulating themselves this week upon local occurrences — resulting in the closing of two works—which are likely to operate in the direction of lessened competition. They contend that to do a large business at prices which ultimately prove to be worse than profitless is a style of trading by which no one benefits, and for which the market is the better when removed. The production of sheets this week is from this same special cause smaller than it has been for some time past. Makers are taking advantage of this circumstance to demand better prices, and where deliveries are required at an early date of good quality sheets they are meeting with some success in their advanced demands.

Some makers who are more independent than certain others on the score of orders, are this week quoting £6 5s. to £6 10s. for galvanising sheets of 24 gauge, and other gauges in proportion. Most makers, however, are still prepared to accept £6 to £6 2s. 6d., a price which leaves only a small margin of profit even with the most economical plant.

The rapid approach of the end of the quarter is not favourable to the giving out of new business this week. Consumers are trying to limit deliveries until next quarter comes in, so as to keep down accounts as much as possible. The works, however, keep on pretty well. Another circumstance which is just now operating to limit new orders is the anticipation which some buyers indulge of a reduction in ironworkers' wages during next quarter. With a view of obtaining all the benefit they can from such an event, they are disposed to curtail present buying operations. Inasmuch, however, as some time must elapse before any change in wages could be effected, consumers need not look for any lower prices at present; and the chances of an alteration in wages are less favourable this week than last, since prospects of a reduction in the North of England are less definite.

On 'Change in Wolverhampton yesterday and in Birmingham to-day—Thursday—the good harvest led to the expression of more hopefulness regarding the prospects of the country trade. The firm condition of the Scotch and Cleveland markets was also noted with satisfaction. Bars, hoops, strips, and stamping sheets were the classes of material most sought after for home consumption; while inquiries on account of foreign customers were principally for galvanised sheets and tin-plates. Russia has been a good market for some time past for sheets and plates, but in consequence of the lateness of the season, the Russian orders are now falling off. With Canada a good business is still being done in sheets and bars, and Australian orders are fully up to the recent average.

Marked bars are still quoted at £7 per ton, but not many of the makers are able to secure the list price. The medium and common qualities are in most request, the price obtained for the former being about £6, and for the latter £5 down to £4 10s. was the minimum.

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

The practice which is becoming more general among the thin sheet makers to roll their product out of steel in the form of tin bars, blooms, billets, and plate scrap, is resulting in a decreased employment of forge hands at best sheet works. At Messrs. Baldwin's, Wilden Works, the puddlers are under notice that their services can be dispensed with since the forges will be laid off, and steel will take the place of puddled iron. The price of plate ends delivered here from Welsh works is about £3 15s. to £3 17s. 6d., and billets keep at £4 5s. easy.

Messrs. Jno. Knight and Co., Cookley Ironworks, quote working up sheets £10 10s.; soft steel, £11 10s.; charcoal, £19; crown bars, £7; plough bars, £9; and charcoal bars, £15. Tin-plates they quote—charcoals, 23s. per box; cokes, 19s.; ternes, 17s.; tin sheets, 24s. 6d. for cokes, singles; and 29s. 6d. for charcoals.

Bedstead strips are selling well, and gas tube strips are in increased inquiry. The former are £5 5s. per ton for ordinary sizes, and the latter £4 15s., easy, for narrow gauges. Angles and tees are about £5 to £5 5s., reckoning them at the customary 10s. per ton above the prices of bars. Plate prices are without change.

The extent of pig iron sales made in Wolverhampton yesterday and in Birmingham to-day was not conspicuous. Consumers mostly covered themselves before the recent advances in imported brands, and they are now generally indifferent about operating. Some of them are bought forward for six or twelve months. With the market against them, they are now content to let well alone for a time. Sellers, however, keep up their quotations, encouraged this week by the strength manifest in the Northern markets. Good Northamptons are quoted 35s. 6d. to 35s. 9d. delivered, and Derbyshires, 36s. to 36s. 3d.; but consumers will not generally give within 9d. per ton of these prices. Lincolnshires are out of the market at the quotation of 38s. per ton. So, too, is the Thorncliffe brand at 47s. 6d.

Only limited sales of native pigs are being booked, and producers are becoming increasingly chary of running up large accounts. Prices are without much change. Common forge sorts are 27s. 6d. easy; common foundry, 30s. to 32s. 6d.; medium sorts, 35s. to 42s., according to mixtures; and best forge pigs, 50s. to 55s. Prices of scrap iron are following the general tenour of the market. Welsh sheet shearings are this week being offered at 40s. per ton—a reduction of 2s. 6d. per ton on last previous contracts. It used to be considered by the makers that prices could never go below 50s. per ton; but times have changed since then.

There would seem but little chance of the colliery owners being assisted by concessions from the men to tide over the present hard times. Matters as they affect Cannock Chase were considered a few days ago at an important meeting in Birmingham. The employers explained to the men's representatives that, owing to the low price of coal, they could not work the collieries at a profit. In order to continue operations, it was necessary for the day men to agree to work forty-eight hours in five days, instead of forty-eight in six days. A mass meeting of the men has this week been held to consider the answer. A resolution was passed "objecting to any interference with the hours of labour," but stating that if they could render any assistance to the employers by restricting the output to five days—of eight hours—per week, they were willing to do so. The men urged that the employers should seek relief from owners of royalties, and from the railway companies, "rather than ask men who were now unable to get a living to work two hours a day longer."

The miners of the Patent Shaft and Axletree Company, Wednesbury, have declined to accept a proposed increase of their stint by one-third, and are resolved to strike against it. The company state that it reluctantly makes the demand in the face of increased foreign competition.

Some improvement is perceptible this week in the North Staffordshire iron trades. Rather more confidence has been imparted by the freer buying of export merchants, who apparently believe that prices have touched bottom, and by home consumers who desire to replenish their lessening stocks. Prices, however, are no stronger. Crown bars are £5 10s. per ton; best qualities being 10s. to 15s. extra, delivered at Liverpool or equal. Plates range from £6 17s. 6d. to £7 5s., and best sheets are £6 10s. to £6 15s.; the quotation for medium qualities being £6. Iron hoops can be had at £5 5s. to £6 5s. Pigs have slightly improved.

Indian orders are here and there coming to hand a little more freely, and several others of an engineering sort are in prospect. It is known that the Indian State Railways are requiring ironwork for wagons and other materials, and efforts are being made to secure the orders for this district. Bridge builders note with satisfaction that inquiries continue to come out from some of the home railway companies. The Mildland Railway is just now in the market for some ironwork for bridges. Pipe founders still complain of the exceedingly low prices. Tenders are going from this district for the supply of pipes needed by the local authorities of Hucknall Huthwaite, near Mansfield.

The operative chain makers of Cradley Heath, have now entered on the seventh week of their strike. They seem determined to have the whole of their demands conceded, and threaten that if masters do not speedily come to terms they will formulate a 4s. list.

The forged nailers in the Halesowen district have decided to give the nailmasters' fourteen days' notice for the 1879 list. It is anticipated that a refusal by the masters of this concession will be followed by a strike.

The determination of the Birmingham Central Tramways Company to adopt the cable system on a portion of its line is likely to find increased work in this district. Some local firms have already sent in tenders for the supply of points, crossings, girders, and other ironwork required in the construction of the new cable line, which is to be begun at an early date.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—To judge from the general tone of the talk which goes on in the iron market, the prospects of trade would seem to be more hopeful, and unquestionably a better feeling prevails; but there is no appeciable increase in the volume of actual business doing, and although prices are steady at some advance upon the late low rates, makers have not been able to maintain the full rates they have recently been asking. What is the basis for the better feeling which prevails it is difficult to understand; in the large iron using branches of industry, except that local forge proprietors are rather better off for orders than they have been recently, there is no increasing activity from which any large expansion of demand for the raw material can be expected; what strength the market has gained during the last few weeks has been due to lessened production and not to increased demand, and although for the present a steadier tone has been given to trade, this has not been established on a healthy basis as to produce of itself a feeling of confidence with regard to the future.

The Manchester iron market on Tuesday brought together a fuller attendance than I have seen for some time past, and a more hopeful feeling seemed to find expression. The market, however, did not bring forward any large weight of business. For pig iron only a limited inquiry was reported generally. Where buyers are disposed to enter into transactions of any importance, they are based either on a return to something like the recent very low rates, or they are for long forward delivery, neither of which conditions makers seem inclined to entertain, and the actual business doing is confined to occasional parcels which consumers have to buy for present requirements, and upon which makers are able to hold out for an advance upon late minimum rates. For Lancashire pig iron makers are firm at 35s. 6d. to 36s. 6d., less $2\frac{1}{2}$, for forge and foundry qualities delivered equal to Manchester, and for good district brands the same figures also represent about the average current rates, but there are one or two sellers prepared to take 6d. to 1s. per ton under the above prices. In outside brands offering in this market prices are being well maintained, and for both Scotch and Middlesbrough iron makers generally are firm at their quoted rates.

Hematites still meet with only a slow sale in this district, and the average quoted prices remain unchanged from about 51s. to 51s. 6d., less $2\frac{1}{2}$, for good foundry qualities delivered equal to Manchester.

The local finished iron makers are in most cases fairly off for orders, but they are not able to get any materially better prices. The slight advance in Staffordshire bars, which are now quoted at £5 per ton for delivery into this district, tends towards a stronger tone, but there does not seem to be much doing at the advance, and it is exceptional where more than £4 17s. 6d. is being got for Lancashire bars, whilst hoops remain at about £5 5s., and sheets about £6 10s. per ton.

The condition of the engineering trades throughout this district remains without improvement; with but few exceptions works are only indifferently supplied with orders, and some of the large concerns have had to go on short time. New orders still come forward so slowly that, in many cases, they are not replacing the contracts that run out, and the outlook for the ensuing winter is, if not despondent, by no means encouraging.

This week I had an opportunity of going over the Ribble works at Preston, where the corporation are improving the waterway of the river, so as to make it navigable for large ocean-going steamers, and building extensive docks. The work, which was commenced in October, 1884, has made very satisfactory progress, and one portion, which consists of a diversion of the river, is, so far as the excavation is concerned, now practically completed. During the two years the work has been in progress nearly 2,500,000 yards of earth and about 170,000 yards of rock have been excavated, and in addition considerable progress has been made in the building of the dock walls. There are at present employed on the works about 1500 men, five steam navvies, thirteen locomotives, about 500 trucks and wagons, and five large Cornish pumps, besides numerous smaller ones. From the excavated material an embankment, three miles in length and averaging forty yards in width to 18ft. and 20ft. high, has been formed along the river, which has already resulted in the reclamation of over 100 acres of land, and a further reclamation will be effected when the embankment is completed. The entrance basin to the docks has been almost entirely excavated, and the stonework for one set of lock gates is in a fairly advanced condition. The construction of the dry docks is being actively pushed forward, and for one of them over 600 yards of the dock wall has been raised to a height of 20ft. or half the total height. This wall, which at the foundation is 17ft. in width, is formed of concrete—nine to one—with prepared chunks of red sandstone carefully embedded in it, and I may add that the whole of the dock walls, with the exception of stone dressings on the top, are built up of concrete in a similar manner, the materials for which are obtained from the excavations. The rubble obtained from the excavations is also being utilised for the formation of training walls in the river, and about 60,000 yards have been sent down. The south training wall has already been carried to a point opposite Lytham Dock, and is ultimately to be extended to a point about one mile below Lytham pier, but the construction of the north training wall will not be commenced until it is found to be necessary. To maintain a requisite navigable depth in the river, it is expected that extensive dredging will be required, and two exceptionally powerful steam dredgers—one of which is already at work—are being provided, with a number of specially constructed iron mud barges. The work is being carried out by Mr. T. A. Walker, of London, who has also in hand the building of dock extensions at Barrow.

