WAGES IN GREAT BRITAIN.

No. II.

THE principal English districts for which we give the rates of wages, &c., are Birmingham, Bradford, Bristol, Cardiff, Carlisle, Falmouth, Gloucester, Hartlepool, Holyhead, Hull, Leeds, Liverpool, London, Manchester, Newcastle-on-Tyne, Nottingham, Plymouth, Sheffield, Southampton, Sunderland, and Tunstall. Considerable difference is to be found in the space devoted to each district, according to the importance of the engineering industries carried on in them, but the plans followed in describing the conditions, &c., are as uniform as possible.

Birmingham.—The principal industries in the district of Birmingham are chiefly brass founding, chain-making, gun-making, ironworks, nail-making, and tin-plate works, of which brassfounding is the most important, and has had a world-wide reputation for over a century. The prevalence of piecework, the fixed card rules of the various trades unions, and the system of much work in some trades being done at the houses of the workmen, render it difficult to accurately estimate the rate of wages. Strikes are not infrequent, but the number and variety of trades are large. In the chain and nail-making districts strikes may be said to be chronic, as there is generally one in progress in one or other part of the district. In many of the chief trades arbitration has been adopted, and has worked fairly well. On the whole, the feeling between employer and employed is not unkindly. Many large employers by establishing at their works eating-rooms where cheap good food is provided, day nurseries for the children of working-women, courses of lectures, night-schools, reading-rooms, systems of social entertainment, &c., have done much to add to the comfort of their men. The working of the Factory Acts has been attended with beneficial results, the ratio of accidents having decreased in the last ten years by 25 per cent. Hospitals are well supported, and education in every branch is within the reach of all who care to have it. During the last few years the appearance of this dingy town has become much brighter, and the possibilities of pleasure for the lives of the labouring classes greatly increased. Irrespective of depressions of trade, the condition of artisans may be described as fairly comfortable. Many contrive to save, and of those who do not a large number receive superannuation allowances from the trades unions they are members of. One feature in this district is the number of females, amounting to over 4000, employed in making bolts, nuts, locks, and the lighter kinds of chains. This is a home industry, carried on in the villages. The cottages are fitted up with forges, which are either worked by the occupier or let out to others. The work is exclusively piecework, the iron being purchased from a middleman known as a fogger, and an agreed amount paid for the finished bolts, chains, nails, &c. By working from twelve to fifteen hours a-day, a woman can earn from 4s. to 5s. a-week. These amounts are quite as low as those earned by women on the Continent.

Wages Paid in Birmingham—General Trades.

		s.	d.
Bricklayers	per hour	0	8
Carpenters	,,	0	8
Masons	,,	0	8½
Blacksmiths	,,	0	9
		s. d.	s. d.
Boilermakers	per week	—	43 9
Ironmoulders	,,	27 11—35	9
,, (Leamington)	,,	23 10—29	11
,, (Smethwick)	,,	31 9—37	10
,, (Worcester)	,,	23 10—31	9

Wages Paid per Hour in the Manufacture of Machinery in Birmingham.

	s. d.	s. d.
Air furnace-men	—	0 6
Angle smiths	0 6 —0	8
Apprentices	0 2 —0	4½
Boilermakers	0 6½—0	7
Borers	0 6½—0	7
Brass finishers	0 6 —0	6½
Brass moulders	0 7 —0	7¾
Coppersmiths	0 6½—0	7½
Core-makers	0 5½—0	6
Draughtsmen	1 0½—2	8½
Drillers	0 4½—0	5
Engineers	0 6 —0	7
Engine fitters	0 6 —0	7
Fitters	0 7 —0	8
Foremen (working)	0 9 —0	10
Grinders	0 6 —0	7
Holders-up	0 4½—0	5
Iron moulders	0 6 —0	8
Millwrights	0 6 —0	7½
Patternmakers	0 6½—0	8
Planers	0 5 —0	6
Platers	0 7 —0	8½
Rivetters	0 6 —0	6½
Screwers	0 4 —0	4½
Shapers	0 6 —0	6½
Slotters]	0 5 —0	6
Smiths' strikers	0 4½—0	5
Steam hammer-men	0 11½—1	0½
Tinsmiths	0 6 —0	6½
Wages paid to members of trade unions—		
Bricklayers (Wednesbury), per hour	—	0 7
Carpenters (Rugby) ,,	—	0 7¼
Amalgamated engineers, per week of fifty-four hours—		
Fitters	—	34 0
Millwrights	38 0—40	0
Moulders, loam	—	38 0
,, sand	—	36 0
Patternmakers	—	36 0
Bicycle and tricycle-making (Coventry)	40 6—54	0
Members of society (Wednesbury)	—	30 0
Society of Ironfounders (Leamington)	—	30 0
,, ,, (Smethwick), p. day	—	6 0

In constructive and machinery departments moulders and pattern-makers average rather more, and in gun factories a still higher rate is paid, ordinary mechanics earning from 36s. to 40s. a week. When in charge of machines, and consequently having a greater degree of responsibility, their earnings amount to as much as £3 a week. In the weighing machine trade, fitters are paid 38s. a week. Fitters and moulders who are non-society men work for 34s. a week and even less, but their maximum wages are higher than those of society men. The best hands do what is called set work, by which means their earnings are considerably increased. This system consists in the workmen undertaking to do an agreed amount of work per day. Upon their quota being finished they can either go home or continue their work, at the increased rate of from time and a-quarter to time and a-third. In piecework shops the wages range from 30s. to £3, according to class of work, and the degrees of industry and skill exercised. In some shops machine erecters and fitters who employ underhands get a percentage upon the value of their work, and so earn from £4 to £5 per week, but members of the Amalgamated Engineers' Society have to share the excess over their weekly rate among the other members. There are two kinds of shops, non-society and society. In the latter non-society men are not employed, and the wages average 36s. a week. In the former all rates are paid, the maximum being higher, and the minimum lower than in society shops, and moulders frequently do much of their own labouring. In society shops the moulders only cast and mould, leaving the necessary work to core-makers and labourers. In the brass steam-fitting department wages are somewhat irregular. The wages of fitters and pattern-makers are the same as those for engineering and ironfounding given above. Fitters engaged as tool-makers in manufactories in several trades, such as buttons, guns, screws, and umbrella furniture, get, in addition to 36s. a week, a commission on work produced by any machines they may superintend, which are largely worked by girls and youths. This commission raises the wages in exceptional cases to £5 and even £6 a week. Brass finishers in engineering works chiefly work by the day, and for finishing any kind of grease cups, steam fittings, water gauges, whistles, &c., are paid from 28s. to 32s. a week. Moulders in brass department earn from 32s. to 38s. a week; when engaged in plumbers' brass founding about 35s. a week. These rates are slightly higher than those given in the preceding table, but do not include inferior workmen, who cannot earn more than 20s. a week, which would bring down the average.

Wages Paid per Week of Fifty-four Hours in Foundries, Ironworks, and Machine Shops in Birmingham.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Anvil and vice makers	26 1	41 8	62 6
Brassfoundry—			
Casters	25 0	28 2	31 3
,, foremen	37 6	50 0	62 6
Dressers	25 0	31 3	41 8
,, foremen	45 10	52 1	62 6
Metal mixers	—	54 2	62 6
Modellers	—	62 6	72 11
Ironworks—			
Blacksmiths	—	45 0	—
Strikers	—	29 3	—
Boilermakers	—	43 9	—
Dressers	—	32 4	—
Drillers	—	29 2	—
Holders-up	—	33 4	—
Moulders	—	47 11	—
Patternmakers	—	45 10	—
Planers	—	40 0	—
Rivetters	—	40 0	—
Slotters	—	40 0	—
Stokers	—	26 1	—
Turners	—	43 9	—

These wages seem high, but they must be considered in connection with the remarks preceding as to piecework, set-work, &c.

Wages Paid per Week of Fifty-six Hours in Messrs. Randle and Co.'s Iron and Tin-plate Works, Birmingham, to Good Workers.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Blacksmiths or mounting forges	25 0	33 4	38 7
Iron branders	28 2	32 4	40 8
Iron plate workers	24 2	30 3	40 8
Japanners (ornamenters)	25 0	35 5	50 0
Stampers	25 0	30 3	50 0
Tin-plate workers	20 3	26 1	40 8

Most of the above generally work by the piece, and in that case usually earn about 10 per cent. more by working about six hours per week less time.

Wages Paid per Week to Workmen in Employ of the Corporation of Birmingham.

	Hours per week.	Lowest. s. d.	Highest. s. d.
Gas department—			
Carpenters	54	—	36 6
Engine drivers	54	—	30 5
Gangers	60	40 6	40 9
Main-layers	54	21 3	28 6
Painters	54	—	30 5
Service-layers	54	21 3	45 6
Labourers	60	20 3	28 2
	Hours per day.		
Public works department—			
Blacksmiths	9½	20 3	32 4
Flaggers	9½	27 3	33 4
Wheelwrights	9½	22 3	32 4
Water department—			
Artisans	10	22 9	40 6
Labourers	10	18 3	18 9

Wages Paid per Week in the Making of Gas and Water Fittings in Birmingham.

	Hours per week.	Lowest. s. d.	Highest. s. d.
Casters	49	*35 0	38 0
Core-makers	49	—	24 0
Putters-together	49	—	25 0

Wages Paid per Week in Gun-making Trade in Birmingham.

	Hours per week.	Lowest. s. d.	Highest. s. d.
Action-freers	54	—	30 0
Barrel-borers	54	—	30 0
Barrel-filers	50	—	*35 0
Barrel-welders	54	—	†45 0
Engravers	45	—	*35 0
Finishers	45	—	*42 0
Fitters-up	50	—	*44 0
Lock-filers	54	—	30 0
Machinists	54	—	28 0
Percussioners	50	—	25 9
Viewers	50	—	40 0

* Piecework. † Find their own iron,

Wages Paid per Week in the Screw-making Trade in Birmingham.

	Hours per week.	Lowest. s. d.	Highest. s. d.
Engine-men	54	—	33 0
Fitters	,,	—	31 0
Headers	,,	—	50 0
Shakers	,,	—	30 0
Turners	,,	24 0	36 0
Wormers	,,	21 0	36 0

Wages Paid per Week in Tube-making Works in Birmingham.

	Hours per week	Lowest. s d.	Highest. s d.
Brass casters	54	30 0	55 0
,, furnacemen	,,	—	24 0
,, rollers	,,	25 0	40 0
Braziers	,,	25 0	40 0
Drawers	,,	25 0	30 0
Dressers	,,	—	22 0
Engine-men	,,	21 0	28 0
Makers	,,	25 0	40 0

Wages Paid per Week in Wire-drawing Works in Birmingham.

	Hours per week.	Lowest. s. d.	Highest. s. d.
Annealers	54	—	29 0
Drawers	50	—	43 0
Pointers	60	—	48 0
Wire nail-making:			
Fitters	54	—	36 0
Machine winders	,,	—	24 0
Shakers	,,	—	18 6

The general condition of working people is pretty good. House rent in Birmingham for such dwellings as the working classes inhabit ranges from 1s. 6d. to 7s. 11d. a week. The house accommodation for the artisan and labouring classes within the borough is, generally speaking, in a fairly sanitary condition, and overcrowding does not prevail to any great extent. In the outskirts rents are cheaper. In Cradley and Lye a comfortable cottage of four rooms, with forge attached, costs 2s. 6d. a week, and in Quintain 3s. 2d. Coal is about 13s. per ton, and gas from 2s. 3d. to 2s. 9d. per 1000 cubic feet.

Examples of Cost of Living per Annum in Birmingham.

	Five in family. £ s.	Five in family. £ s.
Bread and flour	14 9	
Butter, cheese, coffee, milk, sugar, tea, &c.	32 3	
Meats	6 9	
Vegetables	4 0	67 12
Fuel and light	3 9	
Clothing	7 4	20 0
Rent	9 4	9 2
Incidentals	2 0	
Total	£78 18	£96 14
Incomes	£78 18	£120 0

Bradford.—The principal industries of Bradford are the processes employed in the manufacture of woollen goods, the construction of such machinery as the various processes require, the extraction and working of iron ore, and the quarrying of stone, with which the district abounds. The district has an abundant supply of coal and iron, as well as of raw material for manufacturing purposes, being in the centre of the great coal-producing district contained in the counties of Lincolnshire and Yorkshire. During the past five or six years Bradford has made more rapid strides in the excellence and variety of its productions than at any former period. The principal feature of this rapid progress is the marked improvement in skill and taste shown by manufacturers in producing goods which were previously imported from France. To this result, the establishment of the Bradford Technical College, with its staff of art and science teachers, professors of chemistry and dyeing, and its schools of mechanical science, pattern designing, and weaving, has largely contributed. This institution cost over £40,000, and is largely attended, the number of students being near 1000, and constantly increasing. In it managers and overlookers receive an excellent education, especially in all branches of art and science which have a direct bearing on the local industries. Good elementary schools exist all over the borough in connection with the technical college, and the means of education are within the reach of all. There have not been any strikes of importance for years, and there is nothing which can be called an organised condition of either capital or labour. There are plenty of clubs and societies, to which all classes belong, but they are chiefly benefit or sick clubs. Generally speaking, a very good feeling exists between employers and employed. When disputes arise, they are usually settled very quickly, either by direct negotiation, or by reference to an arbitrator.

Wages Paid per Week in Bradford.—General Trades.

	Hours.	Lowest. s. d.	Stand. s. d.	Highest. s. d.
Bricklayers	49½	—	29 5	—
Carpenters	49½	—	28 4	—
Masons	49½	29 5	30 5	31 5
Blacksmiths	54	24 4	31 5	36 6
Strikers	54	16 3	20 3	24 4
Brass finishers	54	27 4	30 5	34 5
Brass founders	54	27 4	30 5	34 5
Cutlers	—	25 3	28 4	32 4
Horseshoers' foremen	54	28 4	31 5	34 5
,, journeymen	54	22 3	24 4	26 4
Ironmoulders	54	29 11	31 9	—
,, (Halifax)	54	27 11	33 9	—
,, (Sowerby Bdge.)	54	20 3	33 9	37 10
Telephone construction-men	49½	23 4	24 4	28 3
Tin smiths	54	20 3	28 3	30 5
Tool-handle turners	—	26 4	27 4	32 5
Labourers	—	18 3	20 3	24 4

Wages Paid to Members of Trade Unions.

Amalgamated engineers (Sowerby Bridge)	per week	28	0

Wages Paid per Week of Fifty-four Hours in Engineering Works and Iron Foundries in Bradford.

	Lowest. s. d.	Stand. s. d.	Highest. s. d.
Cupola-men	22 3	30 5	36 6
Fettlers	22 3	24 4	28 4
Fitters	30 5	31 5	32 5
Moulders	32 5	34 5	36 6
,, loam	32 5	36 6	48 8
Pattern-makers	30 5	31 5	32 5
Turners	30 5	31 5	32 5
Labourers	—	20 3 / 18 3	—

The following is a specimen of rules as to time and allowance for lodgings when working out :—(1) Ordinary time all days except Saturdays, 6.15 a.m. to 5.30 p.m.; one and a-half hours allowed for meals. Saturdays, 6.15 a.m. to 12 noon ; half an hour allowed for breakfast. (2) Allowance out of town—lodging from home—1s. 6d. a day, and if detained from home over Sunday 1s. 6d. additional. (3) Allowance in town—not lodging from home—9d. per day, 6d. additional allowed for night. When lodging from home full hours must be worked, but when lodging at home time is allowed for going to work in the morning and returning at night. Overtime is reckoned at time and a-quarter for the first four hours, and time and a-half afterwards.