After the disastrous explosion some time back at the Clifton Hall Colliery, near Manchester, where it was proved the men were allowed to work with naked lights, it would scarcely have been thought possible that a protracted investigation before official arbitrators and umpire would have been necessary to enforce the use of safety lamps in any mine, however well managed and efficiently ventilated. Such a course of procedure has, however, been necessary in the case of the Ladyshore Colliery, near Bolton, where up to the present the owner and the men have persisted in working the mines with naked lights. After the explosion at the Clifton Hall Colliery, Mr. Joseph Dickinson, H.M.'s Chief Inspector, served notices upon the owners of other collieries in Lancashire where naked lights were still in use in the mines, to the effect that, in the opinion of the Inspector of Mines, this system of working was defective, and dangerous to the persons employed in and about the mines, and must be remedied. With this notice the various colliery proprietors—with the exception of Mr. Herbert Fletcher, of the Ladyshore Colliery—complied, by abandoning the use of naked lights and replacing them with safety-lamps; but in the case of Mr. Fletcher an expensive arbitration, with ultimate reference to an umpire—Mr. Robert Winstanley, mining engineer, of Manchester—has been necessary to enforce the request made by Mr. Dickinson in his capacity as Inspector of Mines. An arbitration to enforce so obvious a duty, and which was strikingly emphasised by the actual occurrence of an explosion at the colliery whilst the inquiry was in progress, could of course have only one result, and the umpire has awarded that Mr. Fletcher shall cease to work the mines at his colliery with open lights as heretofore, and that he shall work, and caused them to be worked, with safety lamps; and he has further awarded that the costs of the arbitration shall be paid jointly by Mr. Fletcher and the Secretary of State.

The commencement of the usual winter's demand for house fire classes of fuel is giving some animation to the coal trade of this district, and many of the collieries are getting into full work, whilst there is much less coal going into stock. The increased demand does not make itself appreciably felt in other classes of fuel outside those suitable for house fire consumption; steam and forge coals and engine classes of fuel still meet with only a very slow sale and are plentiful in the market. In round coals prices show a tendency to stiffen, which in all probability will lead to some advance with the close of the month, but otherwise there is no quotable alteration at present.

For shipment there is a fairly good demand, with rather better prices being got.

Barrow.—I have to report a continuance of the steady tone in the iron trade of this district, which set in about a month ago. A good demand is experienced for all classes of hematite pig iron, and sales have taken place which dispose of large parcels that have accumulated at makers' works, and in the hands of holders generally. Stocks of iron which a month ago stood at 220,000 tons have been reduced to 200,000 tons, and a further reduction may be expected, as delivery engagements have been largely entered into which will require attention before the close of the shipping season at the end of October. In the meantime makers have not materially increased their output, and as a consequence they are able to maintain a very firm tone all round. Prices are steady at 42s. to 42s. 6d. per ton net, at works, prompt delivery, for mixed Bessemer qualities, and at 41s. to 41s. 6d. for No. 3 forge and foundry iron. In some cases where makers are favourably situated for orders higher quotations than these are asked. There is reason to believe that the position of the iron trade will enable makers to employ half the number of their furnaces during the winter. This will represent an output of from 25,000 to 27,000 tons of pig iron per week. Steelmakers are well employed on rails, and they have large orders on hand for rails and tie bars which will ensure a continuance of present activity during the autumn and winter months. There is a good inquiry for rails, especially on foreign account, and home railway companies have been buying largely of late. The demand for merchant steel, however, is inconsiderable, and the minor branches of the steel trade are, generally speaking, short of orders. Shipbuilders have not booked any new orders, and work is so scarce that a large number of hands are expecting every day to be paid off. The employment of a large number of steamers in the shipping trade which for some time have been laid up has obviated any immediate necessity on the part of the shipowners to place new contracts; but a few are in the market and it is hoped and expected some of them will be secured by builders in the district. The improved demand for iron ore experienced during the past few weeks has resulted in the disposal of large parcels of heavy stocks. Quotations are steady at 9s. per ton at mines. Coal and coke are steady and in regular demand at unchanged rates.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

Though the cheerful tone noted in iron circles still continues, iron can still be bought for forward delivery at present abnormally low rates—a fact which does not encourage hopes of any decided improvement on an early date. In some departments, however, there has been more business done, and consumers have no great stocks to fall back upon. They will find no difficulty in securing supplies from the larger stores. The leading companies have found some demand for their shares, which have consequently advanced, much to the comfort of investors, who see in the improvement promise of permanent prosperity.

In the railway material trade there is again more doing in wagons, though the productive power of our establishments are by no means fully employed. Rail orders only partially affect the Sheffield district, as the manufacturers, with the low quotations which have been current since the Railmakers' Association came to an end, find it increasingly difficult to take contracts in the face of competition from firms who have their works situated at the coast. For wheels, springs, and similar goods, there has been a little more animation; but the heavy orders which were anticipated from the colonies have not come to hand, and there has not been such an increase in the rail orders for the United States as was expected. Crucible steel continues quiet, the development of special steels for certain purposes in which high class crucible was at one time solely used, having militated seriously against the oldest of our staple industries. Engineers report that they are doing only a moderate business in the larger descriptions of plant and machinery. Though the armour-plate mills are running full time, chiefly on Government orders, there is not anything like the demand which was expected for heavy steel castings for ordnance, and for marine engines. It was thought the Government would follow up the important orders recently placed for armour by calling for steel ordnance for the arming of the new war ships. As yet, this has not been done.

In the lighter industries several houses report an improved demand for saws, files, and edge-tools. The sheep-shear, scythe, and sickle-making firms have had a very good season. For sheep-shears the South American and colonial call has been much heavier than last year, which proves that the wool growers have largely, if not completely, recovered from the terrible drought which did such havoc among the flocks two seasons ago. Spring and table cutlery is in pretty brisk request, chiefly on foreign account, though some better orders have come in from home markets. Some firms are not able to give their men full employment, but, on the whole, there is not much to complain of in the cutlery trades. There is also a much better business doing in the silver and plated industries. The Australian markets are more fertile in orders, and two of our leading houses have been exceptionally favoured from that quarter during the last few months. Another department which has shown signs of revival is the razor manufacture. Several local firms have had good orders of late from various home and foreign markets. Surgical instrument makers, brassfounders, and stove-grate manufacturers are doing a fair business, which in the two first specialities promises to increase during the winter quarter.

American trade generally continues to improve, and the advance in the price of wool will greatly benefit several of the colonial markets, particularly those where a barter business is done. The wool-growers, by getting a longer price for their chief commodity, will be encouraged to lay in stocks of the cutlery and hardware they need, to take advantage of the favourable turn in prices, and this can have nothing but a beneficial influence upon the home industries.

Our local collieries are doing more business with Hull for export. During August the weight taken to Hull was 128,448 tons, against 126,920 tons for the corresponding month of 1885, showing an increase of 1528 tons. Denaby Main heads the list with 10,776 tons, against 3000 tons in August last year. Aldwarke Main, Corton Wood, Carlton Main, Houghton Main, Kiveton Park, Swaithe Main, Thorncliffe, Wath Main, Tryston, and Mitchell Main all show substantial increases.

Our commercial houses and business firms generally have been much interested in the publication of the *Board of Trade Journal*, the new monthly periodical devoted to tariff and trade notices and commercial information of different kinds. It is believed that the journal will be of great value, particularly if its scope should be extended and the issue be more frequent. The two numbers issued deal with recent tariffs alterations, decisions affecting the application of Customs tariffs, the tariffs of Roumania, with statistical tables, reports from her Majesty's representatives and foreign consuls, and other matters of interest to trading establishments.

In the Erewash Valley there has been an improvement in the house coal trade, though demand has not been equal to supply, and prices therefore remain unaltered. Most of the pits are making three-quarters time. Common qualities of house coal are offered for rail sale from 5s. 6d. to 6s. 6d; yet even at this low figure little business is doing. In iron there is little change in this important district, and engine fuel sells very slowly, prices keeping as low as ever.

Iron is now making as follows: No. 1 foundry, 34s. to 35s.; No. 2, 32s. to 33s.; Nos. 3 and 4, 31s.; forge pigs run from 28s. to 30s.; and mottled and white, 27s. and higher. A better business is doing in pipes and ordinary castings, and the Staveley works are also well employed in these specialities.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE pig iron market held at Middlesbrough on Tuesday last was decidedly firm in tone; for it seems now to be widely believed that the depression which has so long prevailed is at last beginning to pass away. The demand for Cleveland pig iron is slowly improving. Consumers, however, show little disposition to speculate, all that they purchase being for prompt delivery. A fair amount of business was done, and sellers evinced throughout an unyielding spirit. Neither makers nor merchants would take less than 30s. per ton for No. 3 g.m.b. for prompt delivery, and some hold out for more. All of them consider their position to have been much strengthened since the restriction actually commenced. The price of grey forge remains at 29s. per ton. Warrants are nominally 30s. per ton.

The stocks in Messrs Connal and Co.'s pig iron stores are still increasing, though at a much slower rate than has been the case for some time. On Monday last the Middlesbrough stock was 299,582 tons, being an increase for the week of 860 tons, and at Glasgow the stock was 821,237 tons, or an increase of 2005.

This month's shipments of pig iron have been so far satisfactory, 51,661 tons having been exported so far, as against 44,479 tons in the corresponding portion of August.

The demand for finished iron has not improved, but prices are somewhat firmer, in sympathy with the increased firmness in price of pig iron. Ship plates are still £4 7s. 6d. per ton; common bar iron, £4 10s.; and angle iron, £4 5s., all free on trucks at makers' works, less 2½ per cent. discount.

Steel manufacturers are well supplied with orders, but prices are extremely low. Ship plates command £5 17s. 6d. per ton, and angles £5 12s. 6d. at makers' works.

It is reported that Messrs. E. Withy and Co., of Hartlepool, have received two new orders for steamers; one is from Messrs. T. Robinson and Co., produce merchants, and the other from Messrs. George Horsley and Co., timber merchants, of that town.

The directors of Messrs. Sadler and Co., chemical manufacturers, Middlesbrough, have just issued a remarkable report, which is intended to be submitted to their ensuing shareholders' meeting. It will be remembered that Sadler and Co. was originally a private firm, which as such is believed to have been very successful. A few years since the undertaking was sold to a limited company, which was afterwards amalgamated with a similar company, whose works are situated in the South of England. The object of the amalgamation was to obtain, if possible, a monoply of the trade in the products manufactured. The amalgamation, however, did not answer, and the two companies separated, each one taking its own course. The directorate of Sadler and Co. is a very strong one. The shares at first were eagerly sought after, and went to a considerable premium. Large extensions were made in buildings and plant, and all seemed to indicate a long period of prosperity for the company. The disappointment therefore which must be felt by all concerned at the report of the directors which has just been issued must be very great. They say that the extraordinary shrinkage in the value of their manufactures, which affected adversely the balance-sheet of last year, has steadily continued. They proceed to give the market value of a few of their special products at the time of the formation of the company and at the present and intermediate dates. This comparison is as follows:—

	1883.	1884.	1885.	1886.
Alizarine, per lb.	2s. 6d.	1s. 6d.	1s. 4d.	0s. 9d.
Anilines, ,,		About 50 per cent.		
Benzole, per gallon	12s. 0d.	3s. 8d.	3s. 3d.	1s. 6d.
Creosote, ,,	0s. 3½d.	0s. 3d.	0s. 2d.	0s. ¾d.
Pitch, per ton	34s. 0d.	32s. 0d.	18s. 6d.	13s. 6d.
Anthracene (30 p.c.)	£55	£50	£40	£20
Sulphate of ammonia	£22	£15	£12	£10
Oxalic acid, per lb.	0s. 6d.	0s. 5d.	0s. 4½d.	0s. 3d.

The prices which alone they can now obtain are very much lower than have ever been previously known in the trade, notwithstanding that the volume of consumption has increased and stocks have decreased. The loss on the past year's working amounts to £18,003 16s. 1d. The causes of this loss are as follows, viz.:— (1) Keen competition, particularly from German manufacturers, resulting in a heavy fall of prices. But for this—or, in other words, had prices kept up to their former level—no less than £117,258 would have been earned more than actually was received during the past year, without any addition to cost of production worthy of mention. (2) The company has lost seriously on its tar and ammoniacal liquor contracts. It had made, it would seem, a great many of such contracts, probably with the idea of preventing competition by securing all available raw material. Tar, however, has fallen during the year 50 per cent. in value—a result they did not anticipate, and which has proportionately disturbed their calculations. (3) A serious fire occurred in July last year in the alizarine department. Although the property actually burnt was insured, still the loss resulting from interference with business was very heavy. The directors can only comfort themselves and their shareholders by reflecting on the excellence of their buildings, plant, and appliances, and on the high quality of the products they manufacture. The nominal capital of the company is £500,000, in 25,000 shares of £20 each. Nearly half of the above has been paid up. The gross returns for the year amounted to £133,083 5s. 4d., and the value of the stock on the 30th June last was £38,703 14s. 11d.

At the North Skelton mines, which were closed a week or two since, the employers, Messrs. Bolckow, Vaughan, and Co., offered to re-open them for machine work only, at 1d. per ton reduction. This offer has been accepted by the miners, and work will probably be resumed at once. At the Boosebeck mines belonging to Messrs. Stevenson, Jaques, and Co., 120 hands have received notice to terminate their engagements. This is said to be a direct result of the restriction movement. At the Marske mines, belonging to Messrs. Pease and Partners, about forty miners have received notice for the same reason.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron market has been firm this week, with prices a little higher, in consequence of the labour agitation and the putting out of furnaces. As the ironmasters have determined to resist the demands of the colliers for an increase of wages, they are stopping some of their pits, and sending as much coals from the others as possible to compete in the open market with the coalmasters, most of whom have already given one advance of 6d. a day. During the week seven furnaces have also been put out of blast, the seventy-five now in operation being the smallest quantity for a considerable number of years. The result has been a general stiffening in the prices of pig iron, and rather more inquiry for the same. The shipments in the past week were 9396 tons, as compared with 7928 in the preceding week, and 12,214 in the corresponding week of 1885. There is a reduction in the amount of pig iron being sent into Messrs. Connal and Co.'s stores of about 2000 tons a week, as compared with the quantity stocked several weeks ago.

Business was done in the warrant market on Friday at 39s. 10d. cash. Monday's market was active at 39s. 10½d. to 39s. 8d., returning to 39s. 10d. cash. On Tuesday transactions were recorded at 39s. 10½d. to 39s. 11½d. cash. Business took place on Wednesday up to 40s. 3d. cash, receding to 39s. 11½d. To-day—Thursday—transactions occurred at 39s. 11½d. to 40s. 3d., closing at 40s. cash.

The values of makers' pig are generally firmer, and in a number of cases higher, as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 44s.; No. 3, 41s. 3d.; Coltness, 48s. and 42s. 6d.; Langloan, 43s. 6d. and 41s. 3d.; Summerlee, 45s. and 41s. 3d.; Calder, 45s. 3d. and 41s. 3d.; Carnbroe, 41s. 6d. and 39s.; Clyde, 42s. 6d. and 39s.; Monkland, 41s. and 36s. 6d.; Govan, at Broomielaw, 41s. and 36s. 6d.; Shotts, at Leith, 43s. 6d. and 43s.; Carron, at Grangemouth, 46s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 42s. and 40s.; Eglinton, 40s. and 36s. 6d.; Dalmellington, 40s. 6d. and 38s.

Some of the steel works are busy, and there have been reports on 'Change in Glasgow this week that additional shipbuilding orders are coming into the market. Work has been practically at a stand for weeks at the Dalziel Steel Works, Motherwell, in consequence of a strike of the workmen, but there is now some prospect of work proceeding there.

At a number of the malleable iron works of Lanarkshire trade is so slack that the men are working only half-time.

The past week's shipments of iron and steel goods from Glasgow embraced locomotives valued at £7500 for Queensland, and £6750 Kurrachee; machinery, £9000; sewing machines, £557; steel goods, £4550; and general iron manufactures, £27,100.

The demand for coals has shown a considerable revival in the past week, in consequence no doubt of the continued stiffening of prices, and the shipments show a total increase of upwards of 4000 tons, as compared with those of the same week of 1885. From Glasgow, 22,368 tons were depatched; Greenock, 390; Ayr, 8799; Irvine, 1808; Troon, 6331; Burntisland, 25,230; Leith, 4276; Grangemouth, 12,485; and Bo'ness, 7031 tons.

The miners' agitation is proceeding with considerable vigour throughout the colliery districts, and this week some of the colliers of Lanarkshire have made a request for the addition of a second 6d. a day to their wages. The masters point out that the first 6d. has not yet been conceded all over the country, and that the demand is therefore premature. Very few of the ironmasters have yet given any increase, preferring to put out furnaces where coals are lacking instead of making the concession. In Fifeshire the coalmasters have not proceeded to a lock-out, as was at one time proposed. Their alternative policy is to institute prosecutions against the colliers for a breach of the regulations in working short time. Their rules provide that the men shall work at the least eleven days a fortnight, but this they have not been doing of late.

Messrs. William Baird and Co., the well-known ironmasters, have erected machinery at their Lugar Ironworks in South Ayrshire, for the manufacture of coal briquettes, a very handy fuel made from coal dust and a small proportion of pitch. This is the first time the manufacture has been taken up in Scotland, although a similar industry—patent fuel—is somewhat extensively carried on at Cardiff and Sunderland. The firm will be able to produce about 200 tons of the briquettes per day.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

AN important movement is on the eve of being started, and that is to bring about a reduction of coal rates on the various railways. Coalowners have been forced to lower the prices of coals to the smallest figure, to carry out reductions of wages at every turn, to resort to the most economical courses compatible with safety of working, and yet for several years there has been no regular lowering of railway rates. These have been kept hard and rigid, and it is time for the interest of all engaged in the trade that a reduction should be made.

Coalowners of late have adopted somewhat of a defensive policy. They have refused to sell at ruinous prices, and the result is that a keen sale has taken place of Monmouthshire coals. It follows that if railways reduced their rates, and so enabled owners of the best coals to compete more fairly, railways too would share in the benefit. Taking the Taff as one line of rail largely employed in the coal traffic, a fall of 20,000 to 30,000 tons per week must be a serious loss to them, and necessitates measures for correction. Coalowners have another complaint under discussion, and that is the office commission at the ports. Whatever price is quoted in the market, it is subject to the same commission, and this, in their opinion, should be liable to the sliding scale arrangement—coal, f.o.b. Cardiff, say, at 10s., subject to a certain commission, and at 9s. or 8s. proportionately less.

The coal world is rather quiet at present, and only partial activity is to be seen. Few collieries are working regularly, but some are better off than others—Penrhiwceiber and Harris's Navigation for instance. In referring to the latter lately as the deepest colliery in South Wales, and now turning out a much better output than it ever has, I only dealt scant justice to the manager, Mr. Price, to whom I now find all credit is due for the improvement that has been brought about. I am only too happy in noting this, as Mr. Price has risen from the ranks by natural ability and determined energy.

I hear that the "History of the Coal Trade of Wales" is progressing rapidly, and will treat fully of the first workings in the Swansea, Pembrokeshire, and the later Glamorgan districts, with narratives and biographies accompanying the coal development. Travellers by the Taff Vale to Cardiff can see any day an illustration of the changes wrought by coal development. A short time ago there was a large tract of mountain land with only a solitary farm upon it near Aberdare Junction. Now there is a tall colliery shaft near the farm, a siding two miles in length admirably made by the Taff, and quite a township is springing up. This is the last new colliery in point of date, and the problem now is to find any untaken coal area. This fact should encourage coalowners in the present hardness of times. Best coals must sooner or later advance in price. Quotations are firm at 8s. 6d. to 8s. 9d. best coal; small steam remains at 5s.

The Boiler Insurance Society is progressing.

Newport coal shipments, like those of Cardiff, show slackness. Coastwise last week they amounted to 25,423 tons. Swansea shows more briskness than either, and sent off over 28,000 tons of coal last week. Patent fuel trade too is busy, both there and at Cardiff.

A new industry has been started near Caerphilly in the form of lead mines. These are said to promise well. Lead mining was formerly carried on at the northern edge of the carboniferous limestone bed, but failed. This is the first effort, to my knowledge, on the southern edge.

Messrs. Nettlefold's new industry near Newport is going on capitally. Two fine stacks are now built at Rogerston, and the proprietary intend beginning work before the year's end. The make will be hoop and wire.

A firmer tone characterises the iron and steel trades, and the consignments lately have been better, Swansea sending 200 tons of rails to the States. In rail business, particularly steel rails, there is more quietness than one likes to see. This, however, must be expected for a while.