Wages Paid per Week of 54 *Hours in Large Iron Establishments in Bradford.*

	Lowest.	Stand.	Highest.
	s. d.	s. d.	s. d.
Blacksmiths	30 5	32 5	35 5
Strikers	—	20 3	—
Bolt makers	—	32 11	—
Fitters	27 4	28 10	30 5
Girder erectors (49 hours)	—	24 4	—
,, rivetters	—	27 4	—
Holders-up...	—	18 3	—
Locksmiths...	—	30 5	—
Nailmakers	—	27 4	—
Screwers	—	27 4	—
Tappers	—	27 4	—
Whitesmiths	22 3	30 5	32 5
Labourers	—	22 9	—

One shilling and sixpence per day expenses allowed to smiths' when working in the country. The habits of the working classes are generally sober and trustworthy, and in some instances they own their own cottages. There are several co-operative societies for the distribution of clothing and provisions, some of which have accumulated considerable capital. Rents are, for four-roomed houses, from 3s. 7d. to 5s. 1d. a week ; for six-roomed houses, from 5s. 7d. to 7s. 7d.; coal is from 13s. 6d. to 16s. 3d. per ton, the smaller amount being near the average. Gas is 2s. 6d. per 1000 cubic feet.

Examples of Cost of Living per Annum in Bradford.

	Number in family.											
	1.	3.	3.	4.	4.	4.	5.	5.	6.	7.	8.	8.
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Bread and flour ...		6 17	10 5	9 17	12 3	14 9	15 19	15 4	18 5	19 10	24 7	22 1
Butter, cheese, coffee, milk, sugar, tea, &c.	38 0	38 15	46 11	‡60 5	43 1	30 1	48 13	46 18	‡56 2	43 14	37 18	48 7
Meats		9 2	15 4	8 12	15 4	12 8	20 10	18 2	8 12	19 5	9 4	10 8
Vegetables		6 17	—	—	9 2	—	6 17	7 1	—	9 10	13 11	5 11
Fuel and light ...		4 2	3 9	4 8	4 19	§1 3	4 17	6 8	4 8	—	3 18	4 1
Clothing	5 10	7 17	7 16	12 7	10 17	11 2	14 17	15 17	12 7	14 18	10 6	11 10
Rent	—	9 11	†5 4	7 15	10 8	11 8	8 13	13 0	8 13	13 0	9 4	9 13
Incidentals	2 6	2 10	4 17	—	4 9	—	6 3	8 4	4 13	6 12	2 16	4 14
Total	*45 16	85 11	93 6	103 4	110 3	80 11	126 9	130 14	113 0	126 9	111 4	116 5
Income...	71 16	85 14	101 15	114 10	126 15	110 10	130 8	149 19	114 10	151 13	127 17	122 7

* Including rent. † Half a house. ‡ Including beer and tobacco. § Light only.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

No. II.

Germany—Iron Trade during 1886.—That part of the report on the condition of the German iron trade states that it is difficult to find grounds for the optimist views held by the German metallurgical journals. There have been dismissals of hands, interruptions of work, and blowing out of blast furnaces, but all this is kept as secret as possible. Although the attempts to check production by coalition have failed, there has been considerable decrease in the output of pig iron, and the stocks have been very much decreased since May last. The production of Bessemer forge, foundry, and Thomas pig and spiegeleisen for the first nine months of 1885, was 2,783,871 tons, and for the first nine months of 1886, 2,492,022 tons. The reduction has been less rapid since July, the output at the end of 1886 being 14 per cent under that of 1885. There is an almost uninterrupted relative augmentation in the make of Thomas-Gilchrist pig—an unfavourable fact for England, as this article supersedes to a great extent British Bessemer pig. A very marked upward movement in coal, iron, and machinery securities has been going on since November, but it is questionable if the improvement is sufficient to justify speculation in shares. The large Gruson ironworks at Magdeburg has been turned into a company. There were large orders in hand for war material, the excess of subscribed capital was enormous, and the shares reached a very heavy premium. The rolling mills have been described as doing good business, but this is only as regards quantities, the profits being nil. The eight leading firms which command the German market in angle, girder, T iron, and similar articles have arranged a scale of prices, which take effect from the first of November last. The coalition state that they have been selling for less than the cost of production. A syndicate of West German mills has also raised the price of tin. The Anglo-Belgian German coalition, which long dictated the price of rails, expired in April last. The German railways have been in the habit of taking rails from the native makers at their own prices, while foreigners bought from the same market at the natural price. On a recent tender of rails for Saxony the lowest offer was from John Cockerill and Co., of Seraing. The contract was given to the native makers on condition of lowering their prices to the level of the Belgian tender. This reduction is said to be from £6 12s. to £6 a ton, a price which can hardly be remunerative for the German makers.

The report of the leading Silesian blast furnace company—Laurahütte—though describing their affairs as being no worse than for 1885, declares a dividend of only ½ per cent., against 4 per cent. in that year. The Great Dortmund Union, in the Westphalian iron country, pays ⅛ per cent. on its debentures, against 1¼ per cent. for 1885. In the case of Bessemer and crucible steel concerns, which make miscellaneous specialities, and not staple products, the dividends are larger. The Bochum Steel Company—Westphalia—is expected to pay 5 per cent., just half what was paid in some previous years. The Chemnitz machine companies, which are typical for Germany, have been doing well or ill according to the speciality of their manufactures. The Hartnan Company states that in July last its orders had sunk to the lowest point reached for many years, and even with new commissions there was a great falling off against 1885. It has several orders for locomotives, which will employ it up to next March, but their execution will entail a loss. The wages paid in 1886 were 10 per cent less than in the previous year. The dividend was 5 per cent., a fall of 4 per cent. since 1884. The prices asked recently for four-coupled locomotives with tenders were :—

Hohenzollern (Dusseldorf)	£1274
Schwarzkopf (Berlin)...	1258
1 Henschel (Cassel)	1137
Union (Konigsburg)	1115
2 Vulcan (Stettin)	1100
Linden (Hanover)	1078
Schuhan (Elbing)	1025

These prices are about half of those prevailing fourteen years ago. The price of a complete railway engine in Austria is about £2310, or nearly double the German quotation. The leading Chemnitz machine tool company reports that their dividend has decreased from 3 to ½ per cent. Another concern is in a worse position. A Saxon loom company, with normal business, pays 5 per cent., a decrease from previous dividends of one-half. Another, which has a speciality in looms for lace, cloth, and worsted linens, pays 10 per cent. as in 1885. The Golzern firm also pays 10 per cent. as in 1885, but they make special articles for paper machinery and turbines. Schwarzkopf, of Berlin, has made 33 per cent. in electrical machinery and torpedoes. A large sewing machine concern has gone into the manufacture of bicycles as supplementary, and another is abandoning its business for that of making revolvers. German exports have increased in copper, iron, lead, metals, and other wares. Though the iron industry has been specially attacked by the depression, the German artisans have not and are not undergoing any great deprivation of employment. When trade is bad, German employers cling to their operatives long after business considerations would appear to dictate their dismissal, and where reductions in number have been made the superfluous hands have found other employment.

Greece—Iron Ore.—Iron is found in various parts of Greece. The principal mines are in the small rocky island of Seriphos, where the supply is practically inexhaustible. The mines belong to a company called Société des Usines de Seriphos, having head-quarters at Paris. The mining, loading, and transportation are let to a German engineer, Emile Grohmann. The present output of the works is about 50,000 tons of ore per annum, which is sold free on board at Seriphos at 5s. 8d. a ton. Of this sum Grohmann receives 4s. per ton for the expenses of mining, loading, and transportation, the remaining 1s. 8d. being the company's profit. There are employed in the works about 100 labourers, at wages varying from 2s. 5d. to 3s. 2d. a day. The company guarantee 50 per cent. of pure metal, and the last shipped had 55 per cent. The principal market for the ores is France. The United States has also taken a portion, and there has been lately a marked increase. During September last two shipments, amounting to 5600 tons, were consigned to Latasa and Co., of New York. Ships can call at Seriphos in any weather, and lie alongside the wharf for loading.

Turkey—Trade of Eastern Roumelia in 1885.—It is not possible to speak with any degree of accuracy as to the amount or value of British trade with this province, there being no means of determining the same. One house only, and that of secondary rank, deals directly with the United Kingdom. The others, as a rule, deal with the wholesale houses at Constantinople. During the spring of 1886 the Government established a customs cordon on the Turkish frontier, where the quantity and value of all goods entering Eastern Roumelia are registered, but no note is taken of the country of their origin. All foreign articles imported pay a duty of 8 per cent., unless certificates are produced from either the Board of Customs or Chamber of Commerce at Constantinople that the duty has been already levied. The revolution of 1885, and the war ensuing thereon, seriously deranged the trade of this province, communication with Constantinople and the Southern parts being interrupted for three months. The merchandise imported from the United Kingdom consists of articles of the first necessity, and they are not likely to be supplanted by the same kinds of goods from other countries. Among them are hardware, iron in bars, rods and sheets, and sheet copper. Agricultural implements and machines, mainly British, have lately been introduced into this province. At first they were favourably regarded, especially the reaping machines, but they are so frequently injured by rough usage that the demand for them has declined. With more care in ploughing, and the substitution of large horses for buffaloes, their great advantages will be recognised. Many of the smaller implements are furnished by the manufacturers of Posen. These implements are cheap and light, but the workmanship is very inferior. They quickly wear out, and are only bought by the poorer class of farmers. Austrian—including German—trade is rapidly extending. The goods supplied will not, however, compete with British imports, being chiefly articles of a fancy and light description. The quality of all except beer is the very lowest; but here, as throughout the East, the great desideratum is cheapness. The Austrian houses trading with Turkey through their numerous agents, who have the best opportunities of judging their neighbours' character, credit, and means, can carry on their business operations easier than others less favourably circumstanced. It is expected that with the extension of the railway to Sofia the demand for British goods will be considerably increased. Even the portion, about thirty miles in length, which will be open in the spring, ought to exercise upon trade a considerable effect, as heavy goods can then be carried further through a mountainous and remote district hitherto served by bullocks, carts, and horses.

Trade of Smyrna for 1882-5.—The shipping entering the port of Smyrna has steadily increased between 1877 and 1885, the tonnage in the respective years being 725,237 and 1,235,270. British shipping has had its full share of this increase, the tonnage having risen during the same period from 176,012 to 320,259. In both cases the increase has been solely in steam vessels, which have in number and tonnage nearly doubled. From the difficulty of obtaining information regarding trade in Smyrna, the various figures are only approximations, although every care has been taken to ensure accuracy. In 1882-5 there has been a great falling off in the value of British imports, especially during the last two years, though the tonnage of shipping entering during the same period shows considerable increase. If the figures are to be relied on, and an undue proportion of the vessels entering were not in ballast, the decrease of imports from Great Britain is solely in value. The following table shows the British trade with Smyrna from 1882 to 1885 :—

Year.	Exports from Smyrna.	Imports from Smyrna.	Total.
	£	£	£
1882...	1,778,632	1,395,040	3,173,672
1883...	1,653,829	1,347,656	3,001,485
1884...	2,128,034	1,206,342	3,334,376
1885...	1,706,565	904,193	2,610,758
	7,267,060	4,853,231	12,120 291
Average yearly values...	1,816,765	1,213,308	3,030,073

Though this reduction in value of exports from Great Britain may be due more to a depreciation of value than a diminution of supply, it must be attributed chiefly to the increased competition of other countries. In some of the most important articles Great Britain has been successfully rivalled in the last few years by Austria, Belgium, France, and Germany, and has now lost her position of chief purveyor to the material wants of this part of Asia Minor. Germany is her most formidable competitor, and it must be understood the words Austria and Germany in this report are synonymous, for it is impossible in most cases to distinguish between Austrian and German goods. The relative position of Great Britain to France and Germany as regards values of imports into Smyrna during the last four years is :—

Year.	Great Britain.	Austria-Germany.	France.
	Per cent.	Per cent.	Per cent.
In 1882	43·66	14·00	19·25
,, 1883	41·50	17·50	16·00
,, 1884	41·00	15·00	15·00
,, 1885	33·50	17·50	17·00
Average of the four years	39·90	16·00	16·81

The proportions of the values of imports from each country compared by years, is :—

Year.	Great Britain.	Austria-Germany.	France.
	Per cent.	Per cent.	Per cent
In 1882	100·00	100·00	100·00
,, 1883	96·61	124·23	84·02
,, 1884	86·47	97·00	78·00
,, 1885	64·88	103·50	74·35

The above table shows that while there has been a fall in value of British imports in 1885 to the amount of about 35 per cent., there has also been a fall of 25 per cent. in the value of French imports, while those of Austria and Germany have risen only 3½ per cent. Upon the whole, this does not bear out the theory of foreign competition, though that may be the case in particular trades. Among the articles of imports in which Great Britain has lost ground are hardware, iron, and nails. Those in which the supply has increased or maintained steady are coals, copper, lead, manufactured iron and steel, tin bar, and sheet zinc. The monopoly of coals is yearly on the increase, though prices are declining. Hardware has increased to such an extent that though prices have fallen 32 per cent., the total value has increased 17 per cent. In 1885 Austria-Germany imported 35 per cent. and

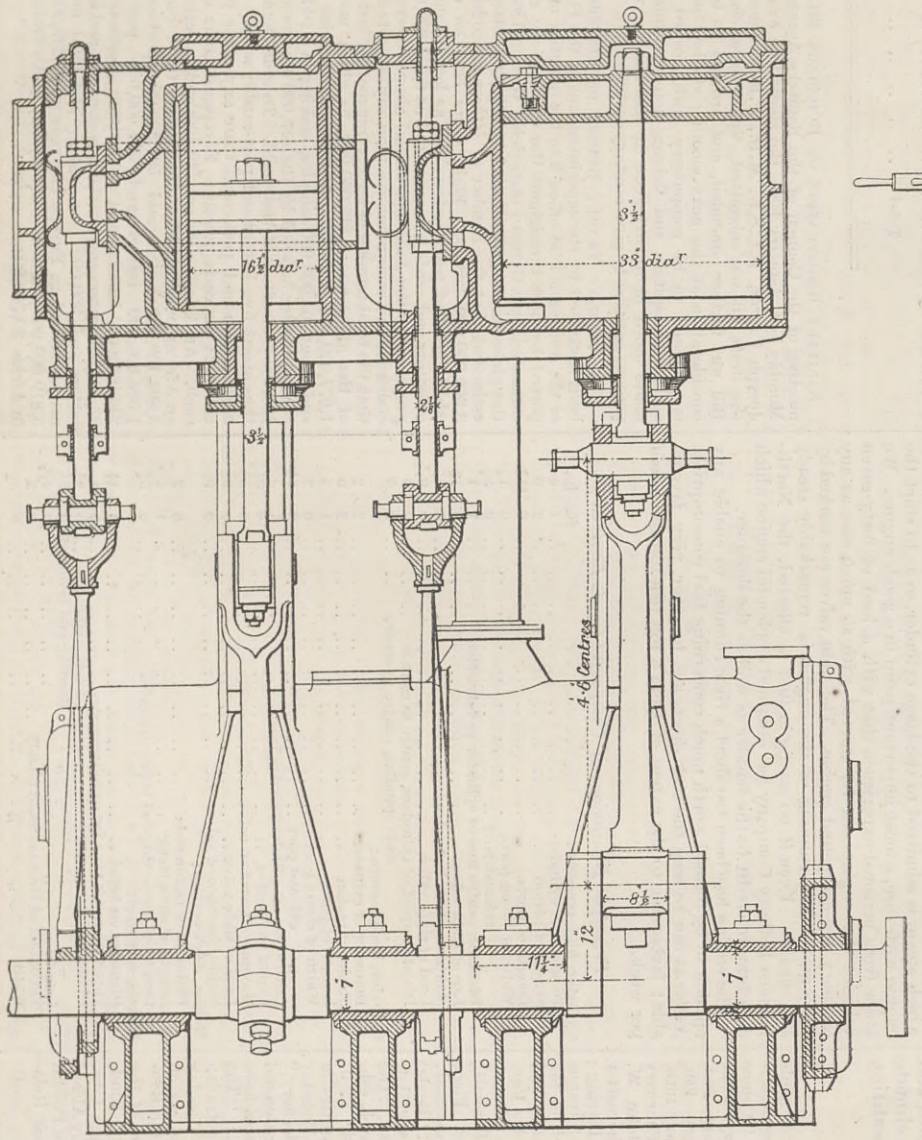
COMPOUND ENGINES OF THE DREDGER DOLPHIN.