Taking a rough calculation, we have 19,000 miles of railway in this country alone, and it is not a difficult matter to arrive at some notion of the average renewals. The difficulty, of course, is in the change from iron to steel, and the longer life of a steel rail. Still, long as the life is, even steel rails wear out, and if I am not very much mistaken, the time is at hand for extensive renewals.

The steel sleeper make is increasing. Directors are sanctioning a good deal of experimental laying, "just to see how they will do;" but for the present there is no regular large order for home railways.

Railway men are acute and investigatory; they want to see how atmospheric conditions suit, how pressure acts. In this district one serious item is the character of the ballast used. A good deal of this is the cinder from ironworks, containing a large amount of sulphur. Steel placed on this without due precaution would soon oxidise. I have just seen some old rails and fragments turned up from a tip at Plymouth; they are almost eaten away.

I have no good news regarding tin-plate. Prices for ordinary cokes and Bessemer steel are down to 12s.; in some cases 12s. 3d., and in a few 12s. 6d.; but, on the whole, business is flat. Small parcels form the leading business, and prospects are gloomy.

Three weeks ago stocks at Swansea were about 66,000 boxes; this week they are 134,000. The exports last week only amounted to 33,000 boxes. This formed little more than half the make.

I am glad to note a systematic reduction of horse labour in collieries; wheels, steam, and ropes are clearing them out of the pits.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

A SOMEWHAT disheartening effect has been produced on the Westphalian iron market, because a foreign firm has just succeeded in carrying off part of an order for steel rails for the State Railways, a thing which has not happened before for a long time.

The market for pig iron in Silesia is more buoyant this week, as there are indications of prices having touched bottom. Forge pigs stand still at 38 to 40, foundry at 51 to 52, and inferior qualities at 48 to 50 M. p.t. The foundries are pretty well occupied on machinery castings, columns, plates, &c., without prices having risen. The rolling mills complain of low prices, but good season orders are flowing in from merchants and agriculturists. The merchants' stocks of plates and sheets had run low, and this branch is momentarily very busy replenishing them. Bars are quoted 87·5; for best sorts, 9 to 9·50 is paid; and for fancy sections, 9·50 to 10. Coke plates are 135 to 140, and best quality 145 up to 160 M. p.t., but these prices are out of all proportion to the cost of production. In the Rhenish-Westphalian market no great change is perceptible. Ores are not much sought after, and the prices have become lower than they were. Raw steel stone, 7·00 to 7·50; roasted, 9·50 to 10·50; brown iron ore, 8·30 to 8·80; glance, 8·80 to 9 M. p.t. at mines.

Pig iron prices remain unchanged by too little demand. Spiegel is in most request, but no export trade is doing in it, and foundry iron is little called for, whilst in forge pig, since the coke combination has practically come to an end, there is no stability in the trade, and as steel begins more and more to take the place of iron, the demand for it naturally diminishes. Bessemer and basic pigs also remain without any alteration in demand or price. Spiegel costs 46; foundry pig, for the three Nos., 45 up to 53; forge, 39 to 42; Bessemer, 42 to 43; basic, 38; Luxemburg forge, 28 to 30 M. p.t., on which prices, however, concessions would be accorded. In the bar iron departments the works keep well on producing, and there is just now a pretty good sale, but the excessive competition of some of them ruins every chance of making a profit, which makes the business very unsatisfactory. In plates the best business is doing. Sheets cannot realise more money, though the demand for them has much improved. Wire rods are much below par, as prices have again fallen. In small railway materials the demand is satisfactory, but the rail business is at a low ebb, for since England competes in the North and Belgium in the west there is no profit left for German works when they do secure an order for domestic wants. A fortnight ago it was shown in this place to be in a worse condition than any other branch of the iron trade, and to complete the remarks then ventured, it may be mentioned that 200,000 t. are all the rails the State railways require yearly, and that there are sixteen large steel works, many of which are alone capable of making nearly that quantity, to compete for them. But that is not all, for the fact of the Cockerill Company successfully competing at Strasburg on the 3rd of September for 3000 t. of rails at M. 105, while the Westphalian works tendered at M. 110 p.t., which scarcely pays, if it does that, shows still further the hopeless position of the trade in this country. Cockerill's price is made up of 70 M. for the rails at works, 25 duty, and 10 for freight. These prices are 10 M. lower than those which obtained for former tenders. To return, good bar and girders are quoted at 91 to 97, but can be bought 1 to 2 marks cheaper; angles and tees, 100 to 105; hoops, 100 to 105; in steel, 105 to 115; rivet iron, 115 to 120; best plates, 143 down to 130 for inferior qualities; thin sheets, 122 to 125; wire rods, 99 to 101; in steel, 96 to 100; drawn wire, 115 and higher; steel rails, 120 to 125; sleepers, 122 to 130; wheels and axles, 315 to 320; tires, 220 to 235 M.

In Silesia and Saxony the coal trade is brisk, whilst in Westphalia it is the reverse for both coal and coke, and prices remain as last quoted. The report of the Bochum Chamber of Commerce says that, in spite of a slightly increased output, the receipts have diminished, and that the number of mines either working without profit, or having had to raise funds by mortgage, has increased for the year, and that as wages have not been sensibly lowered, the capitalist at present bears the loss.

The constructive workshops are not better employed than when last reported. The recent tenders for the ordinary goods engines and tenders for the Rhenish Railway were, Henschill and Co., of Cassel, M. 27,450; and Vulcan Company, Stettin, M. 28,250 per engine. In France and Belgium the market is quiet but firm.

Here it will be *apropos* to state the production of coal in Belgium, which was in 1885 17,346,711 tons against 18,057,499 tons of 1000 ks. in 1884, in both years raised from 148 mines. In the same period were produced 75,416 tons foundry pig in 1885, against 50,620 in 1884; forge pig, 512,753 in 1885; 547,328 in 1884; Bessemer pig, 126,498 in 1885; 152,864 in 1884; rails and plates, 100,260 in 1885; 111,839 in 1884; other kinds of wrought iron, 353,967 in 1885; 359,201 in 1884; steel ingots, 149,189 in 1885; 185,916 in 1884; forgings, rails, and plates, &c., 116,119 in 1885; 153,999 in 1884; together, in 1885, 1,431,212, against 1,561,767 tons of 1000 ks. in 1884, which shows a decrease of 8·4 per cent. for last year.

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS: NORTHERN DISTRICT.—A meeting will be held at West Hartlepool on Saturday, October 2nd, 1886. Members will assemble at 11.30 a.m. in the Commissioners' board-room. The business to be transacted is the election of local district secretary. The following papers will be read and discussed:—"The Construction and Maintenance of Macadamised Roads," by J. W. Brown, C.E., F.G.S., town surveyor, West Hartlepool; "Sea Wall Construction," by H. Mair, Esq., C.E., borough surveyor, Hartlepool. The members will afterwards—under the guidance of Mr. Brown and Mr. Mair—visit Mr. Trechmann's cement works and the sea wall now in course of construction at Hartlepool.

AMERICAN NOTES.

(From our own Correspondent.)

New York, Sept. 11th.

The New York market is gaining a little activity in nearly all kinds of iron and in the metals. Prices are firm throughout. This firmness does not lead to very heavy orders because of the heavy production. The opinion is pretty widely entertained that demand will be heavy, and complaint that higher prices will not be established. Steel rails have weakened a little. Large contracts were placed this week at mill at 34 dols., but the deliveries are late. Railmakers are anxious to book orders for spring delivery. The merchant steelmakers throughout the country have also done a good deal of business since the 1st of September in crucible machinery and general tool steel. The demand for wagons, carriages, tools, agricultural implements, and for small machine shop machinery has set in, and thus stimulated inquiry and orders for all grades of merchant steel. In Western Pennsylvania a great many orders are being received. The pipemakers have more orders in hand than they can conveniently execute for sixty days. The wheeling ironmakers are adapting their mills to the use of natural gas fuel, and within a month or six weeks eight or ten of them will be operated in that manner. An attempt was made at Pittsburgh to operate a blast furnace with natural gas fuel, but failed. A number of new pipe-laying enterprises have been brought to public attention by the granting of charters, and work will be begun as soon as the wrought iron pipe can be secured. The demand is extraordinary for all kinds of pipes and tubes. A large pipe works is to be established near Birmingham, Alabama, where 600 men will be employed in pipemaking. There are heavy orders for cast iron pipe for waterworks. Machinery manufacturers are also well supplied with orders because of the general movement among manufacturers to enlarge their capacity. Quotations for pig iron to-day are at tide-water markets 18 dols. to 19 dols. for No. 1 foundry and 15 dols. 50c. to 16 dols. 50c. for forge, according to quality. There is a fair movement in Scotch iron, but Bessemer pig, although inquired for frequently, has not met with much sale. Quotations are 19 dols. to 19 dols. 50c.; 20 per cent. spiegeleisen has been sold in 500 and 1000 ton lots at 25 dols. A good many blooms are wanted, but quotations have advanced to 27 dols. 50c., and business is therefore off. Buyers of tin-plate are in the market making large purchases for the winter. The retail demand for tin is improving, and the consumption of tin-plates during the next four months will be very large.

NEW COMPANIES.

The following companies have just been registered:—

Buenos Ayres and Valparaiso Transandine Railway Company, Limited.

This company was registered on the 13th inst. with a capital of £700,000, in £20 shares, to purchase from Juan Eduardo Clark, or Mateo Clark, the rights acquired under a concession dated 26th January, 1874, from the Minister of the Home Department of the Argentine Republic, for the construction of a railway from the city of Mendoza or San Juan, in the direction of San Felipe los Andes (Chili), up to the limit of the Argentine Republic, either by the Los Patos Pass, or by the Uspallata Pass. The subscribers are:—

	Shares.
E. C. C. Smith, 54, The Close, Clapham	1
A. P. Driver, 8, Victoria-chambers, engineer	1
H. D. Blyth, 157, Fenchurch-street, ship and insurance broker	1
A. Scott, Lloyd's, underwriter	1
A. Betz ld, Bartholomew House, merchant	1
C. J. Whitaker, 12, Waldegrave-road, Teddington	1
E. Garthwaite Farish, 144, Ebury-street, S.W., solicitor	1

The number of directors is not to be less than three nor more than seven; qualification, twenty-five shares. The subscribers are to appoint the first and act *ad interim*; remuneration, £1500 per annum.

Palmer Company, Limited.

This company proposes to purchase from the City of London and General Business Agency, Limited, the English, French, German, and Belgian patents for improvements in button-hole attachments for sewing machines, for making button-holes. It was registered on the 14th inst. with a capital of £10,000, in £1 shares. The consideration is £3000 in cash, a bill of exchange for £500, and 6500 fully-paid shares. The subscribers are:—

	Shares.
C. F. B. Birchall, 5, Mark-lane, solicitor	1
G. Birchall, 5, Mark-lane	1
A. J. Hayes, 63 and 64, New Broad-street	1
J. M. Hannay, 20, Tollington-place, N.	1
J. Murphy, 43, Vardens-road, New Wandsworth, clerk	1
J. Tucker, Dagmar Cottage, Hampton	1
W. A. Hunt, 52, Wellesley-road, Snaresbrook	1

Registered without special articles.