MESSRS. SIMONS AND CO., RENFREW, ENGINEERS.

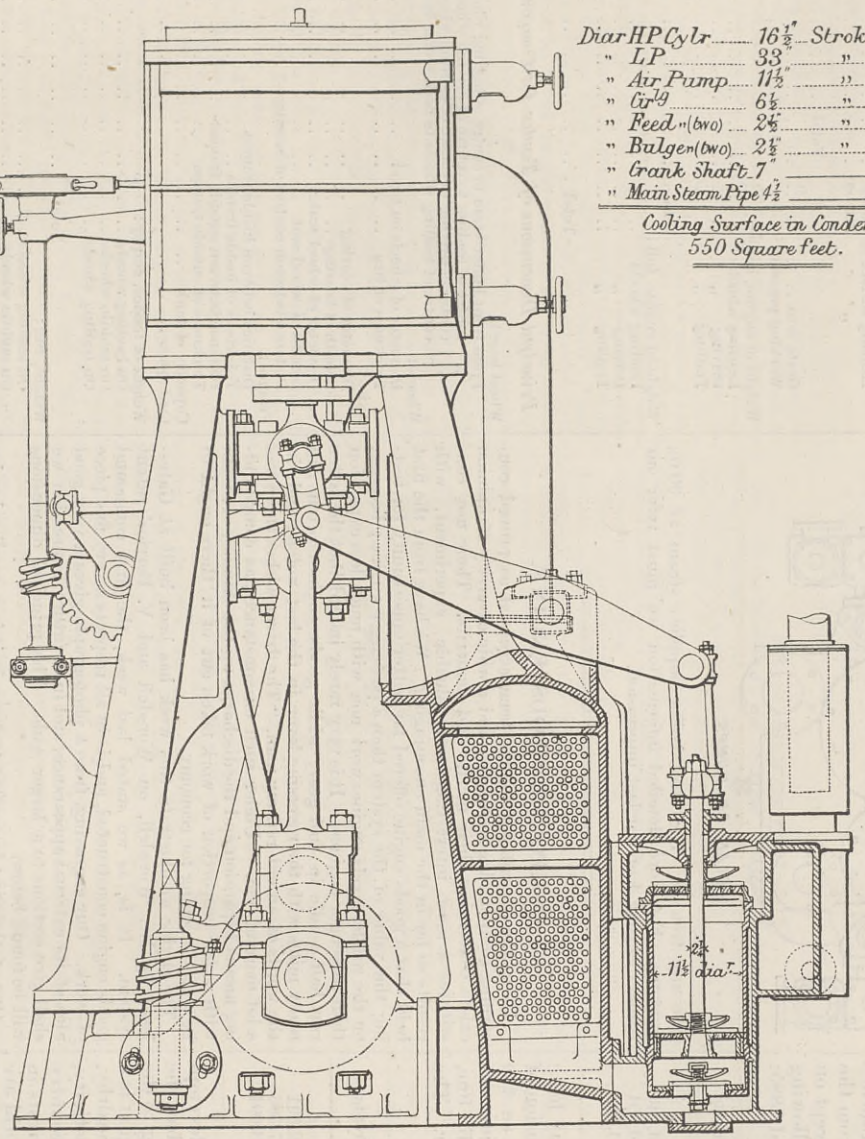
(*For description see page 24.*)

Diar HP Cylr	16½"	Stroke	24"
" LP	33"	"	24"
" Air Pump	11½"	"	14"
" Crtg	6½"	"	14"
" Feed " (two)	2½"	"	14"
" Bulger (two)	2½"	"	14"
" Crank Shaft	7"		
" Main Steam Pipe	4½"		

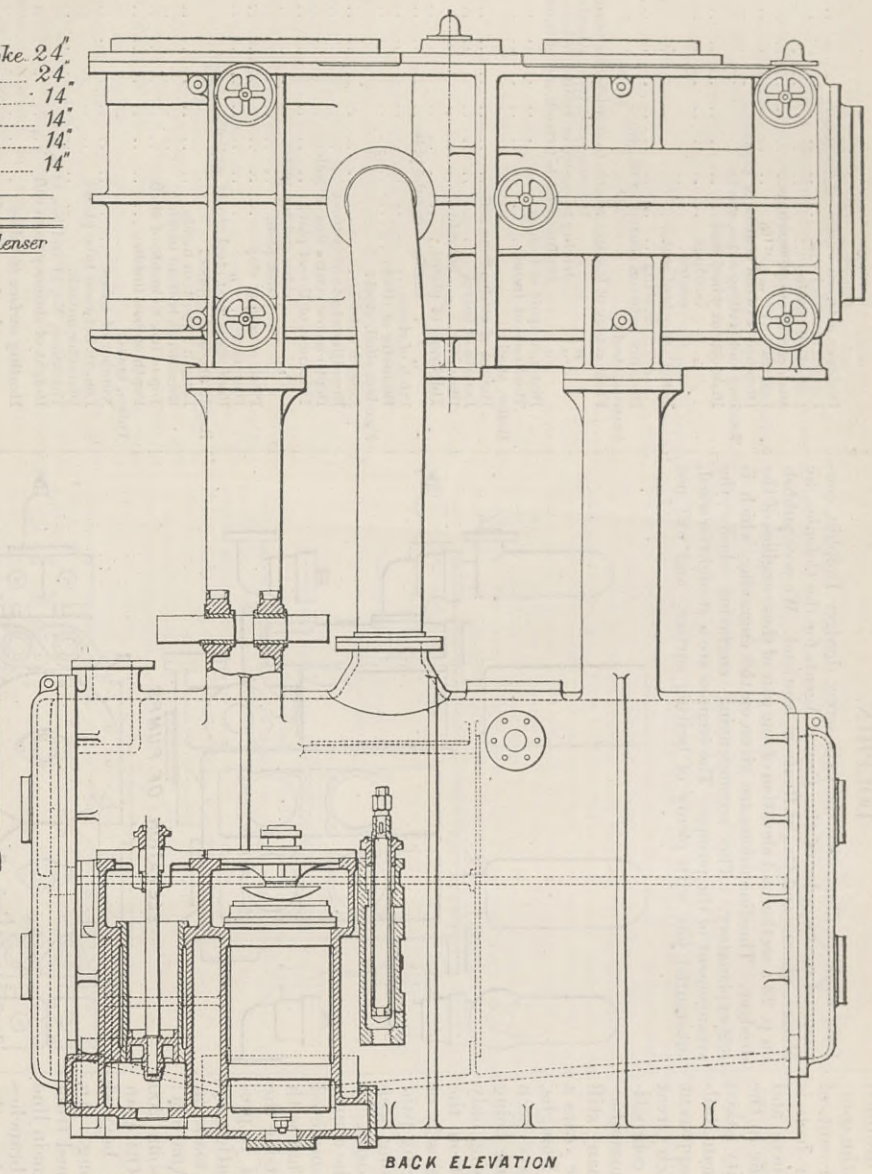
Cooling Surface in Condenser 550 Square feet.



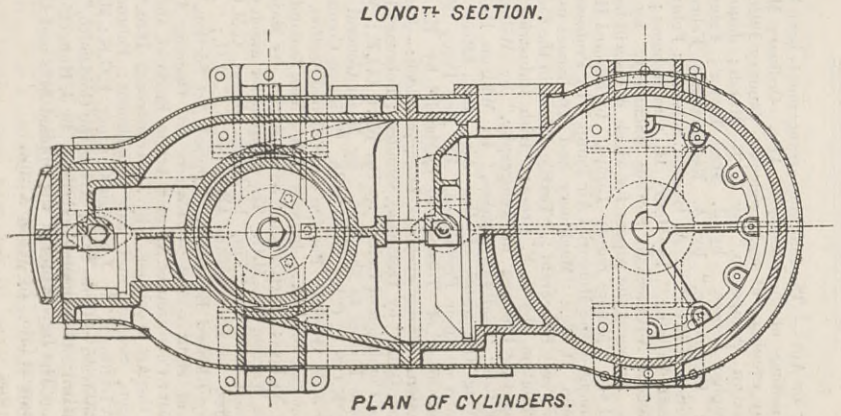
LONGTL SECTION.



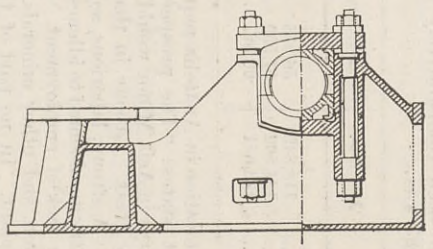
END ELEVATION



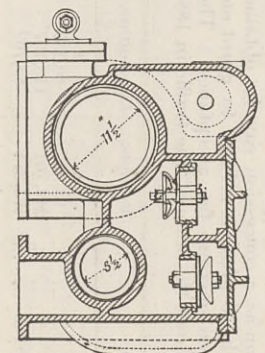
BACK ELEVATION



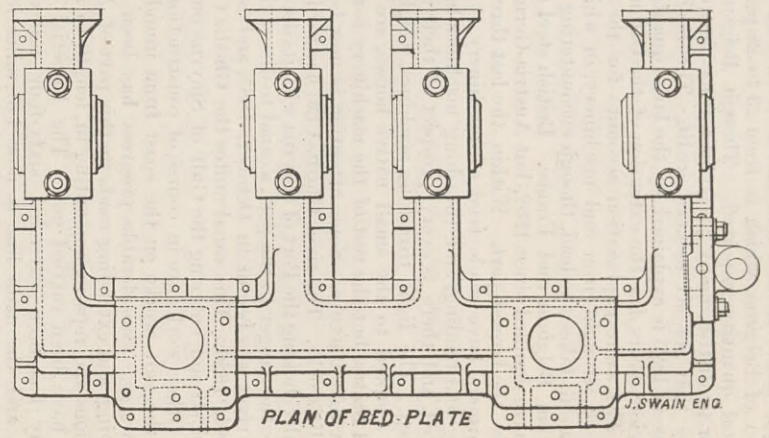
PLAN OF CYLINDERS.



SECTION OF BED PLATE



SECTIONAL PLAN OF PUMPS



PLAN OF BED PLATE

J. SWAIN ENG.

France 40 per cent., whilst British imports, which, during the three previous years had exceeded all others, declined to 18 per cent. British iron has now to bear the competition of Belgium, which is from 23 to 28 per cent. of the total quantity imported. Though Belgian iron is inferior to British, many prefer it for its cheapness and because they get six months' credit. The decline in the imports in 1885 is explained by the large quantity taken in previous years for the extension of the Ottoman Railway. The same explanation accounts for the apparent decline of wrought iron and machinery, in which Great Britain still takes the lead, though encountering competition from Belgium and France. British steel manufactures have doubled since 1882, but Austria-Germany still supplies the largest part. Within the last three years a few farmers have made trial of machinery. Ploughs, reaping and binding, and thrashing machines have been imported, and there is every prospect of their use being extended. The light threshing machines, weighing only 5 cwt., adapted to the small native horses, are from the United States, but the rest of the machinery is mostly of British manufacture. Some attention is now being paid to public works. The river Ghedis Chaï has for long been gradually choking the Port of Smyrna with its deposits. To remedy the danger to the port, a canal to divert the course of the river was begun in October, 1885, and completed in March, 1886. This canal unites the Ghedis Chaï with another stream entering the Gulf of Smyrna outside the port. Other works are in course of construction to preserve the salt works on the coast from inundation by fresh water. Considerable progress has been made in improving and extending roads in this part of Anatolia; extensions and repairs, amounting in length to some 200 miles, have been carried out. The Imperial Ottoman Railway has been extended sixty-four miles beyond Aidin, and the main line is now 145 miles long. An additional branch of thirty miles has been opened from Turbali to Tireh, in the Cayster Valley. The main line will be extended for eighty-one miles, and sundry branches made as soon as a concession can be obtained from the Porte, which at present refuses to grant one except on conditions too onerous for acceptance. The following statement shows the state of the traffic in 1881 and 1885:

Year.	Receipts.	Expenditure.	Profits.
	£	£	£
1881...	94,377	60,137	34,240
1885...	214,101	113,197	100,904
Average 1881-5	164,278	89,769	74,509

The directors of the Smyrna and Cassaba Railway have endeavoured to obtain a concession for the extension of their line, but the result has been the same as the preceding. The length open is 108 miles. This line was constructed at a smaller relative cost than the Aidin line, and the profits have been comparatively larger. The traffic in 1881 and 1885 was:—

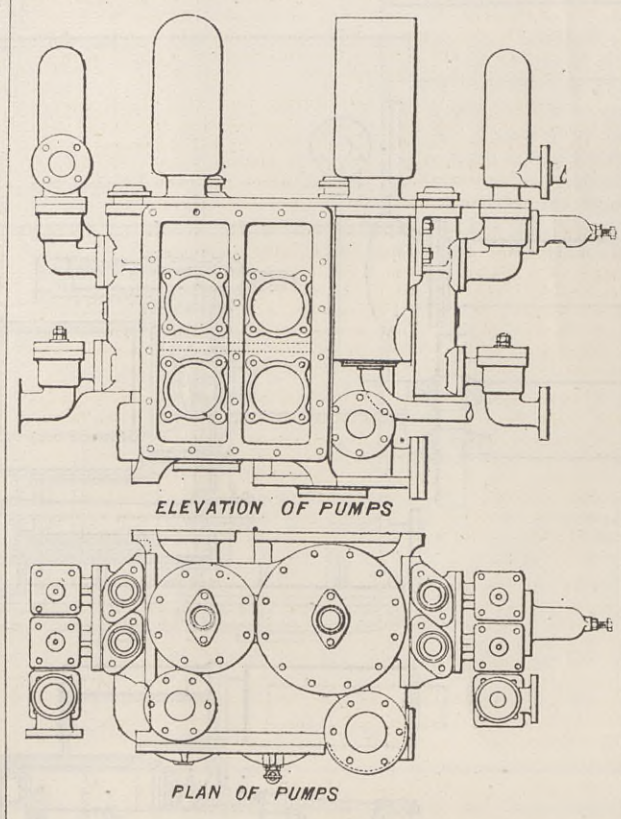
Year.	Receipts.	Expenditure.	Profits.
	£	£	£
1881...	118,849	56,958	62,891
1885...	134,862	57,559	77,303
Average 1881-5	133,681	60,587	73,094

The means of communication in Anatolia require developing. Another report states: "The prosperity that the construction of railways in Asia Minor would bring to the people would be very great. Labour in that region is a drug in the market. A strong, laborious, sober, healthy, and numerous peasantry are doomed to idleness, inactivity, and poverty through lack of employment. The country abounds with coal, iron, and other minerals. Forests in many parts are abundant. In no part of the world are the materials for railway building—coal, iron, stone, and timber—more abundant, and of easier access. The climate is temperate, and, with the exception of a few localities, healthy.

Society of Arts.—The following arrangements have been made for the meetings of the Society of Arts. Ordinary Meetings.—Wednesday evenings, at eight o'clock:—January 19th, "Cameo Cutting as an Occupation," by J. B. Marsh; January 26th, "Photographic Lenses," by J. Trail Taylor; February 2nd, "Electric Locomotion," by A. Reckenzaun; February 9th, "Adulteration of Beer," by A. Gordon Salamon; February 16th, "Handicraft Training," by Henry H. Cunynghame; February 23rd, "Recent Advances in Sewing Machinery," by John W. Urquhart. Amongst the papers for which dates will be hereafter announced are, "Miners' Safety Lamps," by Edward H. Liveing; "Development of the Mercurial Air Pump," by Professor Silvanus P. Thompson, D. Sc.; "Machinery and Appliances used on the Stage," by Percy Fitzgerald; "Textile Fibres in the Colonial and Indian Exhibition," by C. F. Cross; "Irish Industries," by Rev. Canon Bagot; "Progress in Telegraphy," by William Henry Preece, F.R.S.; "Railway Brakes," by William P. Marshall; "The Living Organisms of the Air: the Effect of Place and Climate on their Prevalence," by Dr. Percy Frankland. "The Cultivation of Tobacco in England," by E. J. Beale; Indian Section.—Friday evenings, at eight o'clock:—January 21st, "The Upper Oxus," by Trelawney Saunders; February 11th, "The Economical Condition of India," by Dr. Watt, C.I.E.; March 4th, "Our Trade Routes to the East," by Major-General Sir F. J. Goldsmid, K.C.S.I., C.B.; April 29th, "Village Communities in India," by J. F. Hewitt. Foreign and Colonial Section.—Tuesday evenings, at eight o'clock:—January 25th, "New Zealand Scenery," by Kerry Nichols; April 19th, "South Africa, by Major-General Sir Charles Warren, G.C.M.G. Those papers for which dates have not yet been fixed are "Fiji," by James Mason, C.M.G.; "The West Indies," by Sir Augustus Adderley, K.C.M.G.; "Australian Wines," by Richard Bannister. Applied Art Section.—Tuesday evenings, at eight o'clock:—February 1st, Opening Address on "The present Condition of Applied Art in England, and the Education of the Art Workman," by T. Armstrong, Director of the Art Division, Science and Art Department; February 22nd, "Wrought Ironwork," by J. Starkie Gardner, F.G.S.; March 15th, "The Application of Gems to the Art of the Goldsmith," by Alfred Phillips; April 26th, "Ornamental Glass," by J. Hungerford Pollen; May 24th, "The Importance of the Applied Arts and their Relation to Common Life," by Walter Crane.

COMPOUND ENGINES OF THE DREDGER DOLPHIN.

Last week we illustrated the twin-screw dredger Dolphin, constructed to the order of the Crown Agents for the Colonies, by Messrs. Simons and Co., of Renfrew, Scotland. We now publish on p. 23 a section and elevation of one pair of these engines of the dredger. The dimensions are given on the engraving, which is self-explanatory. The accompanying engraving shows the arrangement of the pumps. The engines are a straightforward, substantial job, with plenty of bearing surface, and will not



give any trouble. The steel boiler supplies steam at 90 lb. pressure. For more detailed information we must refer our readers to page 4 of our last impression.

COMPOUND GOODS ENGINE.

Up to the present nothing has been accepted as proved concerning compound locomotives, and a wide diversity of opinion exists concerning their merits and demerits. Their use constitutes a most interesting and valuable experiment, with results so far in the main encouraging. We have from the first held that a goods engine offered far better opportunity for testing the value of the system than a passenger engine; because, on the whole, goods engines work now with much less expansion than passenger engines. It is very rarely indeed that the latter run half a-mile in full gear, while goods engines often run many miles with the reversing lever in the last notch; and, in the words of an old railway man, "The driver wishes there was a lot more of 'em." Under such circumstances, as compounding means expansion and the discharge up the chimney of steam with a fair proportion of work taken out of it, there ought to be a good opening for economy.

The engine we illustrate this week has been built at Gateshead by Mr. Worsdell, on Worsdell and V. Borries' patent system. It is, as we stated last week, the first compound goods engine constructed, and is in all respects a very fine piece of work. Our engraving, from a photograph, gives a very good idea of its external appearance, and in a future impression we shall give sections to a larger scale. The principal dimensions will be found below.

One of the most important features in it is a small valve by which steam is admitted to the large cylinder, so as to start the engine with ease, a most important point in a goods engine. We know from personal experience that with a load of forty-seven vehicles the engine can be started with as much ease as any ordinary non-compound engine. The slide valves are worked by Joy's gear. The running of the engine is remarkably steady and smooth. Even if no saving in fuel is effected, the North-Eastern Railway Company has obtained a splendid engine which does infinite credit to the builder as well as the designer.

The engine has been too short a time running to enable any opinion to be formed worth much concerning fuel consumption. As far as can be seen the coal sheets are, however, very favourable; favourable to the extent of from a ton to a ton and a-half per week.

Principal Dimensions of Compound Goods Engine.

	ft.	in.
Cylinder, high-pressure:		
Diameter of cylinder	1	6
Stroke of piston	2	0
Length of ports	0	11⅜
Width of steam ports	0	1¾
,, exhaust port	0	3½
Distance, centre line of cylinder to valve face	1	1
Lap of slide valve	0	1⅛
Maximum travel of valve	0	5½
Lead of slide valve	0	0$\frac{3}{16}$
Distance apart of cylinders, centre to centre	2	0
,, slide spindles, centre to centre	2	0
Cylinder, low-pressure:		
Diameter of cylinder	2	2
Stroke of piston	2	0
Length of ports	1	5
Width of steam port	0	2
,, exhaust port	0	3½
Centre line of cylinder to valve face	1	5
Lap of slide valve	0	0$\frac{13}{16}$
Maximum travel of valve	0	5½
Lead of slide valve	0	0$\frac{3}{8}$
Inside clearance of valve	0	0$\frac{1}{8}$
Motion, Joy's system:		
Diameter of piston-rods	0	3
Length of slide block	1	2
Length of connecting-rod between centres	6	5¾
Wheels, cast steel:		
Diameter on tread	5	1¼
Throw of crank pins for coupling-rods	0	11
Diameter ,, ,, (driving wheels)	0	3¾
,, ,, ,, (leading and trailing)	0	3½
Length ,, ,,	0	4$\frac{1}{16}$
Thickness of tires on tread (steel)	0	3
Width ,, ,,	0	5½
Crank axle, steel:		
Diameter at wheel seat	0	8½
,, bearings	0	7
,, centre	0	6¾
Distance between centres of bearings	3	10
Length of wheel seat	0	7⅝
Length of bearing	0	9
Diameter of crank bearings	0	7¼
Length ,, ,,	0	4⅝
Distance between centres of cranks	2	0
Leading and trailing axles, steel:		
Diameter at wheel seat	0	8½
,, bearings	0	7
,, centre	0	6¾
Length of wheel seat	0	7⅝
,, bearing	0	9
Distance between centres of bearings	3	10
Frames, steel:		
From centre of leading wheels to front buffer beam	5	3
,, ,, to centre of driving wheels	8	0
,, driving to centre of trailing wheels	8	6
,, trailing wheels to back end of frame	3	6
Distance apart of frames	4	0
Thickness of frame	0	1
Boiler, steel:		
Height of centre from rails	7	5½
Length of barrel	10	7
Diameter ,, outside	4	3
Thickness of plates	0	0½
,, smoke-box tube plate	0	0$\frac{9}{16}$
Pitch of rivets	0	1⅞
Diameter of rivets	0	0$\frac{13}{16}$
Fire-box shell, steel:		
Length outside	6	0
Breadth outside at bottom	3	11
Depth below centre line of boiler	5	0
Thickness of throat plate	0	0⅝
,, sides and top plate	0	0½
,, back plate	0	0½
Pitch of copper stays	0	4
Diameter ,,	0	1
Roof stays, cast steel girder section.		
Inside fire-box, copper:		
Length at bottom inside	5	3⅝
Breadth at bottom inside	3	3
Top of box to inside of shell	1	3½
Depth of box inside	5	9½
Tubes, brass:		
Number of tubes	203	
Length between tube plates	10	11½
Diameter outside	0	1¾
Thickness, No. 11 and No. 13 B.W.G.		
Height of chimney from rail	13	1

Heating surface of tubes	1026·12 sq. ft.
,, fire-box	110·
Total	1136·12 sq. t.
Grate area	17·23 sq. ft
Working pressure	160 lb.

Weight of engine, empty:	Tons.	cwt.	qrs.
Leading wheels	11	0	2
Driving ,,	15	0	0
Trailing ,,	13	6	0
Total	39	6	2
Weight of engine, full:			
Leading wheels	14	3	2
Driving ,,	15	10	0
Trailing ,,	12	3	0
Total	41	16	2

Principal Dimensions of Tender for Compound Goods Engine.

	ft.	in.
Wheel base:		
From front buffer beam to centre of leading wheels	4	2
,, centre of leading to centre of driving wheels	6	4
,, centre of driving to centre of trailing wheels	6	4
,, centre of trailing wheels to back buffer beam	4	2
Wheels:		
Diameter of wheels on tread	3	9¼
Thickness of tire	0	3
Axles:		
Diameter of bearing	0	5
Length of bearing	0	10
Diameter of wheel seat	0	6¾
Length of wheel seat	0	7½
Distance between centres of bearings	6	10
Frames:		
Distance between inside frames	4	1
Thickness of inside frames	0	0½
Distance between outside frames	6	2¾
Thickness of outside frames	0	0⅞
Capacity of tank	2650 gals.	
Coal space	4 tons	

Weight of tender, empty:	Tons.	cwt.	qrs.
On leading wheels	6	2	0
On middle wheels	5	14	0
On trailing wheels	5	10	0
Total	17	6	0
Weight, full:			
On leading wheels	10	10	0
On middle wheels	12	14	2
On trailing wheels	9	14	2
Total	32	19	0

Sanitary Registration of Buildings Bill.—At the monthly meeting of the Council of the Sanitary Assurance Association on Monday last, January 10th, the above Bill was reconsidered. Sir Joseph Fayrer, K.C.S.I., M.D., F.R.S., presided. A report on the draft Bill was submitted, with several clauses redrawn. The Bill was further amended, and ordered to be printed for final consideration at the next meeting of the Council. The new Bill is proposed to be compulsory with regard to schools, hotels, asylums, hospitals, and lodging houses, while Clause 6 has been made much more stringent in the matter of qualification of persons entitled to give sanitary certificates.

The World's Yearly Budget of Letters.—An inquiry has been instituted by the superintendent of the Foreign Mail Division of the American Post-office into the quantity of mail matter transported by post throughout the entire globe every year. It was estimated by a German statistician that in 1865 the inhabitants of the globe exchanged about 2,300,000,000 letters. In 1873 it was estimated that the number of letters so exchanged had risen to 3,300,000,000 letters. Eight years later an estimate was made which included post-cards as well as letters, and the total number of letters and cards was estimated at 6,257,000,000. The table now prepared by the American official above referred to is much more elaborate and comprehensive than any hitherto compiled. It shows that the total number of letters transported last year in all quarters of the globe was 5,849,000,000, to which may be added about 1,077,000,000 post-cards, 4,610,000,000 articles of printed matter, and about 104,000,000 samples, making in all 11,640,000,000 pieces of mail matter handled by the 489,000 officers and employés in the 154,000 post-offices of the world. To every human being there are thus about five letters and post-cards yearly. Australians receive more letters and post-cards than any other people, the average being 24 for each person. Europeans come next with about 14 each. An Asiatic gets only 40-100ths of a letter or post-card, and an African only 9-100ths. In Europe there were mailed last year 3,894,100,000 letters and 597,500,000 post-cards; in America, 1,596,800,000 letters and 398,000,000 post-cards; in Asia, 246,000,000 letters and 80,000,000 post-cards; in Australia, 93,400,000 letters and 1,200,000 post-cards; and in Africa, 18,700,000 letters and 300,000 post-cards. The total number of pieces of matter mailed in Europe last year was 7,249,300,000; in America, 3,819,000,000; in Asia, 389,600,000; in Australia, 151,400,000; and in Africa 30,700,000.

on that day in the building of a huge mass of rubble masonry in course of construction. The sugar was common raw sugar at three halfpence per pound. As, unfortunately, is often the case with cement, the results are not consistent; but they show that sugar did not benefit cement in its resistance to tensile stress.

Llanwddyn, January 6th. A. NELSON BARNES.

Results given by Briquettes of Neat Cement Gauged with Water only and with Sugar and Water.

Weight of materials.				Setting time of pats of each gauging.	Age of briquettes before testing, and resistance to tensile stress in lbs.		
Cement	Water.	Sugar.	Total.		7 days.	14 days.	21 days.
oz.	oz.	oz.	lb.		lb.	lb.	lb.
18·4	3	0	1·34	3 hours.	620	800	700
,,	" ,,	¼	1·37	8 minutes.	200	120	Failure.
,,	,,	1	1·40	31 ,,	70	66	45
,,	,,	1½	1·43	2½ hours.	113	215	148
,,	,,	2	1·46	40 minutes.	158	100	135
,,	,,	2½	1·49	50 ,,	122	222	112
,,	,,	3	1·52	30 ,,	125	245	136
,,	,,	3½	1·55	80 ,,	Failure.	22	Failure.

PRESTON AND THE RIBBLE NAVIGATION SCHEME.

SIR,—I have to-day read your editorial summary of engineering works in progress during the year that is past, among which you mention the Ribble Navigation Works. Allow me to explain that I went very carefully into the question during last spring and summer, and in October last, after I had consulted the large mill-owners and ratepayers in Preston, it was decided to hold a private meeting to consider what could or should be done in the matter, and we found out after obtaining the best legal advice, that since the Preston Corporation were executing works sanctioned by Parliament we were powerless until the Corporation went to Parliament to obtain increased borrowing powers, which they will have to do in session 1888. They had expended up to 30th of November last £385,299 19s. Their present borrowing powers are £662,244 18s. 1d., and as they are now expending over £18,000 a month, consequently before the end of June in next year over £662,244 18s. 1d. will have been paid away, and how they expect to get their bill in session 1888 through Parliament before June of that year I do not know; only they will have to be very expeditious, and the enormous amount of opposition they will have to encounter must be remembered.

Sir, I have already publicly stated in a letter to the local newspaper, dated 23rd of last November, that it is no pleasure to me to show up the hopelessness of a large public works; but having seen that it is so, should I be justified in not speaking out? Whatever opinion must be formed of the result to be accomplished by certain works when complete must be formed by reference to other works of a like nature; in that I think you will agree with me. Now, Sir, applying that very natural observation to the Ribble Navigation Works, what do we find? But before doing so let me tell you a little of the history of the river Ribble. Up to about 1853 there was a deep water channel—buoyed at low water spring tides—from Lytham to the Irish Sea, and the river from Lytham to Preston was a circuitous, wandering channel; it would go three miles due south, then three to four miles due north; consequently Messrs. Robert Stevenson and Sons, C.E., of Edinburgh, who reported to the Preston Corporation on "The Improvement of the River Ribble" in November, 1836, said if the channel from Lytham to Preston were made straight the navigation of the river Ribble would be complete. In 1853 an Act of Parliament was obtained to do it, and by the time the works were finished, the deep water channel from Lytham and to the Irish Sea had filled up, and is now dry land when the tide is out. In 1866 Messrs. Bell and Miller, of Glasgow and Westminster, reported to the Corporation, that no doubt this deep water channel to the Irish Sea had not quite filled up, and their scheme was to dockise the river, and total outlay £100,000.