Lactina and Restorine Manufacturing Company, Limited.

This company proposes to manufacture lactina and restorine and other artificial cattle foods, and for such purpose will adopt an agreement of the 30th July made with the Lactina Manufacturing Company, Limited, and its liquidator, Mr. H. C. Sargent. It was registered on the 15th inst. with a capital of £10,000, divided into 1000 preference and 1000 ordinary shares of £5 each. The subscribers are:—

	Shares.
*J. S. Clarke, Bedford	1
*J. W. P. Dainty, 25, Algernon-road, Hendon, manufacturer	1
J. R. Bowick, Harpenden, Herts	1
A. Taylor, 31, South-grove, Peckham	1
L. H. Graham, 19, Oakley-square, N.W., accountant	1
*T. Coleman, 161, Strand, advertising agent	1
A. H. Reed, Suffolk House, Laurence Pountney-hill, engineer	1

The number of directors is not to be less than three nor more than seven; the first are the subscribers denoted by an asterisk; remuneration, £100 per annum, to be increased to £250 in any year in which £10 per cent. dividend is paid. Mr. J. S. Clarke is appointed managing director.

Costa Rica Markets and Tramways Company, Limited.

This company proposes to carry on the business of tramway and omnibus proprietors and carriers, in Cartago and elsewhere in the Republic of Costa Rica, and also to construct, equip, and manage markets in the cities of Cartago and Heredia, and elsewhere in the said Republic. It was registered on the 9th inst. with a capital of £50,000, in £10 shares. The subscribers are:—

	Shares.
*J. A. Le Lacheur, 19, St. Swithin's-lane, merchant	1
John Bowes, Grasse, A/M, France	1
J. Livesey, C.E., 2, Victoria-mansions, Westminster	1
T. C. Keith, 9, New Broad-street, contractor	1
*M. van Raalte, 2, Royal Exchange-buildings	1
J. R. Widey, 2, Royal Exchange-buildings	1
W. H. Adams, 30, Peckham-grove, accountant	1

The number of directors is not to be less than two nor more than four; the first are the subscribers denoted by an asterisk, and Messrs. J. L. Phipps, of 19, Billiter-street, J. G. Meiggs, of Dashwood House; qualification, £1000 in shares or stocks; remuneration, £400 per annum, or such sum as the company in general meeting may determine.

Pendleton Flint Glass Company, Limited.

This company was registered on the 15th inst. with a capital of £3000, in £1 shares, to take over the assets of the business carried on by Mr. Thomas Carter, under the style of the Pendleton Flint Glass Company, Limited. The subscribers are:—

	Shares.
Thomas Johnston, 6, Booth-street, Manchester, chartered accountant	1
F. S. Sherratt, Moss Side, Manchester, clerk	1
W. H. Tetlow, Stretford, salesman	1
D. C. Delany, Old Trafford, Manchester, clerk	1
E. G. Cockrell, Deansgate, Manchester, oil merchant	1
H. H. Bambridge, 178, Plymouth-grove, Manchester, clerk	1
T. J. Johnson, Stretford, Manchester, wine and spirit merchant	1

Registered without special articles.

Scarborough Patent Tiled Floorcloth Company, Limited.

This company proposes to purchase the freehold land and works of the Mosaic Floorcloth Company, Limited, at Scarborough, subject to a mortgage for securing £5000 and interest at 5 per cent. per annum. It was registered on the 13th inst. with a capital of £50,000, in £10 shares. The subscribers are:—

	Shares.
*A. H. Darley, J.P., Scarborough	1
*E. T. Newton, J.P.	1
*H. M. Steinthal, Fallowfield, Manchester, merchant	1
M. H. Smallwood, Scarborough, bank manager	1
T. H. Hawksmith, West Scarborough, floorcloth manufacturer	1
J. L. T. Graham, Scarborough, solicitor	1
E. Hudson, Sheffield	1

The number of directors is not to be less than two nor more than five; the first are the subscribers denoted by an asterisk; the directors are to appoint their own remuneration. Mr. H. M. Steinthal is appointed managing director for life at a salary of £1200 per annum.

Rubies.—It is stated that Professor Friedel, of the French Institute, has addressed a report to the Association of Jewellers and Diamond Merchants in Paris on artificial rubies. He found the chemical composition, density, fusibility, crystalline form, and refractive power of the artificial specimens handed to him for examination to correspond in every respect with the qualities of the natural ruby. Both kinds contain alike tiny air bubbles. But while the cavities in the genuine rubies are almost invariably polymetric, with surfaces parallel to the planes of cleavage, those in the artificial specimens examined by Professor Friedel had curved surfaces, frequently of a pear-like form. Moreover, all these pear-shaped bubbles in any given portion of the artificial ruby had their elongated axes running in the same direction. From this Professor Friedel infers that the material out of which the artificial rubies are made was originally of a pasty consistency, and the bubbles of gas striving to escape gave their prison cavities this pear-like form. In consequence of this technical report, the association decided that artificial rubies could not be regarded as precious stones, and any one selling them as such would be guilty of fraud.

The Noise of New York.—There is probably more noise in New York City to the square inch than in any other city on the face of the globe, which accounts for the great amount of semi-deafness that prevails. Ask a New Yorker a question, with perhaps the single exception of "What'll you take?" and he almost invariably responds with an interrogative "Hey?" "How?" "How's that?" or some other form to induce you to repeat your question. This does not arise altogether from pre-occupation of mind superinduced by a multitude of calls on the attention, or from an indolent mental condition; it is semi-deafness. The universal hubbub in the city has a most malign influence upon the brain and nervous system, calculated to produce numerous disorders, deafness among the rest. In fact the celebrated Dr. Hammond says there is more deafness in New York than in any other city he has ever seen. In New York there is no escaping from the noise. With the maddening elevated railroads splitting the city and your ears, and three or four different lines through the whole length of the city; with the universal street cars, trucks, brewery wagons, steam whistles, and the thousand other noise producers out of doors, and the crowded noisy population, with their pianos and their lungs indoors, there is absolutely no escape, no place where the ear and nerves can get repose. The question of noise is a very serious one, and should be looked into by our men of science, and should be legislated for by our city rulers, or it will turn New York into a madhouse.—*Texas Siftings.*

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

14th September, 1886.

11,635. Registering the Fares on Tramcars, E. R. Vaughan, Belfast.
11,636. Automatic Attachment for Working Ships' Pumps, E. Everding, London.
11,637. Dry Glazing, M. Macleod, Manchester.
11,638. Bolts for Dredger Buckets, W. M. Ward and T. I. Gray, Blyth.
11,639. Retention of the Inoperative Weft Threads of Looms, J. Bairstow, J. B. Spencer, and S. Midgley, Yorkshire.
11,640. Self-closing Valves for Tap Sockets, J. Everard, Sparkbrook.
11,641. Machinery for Purifying Semolina, H. Macdonnell, Stockton-on-Tees.
11,642. Convertible Sofa and Bed, F. Lord and E. H. Green, Manchester.
11,643. Picking Apparatus for Looms, P. Sutton, Manchester.
11,644. Screw Propellers of Steamers, W. N. Hutchinson and E. N. Molesworth-Hepworth, Wellesbourne.
11,645. Picking Bands for Looms, J. R. Hutchinson, B. Turton, and C. Heywood, Manchester.
11,646. Tramcars, W. H. Blackwell, Hooley Hill.
11,647. Heating and Circulating Feed-water in Multitubular Boilers, W. Voit and W. D. Hooker, London.
11,648. Direct-acting Pumps, W. Voit and W. D. Hooker, London.
11,649. Manufacturing Safety Pins, J. Jenkins, London.
11,650. Machinery for Heading Safety Pins, J. Jenkins, London.
11,651. Gas Producers R. Howson and W. P. Ingham, Middlesbrough-on-Tees.
11,652. Appliance for Tipping Carts, W. Hewitt and T. Dineen, Leeds.
11,653. Voltaic Electric Batteries, R. H. Courtenay, London.
11,654. Air Compressors and Receivers, A. and M. B. Baird, Glasgow.
11,655. Tables for Polishing Marble, &c., J. J. Lish, London.
11,656. Taps for Regulating the Supply of Gas, A. Brown, Glasgow.
11,657. Attaching Rollers to the Shafts of Washing Machines, &c., T. Isherwood and G. Smith, Ramsbottom.
11,658. Securing Cords to Blinds, G. H. J. Gillard, London.
11,659. Holders for Ink or Writing Fluids J. Tobin, London.
11,660. Telephonic Instruments, A. J. Boult.—(*J. C. Reiff, United States*.)
11,661. Displaying Advertisements, &c., L. Harbord, Liverpool.
11,662. Telephonic Instruments, A. J. Boult.—(*J. C. Reiff, United States.*)
11,663. Adjustable Spanners, J. T. Humphrey, London.
11,664. Mount for Umbrellas, &c., E. Newman, London.
11,665. Gas-burners for Heating Purposes, H. Burnell, London.
11,666. Steam Boilers, L. Burnet, Glasgow.
11,667. Domestic Refrigerators, &c., F. A. Smith, London.
11,668. Steam Boilers, D. Joy, London.
11,669. Construction of Kitcheners, &c., H. Hunt, London.
11,670. Perforation of Sheet Metal, A. Moore, London.
11,671. Driving Engines, T. Griffith, London.
11,672. Umbrella Frames, E. Kleber, London.
11,673. Automatically Indicating Weights on Scale Platforms, W. S. Oliver, London.
11,674. Automatically Indicating the Power Exerted in Lifting a Weight, W. S. Oliver, London.
11,675. Automatically Indicating the Force of a Blow, W. S. Oliver, London.
11,676. Automatically Indicating the Strength of Grasp Exerted by a Hand or Hands, W. S. Oliver, London.
11,677. Cure and Prevention of Pulmonary Diseases, P. Eckhaus and H. Leapman, London.
11,678. Ventilating Tents, A. S. Tomkins, Caterham.
11,679. Twist Nails, &c., T. W. Smith, London.
11,680. Governor for Gas or Oil Motor Engines, J. Fielding, London.
11,681. Moorings for Floating Bodies, E. C. G. Thomas, London.
11,682. Indicator, A. Slatter.—(*F. W. Reeves, Portugal.*)
11,683. Automatic Safety Apparatus for Hoists, H. P. Lavender, London.
11,684. Obtaining Purified Carbon from Soot, &c., R. Pringle, London.
11,685. Fastener for Boot and Shoe Laces, C. A. White, London.
11,686. Electrically Lighting Railway Trains, I. A. Timmis, London.
11,687. Improved Gas Stove, F. R. E. Branston, London.
11,688. Varnish for Boots and Shoes, H. Mason, London.
11,689. Windows for Displaying Merchandise, H. H. Lake.—(*C. D. Williams, United States.*)
11,690. Gun Carriages, &c., H. H. Lake.—(*H. Gruson, Germany.*)
11,691. Carbureting and Mixing Gas and Air, G. R. Cottrell, London.
11,692. Drums, H. G. Lehnert, London.
11,693. Telegraphic Apparatus, H. H. Lake.—(*M. G. Farmer, United States.*)
11,694. Electric Lamps, H. H. Lake.—(*J. I. Clapp, United States.*)
11,695. Journal Bearings, &c., H. H. Lake.—(*M. Randolph and S. W. Hopkins, United States.*)

15th September, 1886.