The present scheme is to lower the bed of the river Ribble to nearly level with the bar, that is to give the channel a fall of four feet in seventeen miles, and there is from three feet to four feet of water on the bar at low water spring tides; therefore from the Irish Sea to the Albert Edward Dock at Preston the distance is seventeen miles, and no water at low water the whole distance except a short length, but this is so narrow no vessel dare anchor. To make this channel, the bed of the river has to be lowered 20ft. at Preston, where is the entrance from the river to the dock, width 300ft., and the last 12ft. in depth is solid rock, which rock will extend down the river over a mile. The first four miles the depth is never less than about 15ft. to 16ft. deep, after that it gets less; opposite Lytham Pier it will be about 9ft. deep, for ten miles it will be from 20ft. deep to 6ft., and the last seven miles is across the centre nearly of a sandy, clayey, and hard gravel estuary ten miles wide, in which no training walls are to be built. But he would be a bold man who would propose to build training walls across an open sandy estuary ten miles in width. Well now, Sir, let us apply my proposition of the amount of success which may be looked forward to in these works. (1) All rivers to be navigable must have water in them at low water. (2) All rivers that are a success have water in them when the tide is out. (3) The river Ribble will not have water in it when the tide is out, consequently these works cannot be a success; that is, there will not be depth of water to navigate ships; a boat drawing 2ft. of water could not get up the channel, when the works are complete, at low water spring tides. Again, by the works carried out under the Act of 1853, the deep water channel from the Irish Sea to Lytham became blocked up, silted up. This channel you can see for yourself by referring to the one inch Ordnance Map—and there are men now living at Southport and Lytham who have used this channel. After the channel silted up, the river went straight across the Horse Bank for nearly three miles; then it turns nearly north, and runs four miles across the sands till it reaches the Irish Sea. It was in this channel, near No. 3 buoy, that a vessel was wrecked on Saturday, the 4th of last month, and the crew were saved by the St. Anne's lifeboat—the very men who, a few days after, were all drowned in this wide estuary a little below Southport. The local newspaper, the *Manchester Courier*, of 6th December, 1886, in describing the gallant rescue, says—"The vessel struck one of the well-known sand banks which have been the destruction of so many ships, and at once floated an ensign as a signal of distress." You will, I trust, observe that the works under the Act of 1853 destroyed the deep water channel from Lytham to the Irish Sea; consequently the vessels, which their new channel from Lytham to Preston could use, had not then a channel from Lytham to the Irish Sea, and the improvement of the river Ribble has really meant filling up the estuary with miles of sand, and where had been miles of water, fathoms deep, is now dry land, and where the waters of the river Ribble flowed down to the Irish Sea from Lytham in a deep channel, it now flows across the sands for a distance of seven miles, and is no deeper than a foot or two, except certain lengths—to wit, where that vessel was wrecked on the 4th of December, 1886, a boat drawing 2ft. of water cannot get up from the Irish Sea to Lytham at low water spring tides.

Sir, I ask you in all sincerity what do you yourself think of the Ribble Navigation Works? I have omitted to tell you that the Corporation have two enormous dredgers at work in the river at Warton, about six miles from the dock; but you will no doubt understand what so few people in Preston can understand, that as the river at Warton is such a height above the sea level—at low water—it is only a very few hours every tide that they can float, and they can only work when they float; in fact they are no sooner up than they are down, consequently it is naturally not much work they do in a week, and it is extremely unlikely if they will be able to reach the dock at Preston in forty-five years, and then the hole they would have made would be, say, 8ft. wide. Well, one dredger has been at work since last July, and what she has done—those who live near say amounts to nothing. If she has time to make a hole when the tide is up, by the rapid flow of the river Ribble the hole is sanded up again by the time the tide is up again; and do not forget that the bed of the river has to be lowered 20ft. at Preston, the last 12ft. through hard rock, and 300ft. wide, and it is seventeen miles to deep water—the Irish Sea—before the dock can be used.

In conclusion, I think you will agree with me that the position of the Ribble Navigation Works is very different from any navigation works you ever heard of, and if the dock had been commenced after they had been sure of lowering the bed of the river—say after they had been at work thirty years on dredging—it would have been soon enough to commence to build the dock. I feel deeply grieved to have to write thus of a large public works. The works of 1853 ended in failure because they blocked up the channel from Lytham to the sea. How will the works now being constructed end—will the forty acres of locks and half tidal basin five acres, now being built, be able to be used in fifty years? The amount of money expended on them is nearly half-a-million—£500,000. You know now the whole details; you can, I daresay, form an opinion. If the dredgers—the people who live near them say they have done nothing—do, say, 100 yards in six months, and they are six miles from Preston, how long would it take them to get to Preston? And remember, the width they dredge is about 8ft., and the width they have to do is 300ft. Would it not be a little over forty-eight years?

G. HENRY ROBERTS, C.E.

87, Fishergate-hill Preston.
January 8th, 1887.

BEHAVIOUR OF STEAM IN THE CYLINDER.

SIR,—I have been much interested in reading and studying your able annual summary in your last week's issue. There is one point in which I feel bound to differ from you, referring to the alternate condensation and re-evaporation of steam worked expansively in the cylinder. As you imply, in the first column of your page 15, that Mr. Isherwood and myself were contemporaneous in the discovery or demonstration of that pregnant evil, allow me to remind you of the communication on this subject from me which you were kind enough to publish in your issue for October 16th, 1885, page 297, in which I proved that I had announced a practical discovery and demonstration of the said cause of loss in 1852, seven years earlier than the date of Mr. Isherwood's "Engineering Precedents" vol. ii., 1859.

Let me add that Mr. Isherwood has not, so far as I am aware, ventured any reply to my letter of October, 1885.

8, Buckingham-street, Adelphi, D. K. CLARK.
London, January 10th.

THE PROBLEM OF FLIGHT.

SIR,—If the track of P, Fig. 1, in Mr. Fitzgerald's letter in your issue of December 10th, be straightened, so as to lie in one direction, the lateral motion will be several times that of the vertical. The question of soaring, as stated by myself at the Buffalo meeting, was this: "Has the weight of a plane ability to move it continuously in a horizontal path in free, still air?" This statement presumed the absence of any force but gravity, and ignored birds and experimental devices.

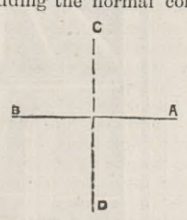
There is no difficulty if the plane comes down, however erratic its path may be; and where air currents are postulated of sufficient strength to keep the body up, of course it will stay up. The thing is to keep up a 16 lb. inert bird for hours, in a dead calm, when, if its weight be resistance to be overcome, nothing but a wind moving vertically upwards at the rate of thirty miles an hour could buoy it.

My contention with the Professors is that they have, in the mathematics of heavy bodies placed on inclined planes, a complete explanation of the case. It would be greedy to ask for anything more; and yet they cannot see it, because the application is in no text-book! They accuse me of advocating perpetual motion, and of asserting the preposterous proposition that the weight of a body does work in a motion that carries it away from the earth's centre.

The bird in soaring is moving downwards at every instant during the time of its flight, and it is in this motion that the work is done. There are two senses in which words must be used here to avoid confusion. Using the sea level, we must say that the normal motion is on a downward slant, and the lateral motion on an upward slant, producing a horizontal resultant. Using the bird's level, we must say that its downward motion is vertical, and its lateral motion horizontal, producing a downward slanting resultant. Certainly the mental image of what is going on is clear enough. Bear in mind that the parallel component of the resolution, which would push the normal into the vertical, is neutralised out of the activity, in which event the normal line becomes the vertical of the soaring system.

There is a play of forces going on here which relegates all conflicting air currents and St. Vitus momentums to the limbo of Mother Goose's Melodies—and we will all see it after awhile. It is surprising to me that it has not been recognised long ago.

A single further conversation with the Buffalo physicists remains to be reported, which throws light upon the confusion resulting from neglecting to keep separate in the mind what seems to be, from what is. Others, so amusing that I awaken at night to laugh at them, were held, but they were of a personal character, but incidentally connected with soaring. I have been presented with a good many schemes of planes driven on air, which brush the birds out of the sky, but this caps them all,—P.: Allow me to point out your fallacy. S.: Willingly.—P.: The plane moves horizontally in a continuous path. Its weight is therefore balanced by some resisting force. As the air is still, this force must be that which drives it horizontally, and must equal the weight. No change in details can affect this result. Resolution of the forces by the plane simply gives the method. S.: Suppose we say that the plane weighs 32 oz. and is inclined 10 deg. I understand you to say that the rear force must be 32 oz?—P.: Yes. S.: I provide myself with spring balances and get the components experimentally. You employ the usual mathematics, which is best, provided you make no mistakes, as the fractions are saved which I lose from imperfection in the devices; but in this case it does not change the result. I employ a 32 oz. weight, suspended by a string, which is then pulled sideways to the desired inclination, keeping the two lines of suspension perpendicular to each other. The tensions of the two strings then give the components.—P.: That should be correct. S.: Very well. I remember them for this weight, at 10 deg. inclination. The normal is 31½ oz. and the parallel is 4 oz. for the vertical force; and 3 oz. normal, and 30 oz. parallel, for the horizontal force. Adding the normal components, we have 34½ oz. on *c d*, and subtracting the parallel, we have 26 oz. on *a b* driving the plane on the upward slant from *a* towards *b*, and it would climb the air at a rapid rate. Not more than 6 oz. rear force would be required to give horizontal motion. A small fraction of this would become normal in the resolution, while the parallel component would balance the opposite one, and the surplus would drive the plane on the upward slant against skin friction, producing a horizontal resultant. — P.: You now have 6 oz. neutralising 32 oz. of vertical force. S.: No. There is now no vertical force to neutralise. The 4 oz., from *b* to *a* is balanced, while the component on *c d* is compressing air and is balanced by the reacting pressures.—P.: But the plane does not come down. S.: Yes. It comes down.—P.: How do you make that out? S.: By stopping the other motion. Stopping either will show what the other is.—P.: You now hold that no weight is lifted in the upward incline? S.: I do.—P.: Please explain this. S.: I treat this case as others are treated. We say that "vertical" is the direction in which gravity acts. As the uncancelled component on the normal line is the only gravity active on the plane, I therefore say that *c d* is vertical. As a plane at right angles to the vertical is a horizontal plane, I therefore say that *a b* is level; my meaning being strictly confined to this special phenomenon. I do not say that *a b* is the sea level, neither do I say that a plumb line would be on *c d*. The plane falls at every instant of time from its own level along the line of its own vertical, and in doing so it passes on the horizon of the world, which is soaring flight.—P.; Then you say that the weight of a plane can not only drive it horizontally but on an upward incline in still air? S.: I do.—P.: Are you aware of the immense consequences following such a result? S.: I quite lost my head when I first saw this matter, but am now over it. Instead of bearing gifts I seem to be carrying a menace. There is enough in it to make half-a-dozen men famous, but I fear the result will be to make one man infamous. I. LANCASTER.



Chicago, January 1st.

TILBURY DOCKS.

SIR,—It is somewhat surprising to hear, in connection with these so-called deep-water docks, that the Garonne, the first of the Orient liners which has ventured there, stuck fast in the mud of the tidal basin for hours, and was only released by the aid of four tugs, after breaking several hawsers in the endeavour to extricate her.

The East and West India Dock Company were told plainly by eminent engineers before the Parliamentary Committees that a tidal basin constructed according to the deposited plans would be simply a mud trap. Events seem to have fully justified this prediction. The docks have been open nearly nine months, during which period frantic efforts have been made by the dock company to induce shipowners to patronise them, with the certainly unfortunate result that the first vessel of any size comes to signal grief. The Garonne is now berthed in one of the inner docks, but the question arises, how will they get her out again? Dredging has been going on night and day for some months, but this is obviously inefficient as a remedy, and a radical alteration must be made in the construction of the tidal basin if uninterrupted access for vessels of deep draught is to be secured.

The Tilbury mud seems to have an unfortunate propensity for creating disasters. The new submarine boat, the Nautilus, stuck fast therein at a trial trip, and for a short time the occupants must have been, if not in actual peril, at least in a very uncomfortable position—so much so, that the engineer of the craft declined to repeat the experiment at Tilbury, and the distinguished visitors who had gone down to witness the trial of the vessel had to leave without the programme being concluded. C. E.

London, January 7th.

AMENDMENT OF SPECIFICATIONS.

SIR,—I little thought when I wrote my last letter that any announcement of so amusing a character as that to which you called attention in your issue of the 31st ult. was likely to appear in "The Official Journal of the Patent-office," viz., an amendment "having been made through a misapprehension, the same has been cancelled, and the words struck out have been restored." But the announcement referred to has a serious as well as an amusing aspect. Supposing the "misapprehension" had not been discovered, the provisions of Section 18, Sub-section 9, of the Act (to which you have referred) might have caused injustice to be done to some patentee owning a patent of later date than that which had been erroneously allowed to be amended.

It is not my intention at present to remark on the peculiarity of this act of administration in the Patent-office for any other purpose than to show how it illustrates the importance of real legal acumen being applied to cases of this kind in order to guard allowances of amendment from possible abuse. This may readily occur to the injury of other patentees if not carefully provided against. It is not, however, a danger to these alone, for supposing it had been left to a Court to find out the defect in the amendment owing to the "misapprehension," the applicant might have been put to great cost in some abortive legal proceedings that he might have instituted in faith of the validity of the amendment.

There is a curious illustration of the importance of accuracy in these amendments in some particulars connected with the case of Foxwell *v.* Bostock, in which Lord Westbury, by way of clearing the ground in the trial of the case, gave an interlocutory opinion as to the construction of the specification after the entry of a disclaimer. The judge restricted the argument, and confined his attention to the interpretation of the document in the first instance—which is the course that in my opinion ought always to be adopted—and arrived at a conclusion as to what was the invention described and claimed by the amended specification.

But, unfortunately, on further argument, which he allowed, he saw reason to alter his opinion, and eventually decided the case on a point altogether distinct from that on which his opinion had been expressed, the difficulty of construction having been greatly increased by the desire to give full effect to the disclaimer. All this tends to show that the allowance of disclaimers is a matter requiring great judicial intelligence in its administration, and, I think, points to the necessity of having in the Patent-office a well-trained lawyer capable of dealing with difficult cases. Such an officer, with the aid of the technical staff or specially called experts—when necessary—would be competent to try questions of infringement and revocation as a technical Court of first instance.

8, Quality-court, Chancery-lane, W.C., WILLIAM SPENCE.
January 11th.

NEUTRAL SURFACE IN SOLID BEAMS.

SIR,—A gentleman has pointed out to me that I appear to have overlooked the gist of Mr. Pearson's question. If the beam is fixed at both ends so that it cannot move longitudinally, deflection must cause an increment in the length and a tensile strain over each section, tending to diminish the compressive and increase the tensile stresses. Mr. Pearson wishes to know what effect this will have on the position of the neutral surface. Clearly such a tensile stress would cause the distance between the neutral surface and the convex side, *i.e.*, the side in extension, to be greater than it would be if the ends of the beam were free. A beam so fixed supports the load partly as a catenary, partly as a beam. The catenary stresses on each section may be ascertained by calculating the increased length of the beam due to deflection, which, for these small deflections, will be practically equal to the sum of the hypothenuses of the triangles whose two other sides are the half span and the vertical deflection. Beams, whose depth is at least one-thirteenth of the span, cannot suffer a deflection of one-hundredth part of their length without being ruptured. Taking this as a limiting value, the increase in the length cannot exceed one-ten thousandth part of the span, which in cast iron beams would represent a tension of a little over half a ton, and in wrought iron of one and a-quarter tons. This slight increase in the tensile stress and corresponding diminution of the compressive stress would not affect the value of the moduli of extension and compression. For a dip of one-hundredth part of the span the catenary stress would be practically the same at the centre as at the points of support.

For deflections of one-thousandth part of the span, which are maximum permissible deflections, the increase in the length would be less than one-millionth part of the span, and the catenary tensile stress less than 12 lb. per square inch in cast iron and less than 28 lb. per square inch in wrought iron. Clearly, then, in ordinary girders the fixing of the ends cannot appreciably affect the position of the neutral axis. WILLIAM DONALDSON.