11,696. Shape and Principle of Sponge Bags, W. Lane, London.
11,697. Differential Gearing for Machinery, &c., J. Dugdale and J. F. Davies, Manchester.
11,698. Knock Off Mechanism for Valves of Steam Engines, R. Nicholson and T. Thorp, Manchester.
11,699. Combined Apparatus for Extracting Corks from Bottles, and Squeezing Lemons, C. Weeks, Dublin.
11,700. Loose Reed Motions, &c., C. Catlow, Halifax.
11,701. Equilibrium Slide Valve for Air Engines, R. Bentley and T. Ford, Staffordshire.
11,702. Retorts for Distilling Shale, &c., J. Jones, Edinburgh.
11,703. Improved Pipe Stopper, W. Singleton and E. Priestman, Sheffield.
11,704. Generating Vapour, &c., J. Murrie, Glasgow.
11,705. Ploughs, J. Hornsby, I. Trolley, and W. Grice, Grantham.
11,706. Couplings for Street Locomotives, &c., W. Devoll, Erdington.
11,707. Combined Victoria and Hansom, F. Forder and C. Forder, London.
11,708. Spinning Frames, J. Wallace, jun., Belfast.
11,709. Electrical Cut-outs, E. Perrett, Weston-super-Mare.
11,710. Adjusting Mechanism for Dressing Glasses, L. Dove and J. S. Bush, London.
11,711. Consuming Smoke in Steam Boiler Furnaces, J. E. Brown, Brighton.
11,712. Wall Brackets, &c., J. M. Porter, Leeds.
11,713. Attaching Watches to a Muff, &c., R. Joseph, London.
11,714. Gangway Rollers for Fishing Vessels, W. Sissons and P. P. White, London.
11,715. Inserting Metallic Staples in Papers, &c., I. W. Heysinger, London.
11,716. Sewing Machines, R. W. Griffiths, London.
11,717. Motor, Pump, Blower, or Fluid Meter, T. G. Redstone, Liverpool.
11,718. Driving the Spindles of Machinery, W. Westley, London.
11,719. Multiplex Telegraph Transmission, G. Gattino, London.
11,720. Combination Couplings for Railways, &c., C. P. Sharpley, London.
11,721. Marking Button-holes, &c., F. Zysel and J. Singer, London.
11,722. Automatic Coupling for Railway Carriages, &c., J. Jex-Long, Glasgow.
11,723. Motive Power Engines, R. Dick and R. Kennedy, Glasgow.
11,724. Checking Apparatus, J. Pover, Liverpool.
11,725. Securing and Regulating the Tension on Window Blind Cords, C. F. Gumby, Leeds.
11,726. Fishing Reels, A. Smith and H. Wall, Birmingham.
11,727. Velocipedes, J. F. Haskins.—(*G. D. Davis, United States.*)
11,728. Gun-locks, H. J. Haddan.—(*F. Gilliquet, Belgium.*)
11,729. Wire Stitching Machines, C. Gebler, London.
11,730. Dyeing, H. J. Haddan.—(*A. Henry, France.*)
11,731. Valves, W. H. Twine, A. M. D. Churchill, and H. J. Honour, London.
11,732. Preparing Malted Wheat, &c., A. B. Lester and A. Meaby, London.
11,733. Stable Fittings, T. and R. S. Wood, London.
11,734. Boxes for Stop Cocks, B. Waldron, London.
11,735. Photographic Shutters, C. D. Durnford, Edinburgh.
11,736. Combing Machines, &c., J. Carroll, London.
11,737. Toilet Looking-glasses, &c., E. A. Miller, London.
11,738. Stiffening Shirt Fronts and Securing Studs, C. Farmer, London.
11,739. Preparing Nourishing Powder, A. Hommel, London.
11,740. Storing Aerated, &c., Mineral Waters, C. W. Fuller, London.
11,741. Fat and Fatty Acids from Compounds containing the Same, W. Graff, London.
11,742. Rice Hulling Machines, H. H. Lake.—(*E. C. Engelberg, Brazil.*)
11,743. Urinals, H. H. Lake.—(*B. Holbrook and H. N. Mann, United States.*)

16th September, 1886.

11,744. Hand Fire Extinguishers, W. Lil c lne, Glasgow.
11,745. Windguards, J. A. Mackeikan, London.
11,746. Mules, T. L. Daltry, Manchester.
11,747. Solitaires, &c., W. E. Paterson, Birmingham.
11,748. Fastener for Gloves, &c., A. Martin, Birmingham.
11,749. Solitaires, &c., G. F. Spittle, Birmingham.
11,750. Fastening for Brooches, &c., A. Martin, Birmingham.
11,751. Steam Cylinders for Compound Engines, J. Hailwood, Sheffield.
11,752. Extinguishing Fires, S. Walker and G. Mills, Radcliffe.
11,753. Mould for Casting Chains, A. Muir and P. Burt, Glasgow.
11,754. Wringing Machines, P. Burt, Glasgow.
11,755. Jacquard Bobbies employed in Power Looms, J. Watson, Manchester.
11,756. Lead or other Metal Pipes, S. Gratrix, Manchester.
11,757. Pedestals or Bearings for Horizontal Shafts, W. Wooler, Manchester.
11,758. Moulding Hat Dishes, J. Rowley, Manchester.
11,759. Mechanism for Operating the Shuttle-boxes in Drop-box Looms, R. Hall, Manchester.
11,760. Taps for Water, &c., J. Lewis, London.
11,761. Pianofortes, &c., G. H. Pohlmann, Halifax.
11,762. Gas Motor Engines, H. Campbell, Halifax.
11,763. Furnace Bars, J. C. Brentnall, Manchester.
11,764. Safety Hoist, C. Jackson, Nottingham.
11,765. Stationary Steam Boilers or Generators, J. Hailwood, Sheffield.
11,766. Producing Induced Draught in Chimneys of Low Altitude, T. Carter and W. B. Tully, South Shields.
11,767. Generating the Energy of Elastic Vapour, J. Murrie, Glasgow.
11,768. Instantaneous Stair-eye Fixer, A. R. Pollard, Worthing.
11,769. Gas-heated Ovens, R. A. Gilson and W. J. Booer, London.
11,770. Apparatus for Suspending Plaques, A. and G. Tuck, London.
11,771. Tapping Barrels Containing Liquids, L. Bell, Sheffield.
11,772. Locks, A. Steiger.—(*R. Combes, France.*)
11,773. Furnaces for Steam Boilers, L. C. Shaw, London.
11,774. Chain Hooks, T. Lafitte, London.
11,775. Tile Stove with Heat Radiating Surfaces J. P. Helles, London.
11,776. Fuel Saving Furnaces for Generating Chlorine, &c., J. E. Baugh and C. Hinksman, London.
11,777. Cigar and Cigarette Holder, H. A. Couchman, London.
11,778. Rose-boxes for Use in Ships' Bilges, J. Scoby, U. R. Boate, and J. Cameron, Liverpool.
11,779. Boxes for Aerated Waters in Bottles, G. Paul, London.
11,780. Field Cooking Apparatus, T. Clarke and J. Fenton, London.
11,781. Mechanism for Governing the Admission of Steam to Engines, J. C. Freeman, Liverpool.
11,782. Screw-drivers, A. C. Barratt, London.
11,783. Cloth Shearing Machines, H. Wyckhuyse, London.
11,784. Pocket Instruments, J. M. O'Kelly, H. Russell, and H. J. C. Somerville, London.
11,785. Boots, H. Standley, London.
11,786. Cutting or Mincing Meat, &c., H. E. Russell, London.
11,787. Rock Drills, H. J. Coles, London.
11,788. Scabbards for Swords, &c., G. Butler, London.
11,789. Scabbards for Swords, &c., G. Butler, London.
11,790. Toilet Brush, Flesh Stain Remover, and Nail Trimmer Combined, C. W. Sutton and J. S. Phillips, London.
11,791. Winding the Wire Rings of Torpedo Nets, H. Gardner.—(*The Compagnie Anonyme des Forges de Châtillon et Commentry, France.*)
11,792. Water-waste Preventers, J. W. Grimston, London.
11,793. Novel Recreation Game, W. Stobbs and E. L. White, London.
11,794. Bronzing Machines, H. Shilton and H. May, London.
11,795. Treating Cocoons of Silk, E. Donner and E. Corsel, London.
11,796. Spinning, &c., Fibrous Substances, J. Harrison, Manchester.
11,797. Printing Machines, R. Cullen, London.
11,798. Hot Water Pipes, R. Knight, London.
11,799. Illuminated Advertising Signs, G. K. Cooke, London.
11,800. Chain Stitch Pocket Sewing Machine, T. S. James, London.
11,801. Registering the Amount of Torsion Exerted by the Forearm and Wrist, W. S. Oliver, London.
11,802. Joint for Mathematical, &c., Instruments, W. H. Harling, London.
11,803. New Game and Apparatus for Playing the Same, A. L. A. Levison.—(*G. Leguina, Montejo, C. Gurney, and C. Levison, Spain.*)

11,804. Preventing the Slipping of the Driving Wheels of Locomotives, L. Huber and P. Kippenhan, London.

17th September, 1886.