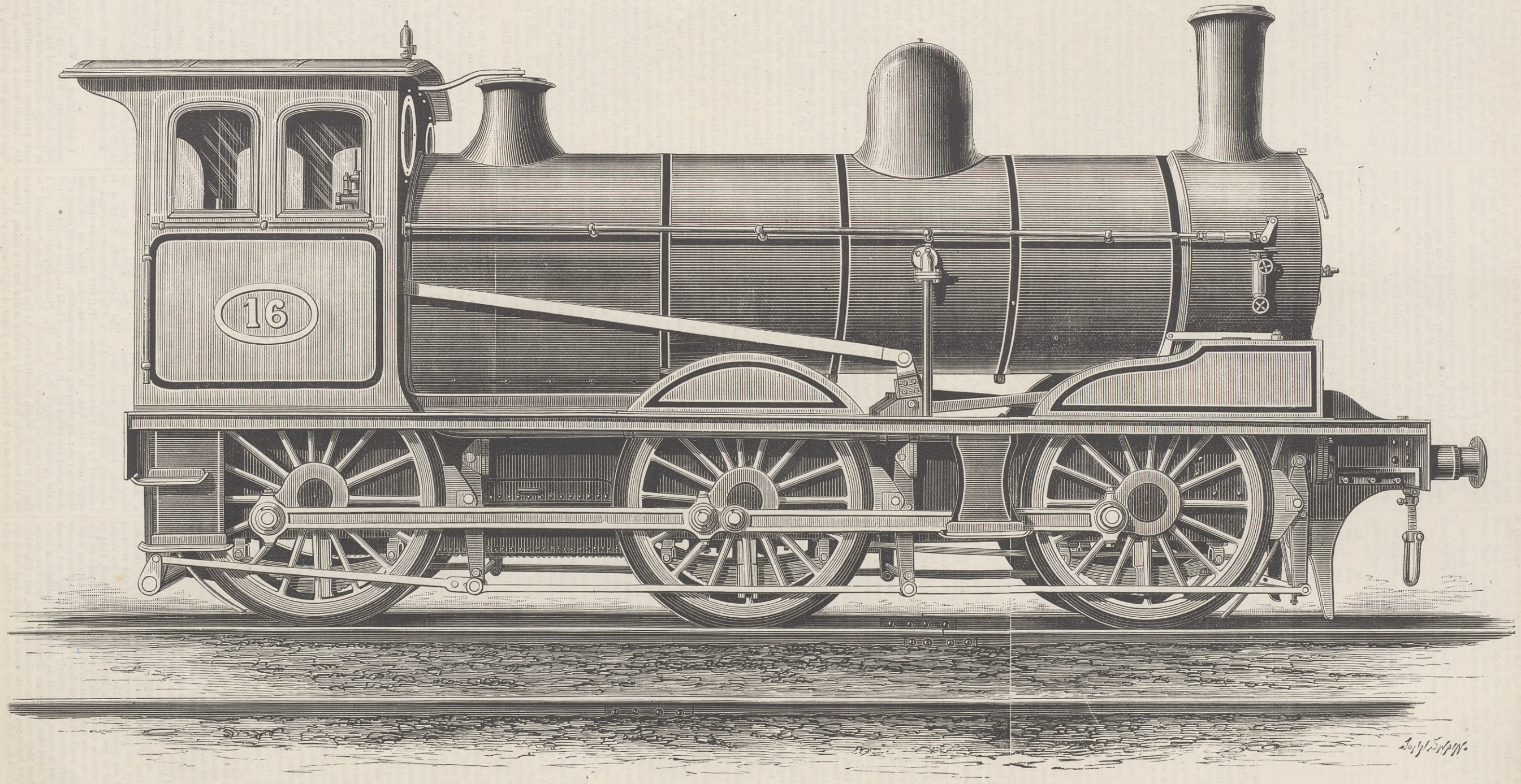
Westminster-chambers, January 13th.

CORPORATION OF WEST HAM.—The Town Council of this new municipality—which adjoins the eastern boundary of the metropolis—have appointed Mr. Lewis Angell, M. Inst. C.E., to the office of borough engineer and surveyor at a salary of £1200 per annum, with privilege of consulting practice, arbitrations, and evidence. Mr. Angell held a similar position under the West Ham Local Board during the past twenty years.

COMPOUND GOODS LOCOMOTIVE, NORTH-EASTERN RAILWAY,

MR. T. W. WORSDELL, M. INST. C.E., GATESHEAD, ENGINEER.

(*For description see page* 24.)



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PATENT-OFFICE AMENITIES.—*There is no doubt about it, but they do not understand the "chunk of old red sandstone" phraseology. Things must be put very clearly indeed in some cases.*

H. W.—*There is not any book published which deals with crucible steel castings alone; but you will find information on the subject in Percy's "Metallurgy, Iron and Steel." You will find all that is really known about the use of aluminium as a flux in* THE ENGINEER *for December 3rd, 1886, page 443. You can get aluminium from Messrs. Webster, of Birmingham.*

C. E. (Dewsbury).—*A 3ft. square flue across the field, and a stack of the same dimensions, 80ft. high, at the point marked B in your sketch, ought to give you a good draught, quite sufficient to enable you to burn half a ton of coal an hour. You will probably have trouble in getting your fires away when the flues are cold. As, however, we assume that this will not often be the case, it will not be necessary to provide for a pilot fire at the base of the chimney. You can, if you prefer it, use a circular flue and chimney of the same cross-sectional area. The chimney would be better 100ft. high if there is any chance that another boiler will be wanted. The rise of 40ft. is not nearly so effectual as a chimney 40ft. high would be. See Wilson, "Treatise on Chimneys."*

McDONALD'S HYDRAULIC PRESSURE REGULATOR.

(To the Editor of the Engineer.)

SIR,—We should feel much obliged if any reader can give us the address of the manufacturers of the McDonald automatic hydraulic pressure regulator.

H. H. AND CO.

ANTI-FRICTION METAL FOR HEAVY MACHINERY.

(To the Editor of the Engineer.)

SIR,—In answer to your correspondent "M. A.," see ENGINEER of the 17th ult., I have frequently used a mixture of 85 per cent. of lead and 15 per cent. of antimony for bearings of heavy machinery, with good results.

W. D.

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ADVERTISEMENTS.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Session 1886-87. Tuesday, January 18th, at 8 p.m.: Ordinary meeting. Paper to be further discussed:—"The Use and Equipment of Engineering Laboratories," by Professor Alex. B. W. Kennedy, M. Inst. C.E. Friday, January 21st, at 7.30 p.m.: Students' meeting. Paper to be read:—"The Use of Cast Steel in Locomotive Construction," by Alfren J. Hill, Stud. Inst. C.E.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Wednesday, January 19th, at 8 p.m.: Ordinary meeting. Paper to be read:—"Cameo-cutting as an Occupation," by J. B. Marsh. Francis Cobb, treasurer of the Society: will preside. Friday January 21st, at 8 p.m: Indian Section. Paper to be read:—"The Upper Oxus," by Trelawney Saunders. Malcolm Low, M.P., will preside.

CHEMICAL SOCIETY.—Thursday, January 20th, at 8 p.m. Papers to be read:—"Some New Silicon Compounds and their Derivatives. I. The Action of Silicon Tetrabromide on Thio-carbamide," by J. Emerson Reynolds, F.R.S. "Derivatives of Chromo-Organic Acids. I. On Certain Chromoxalates," by Emil A. Werner. "Remarks on Bayer's Paper 'On the Constitution of Benzene,'" by Dr. A. K. Miller.

METEOROLOGICAL SOCIETY.—Wednesday, January 19th, at the Institution of Civil Engineers: Ordinary meeting, at 7 p.m. Papers to be read:—(1) "On the Identity of Cloud Forms all over the World; and on the General Principles by which their Indications must be Read." (2) "On the Cloud to which the Name 'Roll-Cumulus' has been Applied." By the Hon. Ralph Abercromby, F.R. Met. Soc.

THE PARKES MUSEUM OF HYGIENE, 74A, Margaret-street, Regent-street, W.—Thursday, January 20th, at 5 p.m.: Lecture on "Engineering and Architecture in Relation to Sanitary Science," by Mr. M. Ogle Tarbotton, M. Inst. C.E.

THE ENGINEER.

JANUARY 14, 1887.

OVERWINDING AT COLLIERIES.

THE coroner's jury empanelled to ascertain the particulars of the Houghton Main Colliery accident returned a verdict on Monday to the effect "That the deceased were killed by being thrown down the pit shaft of the Houghton Main Colliery by the cage in which they were being inadvertently overwound by Allen Beresford, engineman, on the 30th day of December, in the year and parish aforesaid." Whether the verdict will hold is open to doubt. It was subsequently stated that four out of the fifteen jurymen declined to sign the inquisition, and the document is now at Sheffield bearing only eleven names. The coroner has bound over the whole of the jurymen to re-assemble at Darfield on Saturday, to re-consider their verdict. In referring to this catastrophe last week we mentioned the apparent failure of detaching appliances in this case to save life. As a matter of fact, King's detaching hook, with which the cage was fitted, did its work perfectly, but the cage was none the less dashed to atoms at the bottom of the shaft. It smashed its way through English oak planks, 7in. thick, covering the sump at the end of the shaft. All the circumstances about this case are instructive and of much interest. It may, perhaps, be well to premise, for the benefit of those not very familiar with the working of a colliery, that the engine-man sits in a chair, with the brake treadle at his foot. In front of him is the reversing lever, and beside him a handle leading to the throttle valve. A little in front and to one side of him is the huge drum on which the pit ropes coil and uncoil. He has nothing to do with the care of the engine or its lubrication. There is another man for that. The winder very frequently cannot see the cage, or the shaft, or the pit-head frame. Before him is a gong; when this is sounded, he starts his engine and winds. In front of him is a dial round which a hand travels. The dial marks in fathoms the position of the cage coming up the shaft. When this is close to the top—the other cage being close to the bottom—another gong rings automatically to give warning. Then he stops his engine, waits for a signal and receives it, and so the work goes on from morning to night, and is most tedious and irksome. The incessant tap tap on the gong; the wearisome performance of precisely the same motions over and over again in quick succession—it is a deep pit if the engine runs for more than two minutes at a time, and an idle pit if the engine stands more than one minute—is apt to make a phlegmatic man sleepy, and to drive an irritable or nervous man off his head. The wonder is, under the circumstances, not that overwinding takes place, but that it does not take place very frequently.

From the winding drum the two ropes lead out of the engine-house to the pit-head; a lofty and strong structure of wood, at the top of which are the two pulleys—really large grooved wheels — over which the wire ropes run. When overwinding takes place, the cage is drawn up into the pit-head frame until something breaks, usually the rope. Then the cage, no longer supported, flies down the shaft, with results the most disastrous. As an element of safety, the end of the rope is secured to the cage by some form of disengaging hook, while the cage is provided with palls, clutches, or some other device by which, when it is released, it is held in place, and the men can come out at their leisure, and descend by ladders to the ground. Large numbers of hooks and clutches have been patented, and tried, and used. Many colliery engineers, however, have no faith in them, holding that they are sure to fail when most wanted; and that their presence is likely to make winding men less vigilant, for a very obvious reason. We do not agree with them on this point. The Houghton Main accident certainly very clearly shows that it is almost impossible to obviate the perils of overwinding by the use of safety-hooks or clutches, and strongly confirms what we said last week, namely, that it is much better in every way to avoid overwinding than to try to prevent the fall of an overwound cage. At Houghton Main, King and Humble's patent detaching hook and catch plate have been in use for years. The hook is very simple. The rope runs through a hole in a plate of wrought iron 1½in. thick and 3ft. or 4ft. square. This is supported on and bolted to heavy transverse timbers at the top of the pit-head frames. In case of overwinding, two arms hinged at one end, and called "the butterfly," are first pulled up through the hole in the plate, immediately afterwards, by a very simple appliance, the hook is released and the rope is free to fly into the air over the pulley. The butterfly is readily drawn up through the hole in the catch plate because its two arms or wings are compressed; but they fly out again instantly, and as they cannot then return through the hole, the butterfly and catch plate support the cage. As a matter of fact, this mechanism has often prevented accidents. In the case under notice, however, it entirely failed, as all such devices must fail under similar conditions, simply because the cage travelled upwards at such a rate that its momentum carried it on after the hook was unloosed; and it tore the catch plate from its bolts, probably broke the pit-head frame timbers, and went to the bottom of the shaft in less time than it takes to read the preceding sentences. It may be asked why the catch plate was not itself caught in its descent in some of the timber work. On this point no information has up to the present reached us. It is a legitimate subject for inquiry. Winding is now done at a very high velocity. We have heard of shafts in which cages attained at their highest speed 60 miles an hour. This is exceptional. If we halve this, we shall be near the mark as to what took place at the Houghton Main Colliery. Thirty miles an hour is 44ft. per second. This is the velocity acquired by a body falling from a height of 30ft., and the *vis viva* would suffice to lift the body back again to the same height. In other words, the cage would have been projected up into the air 30ft. after the pit rope had been detached, just for the same reason that a train runs for a mile or more after steam has been shut off. At the moment that the cage came in contact with the catch plate it had an energy equivalent to the performance of—assuming the cage and men to weigh 3 tons—90-foot tons of work; that is, it would lift 90 tons a foot high. It is not surprising that it smashed up everything, tearing its way upwards through every obstacle. It is, indeed, not at all improbable that the men were killed at the top and not at the bottom of the shaft.

Here, then, we have in a nutshell the fatal objection to all kinds of detaching hooks and catches. They will work very well provided the cage is moving at a slow or moderate velocity. For example, if the speed had been one-fourth of that we have assumed, or 11ft. per second, the *vis viva* of the cage would only have lifted it 1·88 foot. It fortunately happens that most cases of overwinding occur while the cage is moving very slowly, because the winder shuts off steam and slackens speed before the cage reaches the top, just as a locomotive engine driver does; and the safety hook and plate are analogous in their action to the buffer stops fitted at terminal stations. If a train runs in at moderate velocity, the buffer stops prevent mischief. If the train darts in at full speed, away go buffer stops and all. The overwound cage at Houghton Main behaved like a train running in at full speed, and the safety appliances could of course do nothing to avoid a catastrophe. It does not follow therefore that they ought to be discarded. They ought not to be discarded, but supplemented. From various causes it is impossible to fit a cage with a brake which will serve to arrest its upward movement. Detaching gear is, for the reasons we have stated, under certain conditions useless. It only remains to take precautions which ought to automatically prevent overwinding. This might be done in more ways than one. For example: Gearing might be fitted similar to that used for steering ships. The winder would then have to keep a wheel in constant rotation, first in one and then in another direction, to ensure the running of the engine each way. This might be made to involve little or no appreciable labour; and it is far more improbable that the winder would overwind by mistake under such conditions than now. There have been cases known where a winder has fallen down in a fit, and the cages have been over-wound. Such an event would be impossible with the steering-gear arrangement. If, however, this were considered unsuitable, others are at hand. For example: The crank-shaft carries an endless screw; in this gears a worm wheel; on its shaft is a second worm gearing with a second worm wheel, on the shaft of which is a screw actuating a couple of levers, one of which will shut off steam and the other apply the steam brake the instant the cage reaches the bank. A very little skill will suffice to design an arrangement of this kind which will not interfere with the work of the winder, unless he neglects his duty. It is in this direction, and in this only, that safety is to be found. There is something piteous, we think, about the Houghton Main catastrophe, in the fact that the safety appliances did their duty to the last, and failed to save ten valuable lives. It cannot be otherwise if safety appliances, cage, pit-head frame, and all are involved in one common ruin.

CRITICAL POINTS IN MECHANICAL ENGINEERING.

THE statical, or, as it is the custom to call him, the civil, engineer, has advantages over his professional brother, the dynamical or mechanical engineer, which it is to be feared he does not always appreciate. When a bridge, for example, has been properly designed and sufficiently well made, it will perform its duties for many years without further attention than a painter is competent to bestow on it. A railway or a road, a dock or a tunnel, once made, are made for good, require no more thought, and will last for generations. The case is different with machines. After they are made they have to be worked; and the mere working of them sometimes entails difficulties and responsibilities which are greater than those involved in their original construction. This is especially true of certain machines of comparatively recent origin, which present continually what we have called critical points. In homely but expressive phraseology, whole machines in some cases, parts of machines in others, are worked within an inch of their lives; and nothing but a consummate knowledge of the conditions under which they can exist and operate, manifested by those in charge of them, keeps such machines alive. To the outside world the inner life of, for example, the engines of a great Atlantic steamer, is a sealed book. Much the same may be said of a locomotive engine. Great guns are worked very near the critical point indeed. We might go on to name a great many other examples of what we mean were it necessary. The kind of knowledge

necessary to manage a steam engine very near the critical point is one that cannot be acquired by books. It is quite outside the ken of professors; Cambridge knows nothing of it; it is entirely independent of mathematics; it can only be learned by actual practice, and then only by those who have carefully trained themselves to observe. We once met on board ship a civil engineer of small experience in mechanical work, who yet spoke with much intelligence and knowledge of his subject about the pair of marine engines, then of a somewhat novel type, by which the vessel was propelled. It was for some time taken for granted that he had been at sea as a marine engineer, and when he explained that this was not the case, he was asked, and with some surprise, how he came to possess a knowledge that could not be got from books. His reply was simply, "By keeping my eyes open whenever I went into an engine-room." This keeping the eyes open makes all the difference, very often, between a man considered highly competent and another who is not. But leaving men, let us give, as far as can be given on paper, a few examples of critical points in mechanical engineering.

One which suggests itself almost at once is the condition of the machinery of a hard-pressed vessel, let us say, on a trial trip. Here the maximum possible duty has to be got out of engine and boiler. It is very often touch and go whether the boilers prime or not. If they do, the fires must be eased at once by opening the furnace doors. If this will not suffice, up go the ash-pit dampers, but simultaneously down goes the steam pressure. To counteract this, the feed is stopped. Do what can be done, the result of priming under such circumstances is disastrous. Many of our readers will remember how, being in charge of a stokehole, they have watched the gauge glasses and the pressure gauges with anxious eyes, while they now cautioned, now urged the firemen under their charge. The success of a splendid trial trip has often hung on a hair, and has only been secured by consummate skill on the part of those in the boiler-room; but very little is ever heard about this. Need we say that in the engine-room the difficulties are still greater. If bearings are slack, the engine will thump itself to pieces; if tight, any rubbing surface may get hot at a moment's notice. Only those who have had actual and painful experience know how short a time is needed to render a slipper guide literally red hot. This is no figure of speech. The mischief can be done almost without a moment's warning. The first intimation the engineer has is the unmistakeable and very hateful smell of a hot bearing. Well for him if he does not see sparks flying in another minute. There can be no doubt that in almost, if not all, cases the crank shaft bearings of all large steamers are only kept cool by the unceasing vigilance of the engineers in charge. It is all very well to say that this is all wrong; that it ought not to be so; that crank shafts ought to run cool, and would if properly proportioned. The sea-going engineer knows better. He will take a ship to Australia and never have a hot bearing, but he knows that the credit is not due to the bearings, but to his own skill and judgment; and there are so many things to be thought of. A hot bearing will probably be followed by a split or cracked crank pin. Why? No one knows. In like manner, a crack in a crank pin, as fine as a hair, will make the big end heat. Why? No one knows. A great many men think they know. We may leave them to hold their belief in peace; we shall not disturb them.

Success in dealing with critical points in marine engineering depends on knowledge of what often appear very little things; but in reality there is nothing small or trifling about the management of machinery taxed to its utmost. Take, for example, such a matter as the cooling of a crank-pin with water. If the pin has once got thoroughly heated, water must not be put on the big end. The service pipes must play on the crank webs. If attention is not paid to this, the brasses are almost certain to be cracked or broken. Take a hot thrust carriage again; an injudicious use of the hose will properly result in cracking the cast iron—yet how tempting it is to turn a jet on the hot metal! It may be said again, without fear of contradiction that success or failure in working machinery at or about the critical point is a question of attention to small details. Writing, as we are now, for our younger readers, we make no apology for enforcing a lesson in the best possible way, namely, by supplying an illustration drawn from actual practice. On an important line of railway in the South of England a powerful locomotive was doing all it could to keep time with an exceptionally heavy express train crammed with passengers. The run had been nearly accomplished, when, entering a tunnel, the driver smelt the smell which there is no mistaking. Taking an oil can, he went out on the running board, and found a piston-rod hot and the packing burning. The moment he applied oil it flamed up and ignited the oil on the guide bars, already warm enough. The next moment the cross-head seized, and before his eyes the engine was wrecked. The connecting-rod broke at the small end; the motion plate was bent; one link, with its excentric rods, was torn down. The fireman on the foot-plate shut off steam, and, strange to state, the engine ran for nearly a mile in the condition we have described. The train drew up at its platform, and of the hundreds of passengers who had safely completed their journey, not one knew anything about the accident. The cause of the breakdown was a trifle. The stuffing-box was steam-tight, and the driver did not think the gland needed screwing up. The packing was really slack, and the bush in the cylinder end worked out, seized a little on the rod, and made it so hot that it burned the packing. All the rest followed as we have stated. Here we see that the difference between success and catastrophe lay in screwing or not screwing up a gland.

It may be said that machinery never ought to be worked within an inch of its life, so that there should be no critical points. This might be done, but only at the cost of seriously diminishing its utility, and we may perhaps add, holding out a premium to incompetence. Locomotive engines hauling an express train daily do their very best—are worked their very hardest from one end of the hundred miles or so of the run to the other. They are worked under extremely critical conditions—not, be it understood, critical in the sense of dangerous—but critical in the sense that they may fail to do the work expected of them, and lose time. The least mistake about water, or fire, or lubrication, and all is over; time is lost, and can never be made up. The consummate skill, exercised unconsciously, with which a first-rate driver and fireman will jockey a locomotive and get the last mile an hour out of it must be seen to be appreciated; and we may add that can only be appreciated by one who understands why some things are done and others left undone. The perfection of engine driving under difficulties is seen, however, on torpedo boats running their trials, and the wonderful success which has been achieved bears powerful testimony to the skill of those who take charge of the machinery after it has been made. It is, we think, a noteworthy fact that, taken all round, no engineers in the world are superior to those of Great Britain, in dealing with machinery worked under critical conditions. They do not know when they are beaten. They have audacity enough to dare anything. They know how to let well alone; and while attending to a hundred things *seriatim*, they attend to but one thing at a time. They keep their heads; they are obedient to those in authority; and they make no noise. Under the most trying circumstances an engine-room staff will do their work in absolute silence. We are apt in the present day to take mechanical triumphs as matters of course. When we hear of such ships as the Etruria or the Alaska flying across the Atlantic we praise, and justly praise, the builders of the ship and her machinery; but we are, we fear, prone to forget that the engineers in charge of this machinery have onerous duties to perform, and that any lack of skill and judgment would render the labours of engine and shipbuilder nugatory. The machinery and boilers of our ocean racers are worked very close indeed to the critical point.

ECONOMY IN THE IRON TRADE.

The title of this article is chosen advisedly. We do not mean economy in the iron manufacture; for we think the lowest limit in the cost of production has been reached—at least for the present. We fancy, however, that we see where a saving may be effected in the disposal of the finished product. At present comparatively very little iron is delivered by the producer direct to the consumer. It goes through the hands of the merchant or middle man, who takes by far the largest share of the profit. Both the other parties come badly off. While the ironmaster gets a low price, the chances are that the consumer—especially in India—pays the full price for an inferior article, the merchant and his Indian agents dividing the spoil between them. Now the office of the middle man is to facilitate relations between the producer and the consumer. But does he do so? Does he not rather make them more difficult? At any rate, the tendency of the present day is to oust the middle man; and, if he does not honestly and conscientiously favour business between the two parties in return for the handsome commission he takes out of each transaction, what reason is there for his survival? It is urged that he favours trade by giving longer credit than an ironmaster can afford; and this is probably true if the relative amount of profit made by the two parties be taken into consideration. After all, the long credit system is bad; but, if it be necessary in some cases, the ironmaster will surely be able to give as long credit as the merchant if no longer burdened by the heavy commission.

The tendency of modern business is for producer and consumer to come together without any intermediary; and this tendency should be encouraged. We lately recorded the spirited policy, certain to pay in the long run, of a well-known and old-established iron-making company, which has sent one of its principal officials on a lengthened tour through India and Australasia, not so much to secure orders as to cultivate direct relations with consumers, to learn their requirements, and probably to consult how best to meet them. This is an example to be followed by firms who have a reputation to sustain. Such a course will put an end to all the trickery lately exposed, of palming off inferior iron as the treble best of a well-known brand. The consumer would know precisely what he gets, and the producer to whom he is selling; so that, in the event of a complaint being made, its validity may be tested; and, if ascertained to be well founded, the matter may be set right, thus affording experience for the future. When the producer is in direct contact with the consumer, he learns to meet his wants, and give him exactly the quality of iron that suits his requirements. He may also make suggestions for avoiding unnecessary expense, which is impossible when the middle man comes between.

The advisability of the producer and consumer dealing directly with each other, to the exclusion of an intermediary, may be illustrated by a case of very common occurrence. Two puddled irons of equally good quality, but treated somewhat differently in the piling, heating, and rolling, produce finished bars with different characteristics, and therefore suitable for very different purposes. To give a specific example, A, who has to make a hook or chain, requires the finished bar to be sound, though not necessarily smooth on the surface, and to present a fibrous fracture, thus indicating that it is tough and somewhat loose in structure. On the other hand, B, who requires his iron, say, for shafting, or any bright turned work, does need a fine surface, and prefers stiffness to toughness. Now, though these two irons are of precisely equal excellence, if B should get the iron intended for A, and *vice versâ*, they will both complain of their sample and probably call it bad. Such a complaint is frequently made, justly as far as the consumer is concerned, but unjustly in that of the producer, while the middle-man, who has the lion's share of the profit, comes in for none of the blame or responsibility. When he receives an order for a certain quality of iron, he sends it out of stock, without asking or caring about the purpose for which it is intended; and if A or B should complain, he simply passes the letter on to the ironmaster. Supposing the latter had received the order direct from either A or B, he would have ascertained the purpose for which the iron was intended, and would have given instructions for its manufacture accordingly. That is to say, the iron intended for shafting or bright work would be rolled off quickly from a specially prepared pile, highly heated, while that for a chain or hook would be piled in another form, heated less highly, and rather "kept back" while being rolled, thus giving the characteristics required for the two different purposes.

All trouble taken by the producer with the consumer must bear fruit, although the same does not hold good in the case of the merchant or middle-man. To take the homely example of a tailor fitting on a new coat, that tradesman who consults his customer's wishes, even and indeed especially in minor matters, who studies all his ideas about pockets, &c., is far more likely to receive the next order than the man who supplies an equally good coat, but without attending to his customer's idiosyncracies. It is the rule of the company above referred to, to ascertain, if possible, the purpose for which a consignment of iron is intended, and to roll it off in view to that special purpose. In such a case the ironmaster and the manufacturer can consult together, and offer mutual suggestions, so as to arrive at the desired result with as little expense to both parties as possible. Then, if the producer sees that his efforts to meet his customer are appreciated, he will strive more and more to consider them. From a single transaction, concluded to mutual satisfaction, often spring life-long relations which are constantly being strengthened, while, with the merchant, too often a single order is the first and last, neither party having any interest beyond that single transaction.

In conclusion, we would observe that, while all the arguments appear in favour of direct relations between ironmasters and those who use iron—and there appear very few reasons for retaining the merchant or middle man—the saving of his commission may make all the difference between just escaping a loss and making a fair profit, especially at the present time, when slackness of trade creates such keen competition. We therefore commend to ironmasters the desirability of cultivating direct relations with consumers, as a means of achieving economy in the iron trade. We are not, however, blind to the fact that it is in many cases simply impossible to dispense with the middle man, who is really a retailer, and does as good service to the consumer as to the producer. But it is indisputable that the middle man gets too much power into his hands, and that his services are often used when it would be for the advantage of both producer and consumer to dispense with them.

THE COST OF TREATING LONDON SEWAGE.

Considerable interest attaches to the cost of the approaching operations for dealing with the London sewage, and a letter on this subject has appeared in the columns of the *Pall Mall Gazette* from Mr. J. F. B. Firth, the late member for Chelsea, referring to the statement made in our columns last week as to the estimated charge for carrying out the plans of the Metropolitan Board at Barking and Crossness. Mr. Firth speaks of the "enormous additional liability to be charged upon Londoners," in pursuance of this scheme, and objects to so large an outlay being incurred by a "non-representative body," without there being, in the first place, the fullest opportunity for its public discussion; and, in the second place, what the late Chancellor of the Exchequer called "a predominant opinion" in its favour. In urging these considerations, Mr. Firth says he is "of course aware that the scheme of the Board has received the support of four or five eminent chemists." In regard to the estimated outlay, we should like to add a few words, in order to make the subject as clear as possible. Mr. Firth writes to our contemporary under the impression that the anticipated annual charge of £115,000 for dealing with the whole volume of the London sewage has reference solely to the interest and sinking fund in respect to the capital account. We never intended to convey that impression. We slightly understated the amount; it should be £118,000 per annum, but this includes every item, so as to comprehend interest of capital, depreciation of plant, wear and tear, chemicals, pumping, labour, and all the elements of current expenditure. According to the latest and most trustworthy estimate, the entire capital outlay, including the operations on both sides the river, will be about £750,000. It is not quite clear whether or not this includes the cost of the sludge fleet. If it does not, the total becomes £850,000. More light will be thrown upon the subject to-day, when the tenders for the Barking works are opened. Mr. Firth's proposal that the Board's scheme for disposing of the sewage should first of all be subjected to the full ordeal of "public discussion" is, we fear, scarcely practicable. It is difficult to say where such discussion would end, or in what error it might terminate. At the best, there is the danger of delay in regard to a matter which demands prompt and vigorous action. If it is thought that some other scheme might answer better than that which is proposed by the Board, there is the Canvey Island project, on which Mr. Bailey-Denton and Lieut.-Colonel Jones have bestowed so much pains, and which they estimate as costing £198,000 per annum, including the charges in respect to capital. In this estimate the cost of constructing the great main sewer down to Canvey Island is reckoned at £3,250,000. There is also the plan of Sir J. Bazalgette for taking the sewage down to Thames Haven, or to Hole Haven. Sir Joseph has estimated the cost of conveying the sewage to Thames Haven, and of the works that would have to be constructed there, at £3,750,000. The annual charge for this scheme, including all the current expenses, is reckoned at £215,000. Contrasting this with the estimate of £118,000 per annum for treating the sewage at the present outfalls, the decision of the Board has been given in favour of the less expensive mode. This is a question which the ratepayers can readily appre-

ciate, and there can be little doubt as to the popular vote on such an issue. But, on the other hand, a question is raised as to the efficiency of the cheaper plan, in reply to which there is the report of four eminent chemists in its favour. So the matter rests for the present, and the ratepayers may take such comfort as they can from the thought that what is going to be done will at least effect some improvement in the state of the Thames; and if that is not sufficient. the next step is plain enough—though the cost will be formidable. Yet even then the battle will have to be fought, whether the plan of Sir Joseph Bazalgette shall be adopted or that of Mr. Bailey-Denton. It is perfectly certain, whatever plan is proposed, there will be a fight.

THE NEW SOUTH WALES RAILWAYS.