11,805. Wire Working used as a Fence, T. R. Bain-Bridge, Gateshead.
11,806. Mechanically Locking Brakes of Bicycles, &c., F. L. Striffler, Middleton.
11,807. Coupling Railway Wagons, W. B. Maxfield and J. W. Hancock, Leicester.
11,808. Latch and Lock Boxes, J. Whitehead, Harborne.
11,809. Regulating Water Waste Preventer, W. Wright, Plymouth.
11,810. Heels for Boots, &c., A. W. Wilson and B. Silver, Leicester.
11,811. Suspenders for Stockings, &c., J. Walker and F. R. Baker, Birmingham.
11,812. Motions for Actuating Shuttle Boxes of Looms, S. Walker and G. Leek, Radcliffe.
11,813. Gas Lamps and Burners, E. H. Stevenson, London.
11,814. Umbrellas and Parasols, E. B. Gaze, London.
11,815. Prolonging the Life of Electric Incandescent or Glow Lamps, W. D. Reid, Streatham.
11,816. Metallic Oxides, A. and L. Q. Brin, London.
11,817. Obtaining Gold, &c., from Ores, J. S. McArthur, R. W. Forrest, W. Forrest, and G. Morton, Glasgow.
11,818. Looms for Weaving Ornamental Fabrics, R. A. Whytlaw and J. Kincaid, Glasgow.
11,819. Lamp Wick, F. Newby, Ipswich.
11,820. Carbon for the Compression of Sewage Sludge, G. H. Leane, London.
11,821. Pipe for Smoking Tobacco, C. G. Leak, London.
11,822. Separation of Isomeric Xylidines and Commercial Xylidine, W. R. Hodgkinson.—(*L. Limpach, Germany.*)
11,823. Primary and Secondary Batteries, P. Bailly, London.
11,824. Needle Case, J. W. James, Birmingham.
11,825. Appliance for Basting Meat, &c., while Cooking, L. Phillott, London.
11,826. Propulsion by Water Power, T. Vosper, Callington.
11,827. Stench Trap, J. Ashworth, London.
11,828. Equalised Spring Power Motor, C. Nicholson, Philadelphia.
11,829. Carburetting Compounds, P. M. Justice.—(*A. P. Rockwell, United States.*)
11,830. Filtering, &c., Water, C. H. Gerson, London.
11,831. Pumps, G. Schnass, London.
11,832. Boat Propeller, E. Boxall, Upper Norwood.
11,833. Gas from Mineral Oil, J. M. Turnbull, Glasgow.
11,834. Automatic Primary Battery, C. E. O'Keenan, London.
11,835. Dry Rennet, G. F. Redfern.—(*L. J. Eriksson and E. E. R. Nordling, Sweden.*)
11,836. Economic and Automatic use of Disinfectant to Water-closets, &c., E. T. Leigh, London.
11,837. Binding Screw for Connecting Telegraph Wires, &c., F. J. Beaumont and J. Kent, London.
11,838. Printing Pictures, &c., on Enamelled Iron, J. Reid, London.
11,839. Umbrellas and Sunshades, W. S. Bond, London.
11,840. Electric Alarm for Indicating the Temperature of Places at a Distance, A. G. Simmonds, London.
11,841. Applying Arsenic and Sulphur for Destroying Animal and Vegetable Parasites, A. Blackie, London.
11,842. Banjos, G. G. Bond, London.
11,843. Sheet Metal Roofing, A. Moore and J. Lowes, London.
11,844. Treating the Eyes by Electricity, C. B. Harness, London.
11,845. Barbed Wire for Fences, P. Miles, London.
11,846. Production of Ozone, &c., A. and L. Q. Brin, London.
11,847. Saw Frames, P. C. Gérard, London.
11,848. Cooking Utensils, F. A. L. and C. L. Hancock, London.
11,849. Indicating Electrically the Muscular Strength of a Man, W. Oliver, London.
11,850. Hot Water Boilers, J. Turtle, London.
11,851. Lever Presses for Compressing Vegetables, J. H. Wathew, London.
11,852. Plunger Pumps for Raising Water, E. Barnes, London.
11,853. Projecting a Beam of Light, R. A. Scott, London.
11,854. Organs and Wind Musical Instruments, F. W. Rawston, London.
11,855. Picks and their Attachments to Shafts, T. Brown, London.
11,856. Ship Lamps, C. Asbury, London.
11,857. Permanent Way of Railways, T. W. Worsdell, Gateshead.
11,858. Reversing, &c., Steam Engines, J. G. Galley, London.
11,859. Fastener for holding Windows, &c., T. Smith, London.
11,860. Rotary Pumps, E. Tate and S. Smirke, London.
11,861. Moulding of Sugar, T. C. A. Carre, London.
11,862. Connecting the Edges of Cardboard, &c., Boxes, D. Gestetner, London.
11,863. Electric Arc Lamps, J. Swinburne, London.

18th September, 1886.

11,864. Preventing Breakage of Marine Cranks, J. Walker, Leeds.
11,865. Valves of Water Gauges, W. Hartcliffe and W. H. Malkin, Manchester.
11,866. Self-acting Mules, J. Clegg.—(*R. Gudgeon, Belgium.*)
11,867. Toy Wheelbarrows, J. Groom, Ettingshall.
11,868. Regulating Mechanism for Doors, &c., L. Dove and J. S. Bush, London.
11,869. Indicator for Tramway Cars, &c., F. C. Lynde, Manchester.
11,870. Drying Pottery Ware, R. Kelsall and W. Lee, Longport.
11,871. Woven Wire Mattresses, R. Siddall, Halifax.
11,872. Tentering Machines, M. Stubley, Halifax.
11,873. Chimney Pots, S. H. Jefferys, Halifax.
11,874. Safety Coupling Box for Railway Carriages, J. D. Denny, Llangollen.
11,875. Automatic Flushing Apparatus, J. Tonge, Rochdale.
11,876. Boring Machines for Coal, &c., S. Thompson and R. Thompson, Newcastle-on-Tyne.
11,877. Indicating Calls of Electric Bells, W. H. Baugham, Charlbury.
11,878. Screw Nuts, B. J. B. Mills.—(*F. Redmond, United States.*)
11,879. Floor for Toboggan Slides, &c., J. S. Brown, London.
11,880. Dust Collectors, J. E. Wilson, Canada.
11,881. Studs, F. A. Walton, London.
11,882. Nose Bags, W. Cullen, London.
11,883. Treatment of Sewage Sludge, J. H. Barry, London.
11,884. Automatic Fire Extinguisher, R. Dowson and J. Taylor, London.
11,885. Railway Couplings, &c., R. Greenwood, London.
11,886. Combing Hemp and Flax, H. J. Haddan.—(*H. Raynal, France.*)
11,887. Ring Thread Guides, J. Dalton, London.
11,888. Raising Water, A. J. Boult.—(*F. Vallmitjana, Spain.*)
11,889. Pigments, F. M. Lyte, London.
11,890. Printing on Fabrics, J. Kerr, London.
11,891. Bleaching Liquid, &c., A. and L. Q. Brin, London.
11,892. Electric Cigar and Pipe Lighter, S. Williams, Newport.
11,893. Gas and Petroleum Stoves, H. H. Doty, London.
11,894. Metallic Wheels, W. L. Wise.—(*C. Gérard, Alsace.*)
11,895. Producing Spray, J. G. Franklin, London.
11,896. Refrigerating Apparatus, &c., W. H. Beck, London.
11,897. Apparatus for Washing Potatoes, D. W. Petrie, London.
11,898. Draughters for Fire-places, &c., M. Wilson, London.
11,899. Fitting Veils, S. Guiterman.—(*C. Heavenrich, United States.*)
11,900. Revolvers and Pistols, &c., H. A. Schlund, London.
11,901. Teaching Music, G. F. Redfern.—(*J. Saxton, France.*)
11,902. Preventing the Escape of Water, J. Patrick, London.
11,903. Telegraphic Apparatus, H. H. Lake.—(*M. Martin and C. F. Adams, U.S.*)

20th September, 1886.

11,904. Automatic Air Brakes, W. W. Hanscom, London.
11,905. Fastening Sacks, W. McDonnell, Limerick.
11,906. Facilitating the Estimation of the Refraction of the Human Eye, H. Haines and G. Prescott, Dublin.
11,907. Aerated Waters or Beverages, J. Meadowcroft, Halifax.
11,908. Cigar and Cigarette Cases, A. Gray, London.
11,909. Toy for Exploding Paper Caps, R. Wallwork, Manchester.
11,910. Electric Furnace, D. Cook Glasgow.
11,911. Magneto-electric Telephone, D. Cook, Glasgow.
11,912. Portable Brake for Measuring Power, D. Cook, Glasgow.
11,913. Closing and Breaking Electric Circuits, D. Cook, Glasgow.
11,914. Suspending Telegraphic or other Wires, D. Cook, Glasgow.
11,915. Transmission of Articulate Speech by Electricity, D. Cook, Glasgow.
11,916. Reducing the Speed of Machinery, D. Cook, Glasgow.
11,917. Measuring Currents of Electricity, D. Cook, Glasgow.
11,918. Arrangement of Telephonic Circuits, D. Cook, Glasgow.
11,919. Generating, &c., Currents of Electricity, D. Cook, Glasgow.
11,920. Dynamometer for Measuring Power, D. Cook, Glasgow.
11,921. Electro-motors, D. Cook, Glasgow.
11,922. Preparing Cheques, Bills of Lading, &c., C. L. Hindle, Handsworth.
11,923. Joining Railway Rails, &c., J. Ashton, Shaw, near Oldham.
11,924. Window Sash Fasteners, W. Adkins, Birmingham.
11,925. Stick for Carrying Game, C. I. Richards, Kettering.
11,926. Trousers, H. J. Hill, Maindee.
11,927. Renovating, &c., Strainer Plates, H. J. Rogers, Watford.
11,928. Aerated Beverage, M. Williams and E. S. Gunn, London.
11,929. Giving Instruction in the Laying of Ordnance and Practice in Artillery Fire, J. Bray, London.
11,930. Heating or Cooking by Gas, &c., L. W. Leeds, London.
11,931. Folding Urinal, H. J. Conolly, London.
11,932. Oil-can, J. Lee and G. Flood, Birmingham.
11,933. Securing Removable Studs and Frost Calks to Horseshoes, H. Standish and C. Dickinson, Sheffield.
11,934. Equilibrium Steam Slide Valves, J. P. West, London.
11,935. Saving Life from Fires, &c., D. F. Campbell, London.
11,936. Trusses for Rupture, J. Simmons, London.
11,937. Brick-cutting Tables, R. C. Robinson, London.
11,938. Receptacles for Water, G. A. Dick, London.
11,939. Preparing, &c., Cane for Filter Cloths, &c., A. Ehrich, London.
11,940. Counter Check-books, M. H. Spear, London.
11,941. Covering of Preserve, &c., Jars, J. Nield, Stalybridge.
11,942. Self-closing Stop Cock, F. Marey and E. Colle, London.
11,943. Folding Carriage Hoods, M. Koblassa, London.
11,944. Sheeting or Fabric for Medical Use, A. Southall and T. Barclay, London.
11,945. Bottles for Aerated Liquids, G. H. W. Thomas, London.
11,946. Weaving Two Pieces of Fabric Face to Face, J. C. Mewburn.—(*F. Grandel, France.*)
11,947. Convertible Velocipedes, R. H. Lea and G. Singer, London.
11,948. Lamp-burners, C. Crastin, London.
11,949. Locking and Unlocking Nuts, T. R. Weston, Bristol.
11,950. Auto-magnetic Motor, E. Delabre-Fournier and Co., London.
11,951. Secret Springs for Keyless Watches, T. B. Ward, London.
11,952. Weighing Apparatus, L. Steffens, London.
11,953. Printing and Binding Machines, H. P. Feister, London.
11,954. Increasing the Leverage or Throw of the Crank Pin in Steam, &c., Engines, A. Kissam and J. F. Sleat, London.
11,955. Braces and other Dress Suspenders, G. J. Flamank, Stafford.
11,956. Portable Sewing Machines, E. Ward, London.
11,957. Exhibiting Goods in Shop Windows, J. O. Spong, London.
11,958. Sack Elevators and Hooks, F. A. Poupard, London.
11,959. Supporting, &c., Centrifugal Machines, C. G. P. de Laval, London.
11,960. Distributing Type, A. Von Langen and C. G. Fischer, London.

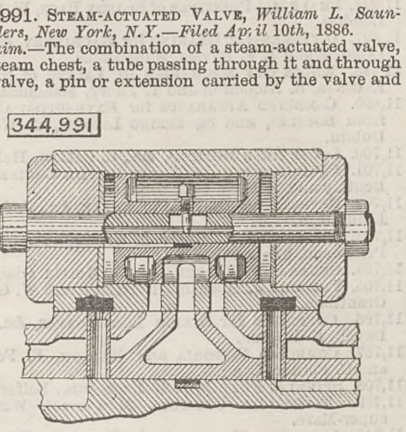
SELECTED AMERICAN PATENTS.

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

344,991. Steam-actuated Valve, *William L. Saunders, New York, N.Y.—Filed April 10th, 1886.*

Claim.—The combination of a steam-actuated valve, its steam chest, a tube passing through it and through the valve, a pin or extension carried by the valve and

344,991

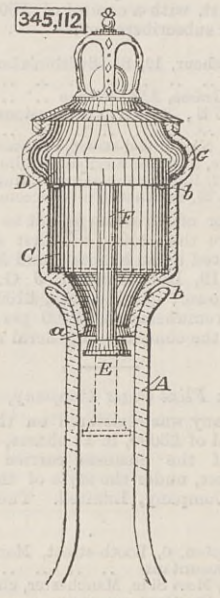


extending through a suitable slot in the tube, and a rod adapted to be inserted in the tube, and to engage the pin extending thereinto from the valve, whereby the valve can be adjusted as desired, substantially as set forth.

345,112. Bottle, *James Canan, Port Colborne, Ontario, Canada.—Filed March 15th, 1886.*

Claim.—(1) The combination, with a bottle provided with a case having valve seats, of a double-ended stopper arranged to automatically close the inlet and open the outlet of said case upon a reversal of the bottle, substantially as and for the purpose specified. (2) A case C, adapted to fit the neck of a bottle, having the seat *a* and an enlargement G, formed in it as shown, in combination with the valve D, fitting the said case, and valve E, substantially as and for the purpose specified. (3) A case C, having an enlargement G, formed in it and connected to the stopper B,

345,112

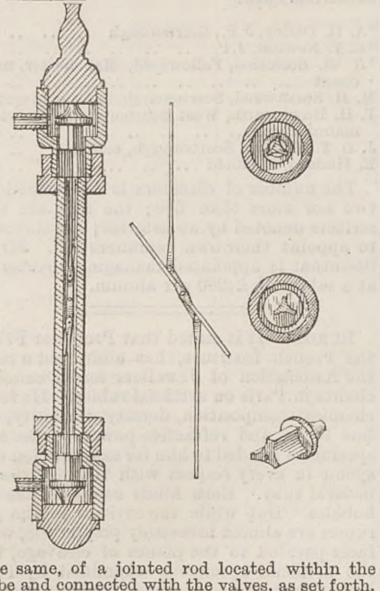


fitting the neck A, and having a seat *a*, formed on its bottom, in combination with the valve D, connected by the stem F, and the valve E, designed to fit the seat *a*, substantially as and for the purpose specified. (4) A case C, having an enlargement G, formed in it, in combination with a valve D, having a series of rubber buttons *b*, and a valve E, connected to it, and designed to close the aperture in the bottom of the stopper B, substantially as and for the purpose set forth.

345,156. Safety Water Gauge, *Joseph B. Little, Winnipeg, Manitoba, Canada.—Filed February 18th, 1886.*

Claim.—(1) The combination, with a glass tube and its mountings, said mountings having valve seats, of valves to close seats, and means located within the glass tube for supporting the valves from their seats, as set forth. (2) The combination, with a glass tube and its mountings having valve seats and valves to

345,156

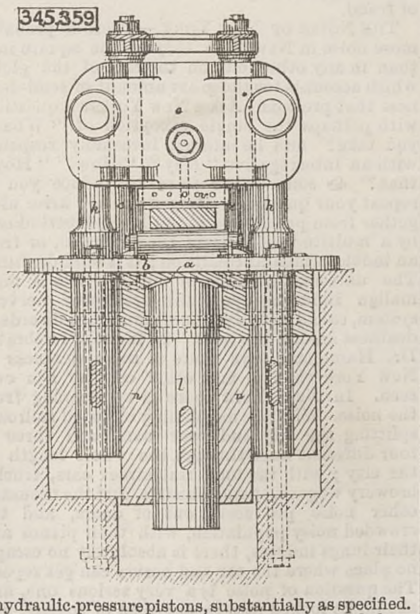


close the same, of a jointed rod located within the glass tube and connected with the valves, as set forth. (3) The combination, with a glass tube and its mountings, said mountings having valve seats and valves, of a jointed rod located in the tube and connected with the valves and a cross rod pivotted to one of the sections of the jointed rod, as set forth.

345,359. Hydraulic Shears, *Emil Boehme, Breslau, Prussia, Germany.—Filed April 8th, 1886.*

Claim.—(1) The combination, in hydraulic shears, of head *e* with piston *l*, crosshead *n*, and drawing rods *h h*, all being so constructed that the water pressure is transmitted to head *e* by piston *l* by means of crosshead *n*, and of two rods, *h h*, used at the same time

345,359

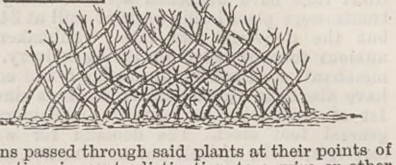


as hydraulic-pressure pistons, substantially as specified. (2) The combination of head *e*, carrying shear blade *v*, and guided on rods *c c*, with rods *h h*, and with crosshead *n* and piston *l*, substantially as specified. (3) The combination of the triplicate hydraulic cylinder *a* with the base-plate *b*, block *f*, carrying lower blade, *g*, and with the crosshead *e*, upper blade *u*, pistons *l h h*, and crosshead *n*, substantially as specified. (4) The combination of crosshead *n* with the main piston *l*, fixed therein, and with the two differential pistons *h h*, serving at the same time as drawing rods, substantially as specified.

344,885. Hedge, *William M. Viser, Paducah, Ky.—Filed April 6th, 1886.*

Claim.—A hedge fence composed of living plants bent down in the plane of the hedge, each alternate plant being inversely inclined, combined with retain-

344,885

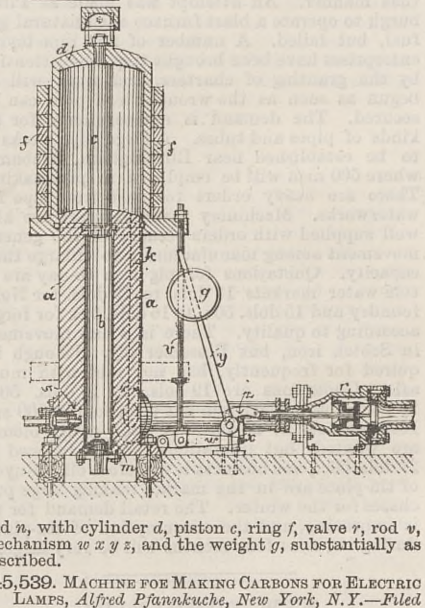


ing pins passed through said plants at their points of intersection, in contradistinction to a wire or other substance passing around the same, substantially as described.

345,360. Differential Accumulator, *Emil Boehme, Breslau, Prussia, Germany,—Filed April 8th, 1886.*

Claim. The combination, in a differential accumulator, of piston *a*, provided with the channel *k*, and having cylindrical hollow space *b*, and the valves *m*

345,360

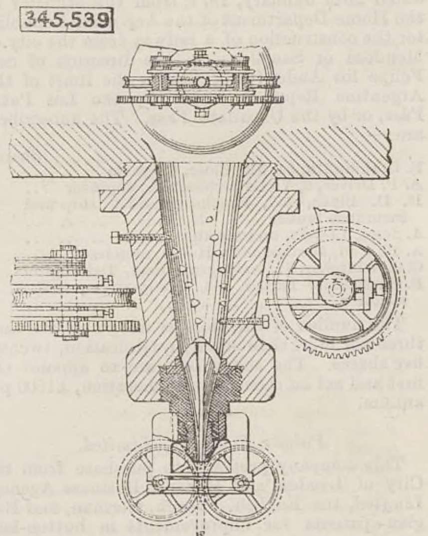


and *n*, with cylinder *d*, piston *c*, ring *f*, valve *r*, rod *v*, mechanism *w x y z*, and the weight *g*, substantially as described.

345,539. Machine for Making Carbons for Electric Lamps, *Alfred Pfannkuche, New York, N.Y.—Filed March 19th, 1886.*

Claim.—(1) In a machine for making electric light carbons, the combination with a press of a discharge nozzle provided with a series of adjustable internal projections, substantially as described. (2) In a machine for making electric light carbons, the combination, with a press, of a tapering discharge nozzle having a series of adjustable internal projections and a die supported at the outer end of said nozzle, substantially as described. (3) In a machine for making electric light carbons, the combination of a press having a tapering discharge nozzle, a die supporting block

345,539

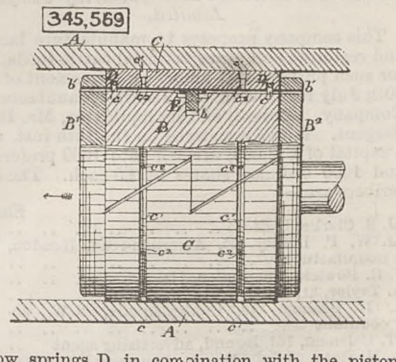


detachably connected to the outer end of said nozzle, a detachable die supported in the outer end of said block, a crosshead supported in the inner end of said block, and a removable pin supported in the crosshead and passed centrally through the die and its support, substantially as described. (4) In a machine for making electric light carbons, the combination of a press, a die, and a guiding and cutting mechanism consisting of a pair of adjustable circumferentially-grooved wheels provided with cutters, substantially as described.

345,569. Piston Packing, *James Brandon, New York, N.Y.—Filed December 14th, 1885.*

Claim.—(1) The broad packing C, provided with the grooves c^1 and holes c^2, in combination with each other, and with the narrower internal ring E, and with the piston body B B^1 B^2, having the groove *b* and holes b^1, and cylinder A, as herein specified. (2) The

345,569



narrow springs D, in combination with the piston B B^1 B^2, having holes b^1, narrow packing ring E, fitted loosely in the groove *b*, and wide packing ring C, made in sections, and grooved on the interior, all arranged for joint operation relatively to each other and to the cylinder A, as herein specified.