ALTHOUGH the need for placing the New South Wales Railways beyond the reach of the political influences which now burden them seems to be admitted on all sides, there appears to be considerable difference of opinion on the part of leading politicians in the Colony as to the means proposed for giving effect to this in the Railway Management Bill, to which we alluded in our impression of November 26th last, as having been recently introduced by the New South Wales Government. In a recent address to his constituents at St. Leonards, Sydney, Sir Henry Parkes, ex-Premier of the Colony, and now leader of the Opposition in the Legislative Assembly, is reported in the *Sydney Daily Telegraph* to have stated:—"He had a word or two to say arising out of the Railway Bill. He was one of those who believed that the railways of this country, which were so important an asset, ought to be managed in the interest of the public and separated from all parliamentary or political interest. This Bill provided to do that, but he would tell them how it provided to do it. It provided to create a board of three Commissioners, one of whom was to have the handsome salary of £3000 a year, and the other two to have £2000 each. These were not only to take the management of the railways which were constructed, but they were to take charge of the construction of all new railways. What was the use of the Department of Public Works if the most important public works of the country were to be taken from the responsible direction of the Department? What they really wanted in regard to the railways was a Commission not of such highly-picked men—because he was quite sure they would get honourable and capable men without giving them very high salaries—but they wanted a Commission of thorough business men to work the completed railways, the railways that were open to traffic. But the construction of the railways formed a part of the ministerial policy of the country, and must be carried out under the direction of one who was directly responsible to Parliament. He would still hold the minister responsible for the railways, especially in the construction of new lines, and he would still have that able man Mr. Whilton—Engineer-in-Chief for Railways—and other engineers, directly under the responsible ministers. But there was one proposal of the Bill—these Commissioners, when appointed, the Government itself should not have the power of removing them; they should only be removable by a vote of both Houses of Parliament. While he did not suppose any minister in this country would do such a thing, still there might possibly come such a time when there were ministers mean enough to appoint themselves. Suppose they did appoint themselves and Parliament had no power to deal with them, what a nice position that would be—only removable by a vote of *both* Houses of Parliament. That Bill therefore, upon the whole, though ostensibly for a good purpose, was a bad Bill, and they would agree with him—and he thought he had made it very clear—that if it had been passed in the form it was, it would have been a very injudicious measure for the country." Whatever be the means adopted for best giving effect to the principle of the Bill, it is to be hoped, in the interests of the members of the profession as well as for the credit of the Colony itself, that the relations of the technical Departments to each other shall be placed by the Bill, once and for all, on such a footing as to prevent the unseemly antagonism exposed in the letter referred to in our issue of December 10th last by "Taxpayer."

A REMARKABLE PATENT.

SECRETARIES of technical societies are often embarrassed by offers of papers, not always without merit, but which have to be refused on account of their portentous length, and the consequent expense of publication in the society's proceedings. A Mr. William Golding, of Moss Side, Manchester, has been engaged for some years in perfecting "a complete scientific system of practical mechanics effectuated by means of a new mechanical power to be called 'claviger,' for receiving, controlling, and applying force in motion." The result of his labours might have been given to the world in the shape of an independent treatise, printed and published at his own expense, or he might have persuaded the governing body of some mechanical society to devote a special extra volume of their "Proceedings" to his paper. But Mr. Golding has done much better, and has earned the title of inventor in more senses than one; for he has taken out a patent for his system—No. 11,990, October 9th, 1885—and the Patent-office authorities have in the most liberal manner taken upon themselves the cost of printing his treatise, which fills no less than 139 printed pages of imperial octavo size, and is accompanied by seventy-two quarto sheets of drawings. The price of the volume is half a guinea, and as the patent specifications, of which two hundred copies are printed, are issued at cost price, it follows that the country has been put to the expense of upwards of £100. Seeing that Mr. Golding only paid £4 for his patent, he must be congratulated upon having had his printing done very cheaply. As to the nature of the "invention," it will be sufficient to state, in the words of the patentee, that "the principle upon which this system of practical mechanics is founded is that of the parallelogram of forces, and the mechanical power called 'claviger,' which is employed to carry it into effect, is an exact practical counterpart of the theories which have been established in connection with that principle." The 'claviger' consists of two straight levers of unequal length, the shorter one being pivotted to the longer one in the centre. From this simple element the inventor developes an extraordinary number of combinations, and, although at first sight the machines described have no resemblance whatever, the "claviger" is always present in some form or other. There are no less than fifty-three claims to the specifications, and they include valve gear, drill braces, clocks, clutches, quick return for machine tools, driving gear for velocipedes, &c. Notwithstanding this variety, the specification has been regarded by the Office as containing only "one invention," a view which few experts would agree with. Although nominally the specification of a patent, it is in fact a big mechanical exercise, certainly not wanting in ingenuity, such as might be sent in by the competitor for a prize offered for the largest number of combinations of which a pair of jointed levers should form a part.

LITERATURE.

Abridgments of the Specifications Relating to Velocipedes. By R. E. PHILLIPS. London: Iliffe and Son, Fleet-street.

MUCH is left in this country to private enterprise, and Mr. Phillips' book furnishes a good instance of the manner in which a private individual often steps in and does that which a Government department, either from incapacity or sheer idleness, has failed to do. If the Patent-office authorities were in the least alive to their responsibilities and duties they would long ago have devoted a volume of the series of "Abridgments" to the subject of velocipedes. The number of patents relating to the subject is enormous, and the trade has assumed very important dimensions. There are many interesting points of mechanical detail about the velocipede, such, for instance, as the "spider wheel," the principle of which has been applied to driving pulleys, and ball bearings have been brought out of the domain of theory and made actually useful. We merely mention these points for the benefit of the gentlemen in Southampton-buildings. It is only fair to them to say that the author offered his manuscript to the office; but, says Mr. Phillips, "the offer was politely declined on the ground that the abridgments were only compiled by the staff of the office, a statement the veracity of which I will leave others to judge." This statement may be profitably compared with the items of expenditure in the Comptroller's annual reports. Mr. Philips includes the whole of the patents relating to the subject from the earliest period down to the end of the year 1883. The first patent is dated 1818, and the next was taken out in 1845, and there was another in 1857, but we fancy that the compiler must have missed some inventions during this period. Some years ago we made an extensive search for the purpose of writing some articles on the subject, and, speaking from recollection, there were certainly more than three parents for velocipedes under what is known as the "old law," that is, prior to October, 1852. It is very instructive to turn over the leaves of this work and note the sudden rise and fall of the numbers of patents in successive years. In the years 1861-66 only 9 patents were granted; in 1867, 2; and in 1868, 5; but in the following year no less than 97 applications were made. In 1870 the numbers fell to 23, in 1871 only 9 applications were accorded, and in 1872 there was a further decline to 2. In 1873 the subject again came to the front, and from that time a constant increase is exhibited. To show the enormous development during later years, we may mention that the patents of 1881, 1882, and 1883 occupy nearly one-half of the book. The work is provided with an index of names, and an analytical index of subjects containing references to the various parts of the machine, which will render a search as little onerous as may be. We cannot say that it will make a search easy, as it is sometimes difficult to understand what the inventor means, and there is, consequently, room for a difference of opinion as to where and how a patent should be indexed. Mr. Phillips is entitled to the warm thanks of all who go on wheels for the care and patience which he has displayed, and for the enterprise which he has exhibited, in making good the shortcomings of a public department specially entrusted with this particular work.

The Watch and Clockmakers' Handbook, Dictionary, and Guide. By F. J. BRITTEN. Sixth Edition. London: W. Kent. 1886.

NOTWITHSTANDING the extensive use of machinery in the manufacture of watches, the appearance of a sixth edition of such a work as this shows that there is still a brisk demand for works dealing with what may be called the "art" of horology. There are, we believe, a considerable number of persons who regard a watch not as a machine, of which a gross or a dozen will be supplied, a reduction in price being made "on taking a quantity," but as a distinct creation of the artist's brain. There is, perhaps, something to be said for this view, and it may be that the high character which English chronometers still enjoy is in part due to the severe views which have been held by our leading makers. Although we have little concern with clock and watchmaking, we willingly call attention to a book the object of which is to inculcate accuracy of workmanship, the nice adjustment of parts, and smoothness of working. The book is in the form of a dictionary, and the present edition is considerably enlarged, a new feature being a glossary of French and German technical terms. The author, though an engineer by profession, we believe is secretary to the British Horological Institute, a position which gives him ample opportunities of becoming acquainted with the most recent improvements in the business to which he has for many years devoted himself.

PROSPECTIVE PRIVATE BILLS.

CONTINUING our *résumé* of Private Bills in prospect for the approaching session, and dealing slightly with general as well as railway Bills, it may be first mentioned that the Board of Trade authorities have informed the promoters of the Channel Tunnel that if their measure on that scheme is proceeded with they will feel bound to oppose it. The intention announced by the promoters was to apply for an Act authorising them to continue their experimental borings, and making provision, in the event of those borings proving the practicability of making the tunnel, for vesting in the Lords of the Treasury the sole right of determining the expediency of continuing and prosecuting the permanent works of the tunnel, and for the ultimate transfer of the undertaking to the Government. From past experience it does not seem likely that the promoters will be deterred by this intimation, and it will be more than interesting to see what happens. In the next place, it is now understood that the contemplated Bill for the extension of the West London Extension Railway, which we described in our previous article, is not to be proceeded with. This would have been one of the most important measures of the session, its intended scope being very considerable, and embracing costly and important developments of the metropolitan railway systems.

Again, taking the schemes in or around the metropolis first, an important project is one for constructing new railways and docks at Gravesend and Northfleet by a company yet to be incorporated. With respect to docks the proposals are (1) to make a dock consisting of a main dock about 380 yards long and 300 yards wide, with two branch docks each 316 yards long and 100 yards wide, and a lock and tidal basin 330 yards wide and 293 yards long, with an entrance from the Thames close by Rosherville Gardens; (2) to make a river wall or embankment with an opening into the tidal basin, on the bed or foreshore of the Thames, over 6 furlongs long, commencing at the north-east angle of the London Portland Cement Company; (3) to construct two piers or jetties, one at each side of the entrance to the tidal basin referred to, the eastern pier to be 30ft. long and the western pier to be of the same length; (4) to provide all necessary roads, locks, gates, graving docks, slips, bridges, and other works connected with the dock and basin. Then in regard to railways, as an essential accompaniment to the docks it is proposed to construct (1) a line commencing by a junction with the London, Chatham, and Dover Railway, Gravesend branch, near Pepper-hill-lane, and on to Northfleet; (2) a line beginning by a junction with No. 1 as last described, near the pits of the cement company, and ending near the junction of Northfleet-hill and London-road; (3) a line from the down-line of the South-Eastern Railway, North Kent branch, to the point of junction between lines 1 and 2; (4) another line from a junction with the up-line of the South-Eastern Railway, also North Kent branch, opposite the eastern end of the Northfleet platform, to line No. 1. Then for the purposes of the new docks the promoters will ask for sanction to divert and use the Thames, to acquire various lands by compulsion or agreement, and numerous other operations of the usual description.

The main purpose of the Bexley Heath Railway Company's Bill is to form a railway from Eltham by a junction with the line authorised by the Act of 1883, through Kidbrooke and Charlton to a point near the Blackheath station of the South-Eastern Company by a junction with the North Kent branch, that portion of which between Charlton and Blackheath they will ask for power to use on terms to be decided. A measure affecting another district closely connected with London will seek authority to transfer on sale the original undertaking of the Felixstowe Railway and Dock Company to the Great Eastern Company, and power to improve and enlarge the undertaking, and to enable the Great Eastern Company to apply the funds of the Felixstowe Company and raising further capital.

Going further afield, we find a number of schemes projected besides those previously referred to, for northern parts of the kingdom. For example, one is a Bill for extending the time for acquiring land for and completion of sundry short lines authorised by the Hull, Barnsley, and West Riding Junction and Dock Act of 1882; to incorporate a Commission and to transfer to it the powers of the Hull and Barnsley Railway and Dock Company; and to empower the new company, and the Hull Company, the North-Western, Midland, Great Northern, North-Eastern, Lancashire and Yorkshire, and Manchester, Sheffield, and Lincolnshire companies to enter into working arrangements in respect to the transferred lines. The Bill will also take powers for the abandonment of certain lines, and for the laying down of new lines in Hull, to join Hull and Selby, and South Kirkby Colliery Works. The provisions of this measure are too numerous to follow more in detail at present.

A Bill promoted by the North British Railway Company aims at the construction of a branch line from Drumshoreland to Broxburn, the acquisition of additional lands, the amalgamation with the company of the Glasgow City and District Railway; power to enable the Forth Bridge Railway Company to borrow in respect of each one-third portion of the additional £640,000 authorised by the Act of 1882; and, amongst other general matters, authority to work by locomotive traffic over the level crossing on the Glasgow and Dumbarton at Clydebank, Old Kilpatrick.

In pursuance of the enterprise of which the Mersey Tunnel was but the beginning—or rather the central operation—the Mersey Railway Company now come forward with a Bill to authorise them to construct a number of short extensions of their system on both sides of the river; to make additional airways and ventilating shafts in Birkenhead and Liverpool, and to acquire a considerable amount of property for these purposes; to abandon certain lines authorised by their Act of last year; to subscribe to the capital required for the authorised railways of the Wirral Railway Company; to become joint owners of an undivided moiety of the Wirral railways; to appoint a joint committee of the two companies, and a standing arbitrator for the settlement of differences, and to take power from the two companies to provide for any other railway to use their two systems on terms to be determined hereafter. Besides a "Various Powers" Bill, the Mersey Docks and Harbour Board have a measure for extending and carrying out a number of overhead railways authorised by an Act in 1882; the Liverpool, Southport, and Preston Junction Railway Company will ask for authority to extend their lines to Hill House, and to raise additional capital; and the West Lancashire Railway Company will apply for an extension to 1889 of the time for the completion of the Preston Docks Extension undertaking.

The Leeds Suburban Railway Bill, although apparently mainly a matter of local interest, is yet one of considerable importance. It proposes to construct a line touching and including a large number of parishes and townships around Leeds, and then to take running powers over some of the large systems having termini in that town, in order so to secure direct access to the New Station. Among the smaller Bills affecting railways are one to authorise a line ten miles in length, from Pool in Montgomery to Llanfair Caereinion, upon a three-feet gauge; another to authorise an extension of the Didcot, Newbury, and Southampton Railway to, and a junction with, the London and South Western system near Winchester, and one to sanction the abandonment, through an insufficient subscription of capital, of certain lines authorised by the Merionethshire Railway Act of 1878.

Finally, there is the scheme to amalgamate and consolidate into one the numerous small systems existing in the Isle of Wight, viz., the Isle of Wight (Newport Junction) railways, and the Cowes and Newport, the Ryde and Newport, the Freshwater, Yarmouth, and Newport, the Shanklin and Chale, and the Brading Harbour Railway Companies, and, this being effected, to empower the London and South-Western Company, or the London, Brighton, and South Coast Railway Company, or both of them, to acquire or lease these united railways.

The list of miscellaneous measures to be brought forward includes the Westminster Improvements (Parliament-street), Hyde Park Corner (new streets), Chelsea Waterworks, West Metropolitan Tramways, City and Southwark Subway (Extension), Leadenhall Market Approaches, Thames Tunnel, Blackwall Tunnel, and Glasgow Subway Bills. Several of these will deserve special attention when they come before the Committees.

LIVERPOOL WATER SUPPLY.—MAP OF INTENDED LAKE VYRNWY.

MR. THOS. HAWKSLEY AND MR. GEORGE F. DEACON, MM. INST. C.E., ENGINEERS.

LIVERPOOL WATER SUPPLY AND THE VYRNWY LAKE AND MASONRY DAM.

No. I.

For many years the great town and port of Liverpool has been threatened with an approaching deficiency of water; but thanks chiefly to the waste water prevention system, the failure of the supply has been staved off, and there is little fear that it is likely to be felt before the artificial lake in the Vyrnwy valley is completed and ready to deliver to Liverpool the millions of gallons which that lake will intercept on its way to the Severn.

It is now twenty years within a few months since Mr. Duncan, then engineer to the Liverpool Corporation, sent in, at their request, a report, proposing several alternative sources of supply, it having become necessary at that time to reduce the number of hours supply per day, although the Corporation had established the Green-lane works, had purchased the property of the old waterworks companies, and had constructed the Rivington works, which were completed in 1856, under an Act obtained in 1847. In 1866 the Corporation went to Parliament for powers to purchase the compensation water which, under the 1847 Act, had to be given to the river Roddlesworth, and for the construction of the Yarrow reservoir. Mr. Duncan examined and rejected several possible sources of supply, including the Lancashire and Westmoreland Lakes, the Haweswater and Ulleswater Lakes, the Ribble, Dee, and Hodder rivers, several Welsh sources, and finally decided upon the Bala Lake as the best adapted for Liverpool. In May, 1874, the Corporation retained Mr. J. F. Bateman and Mr. Thomas Hawksley to report upon several schemes for an increased water supply described in a report by Mr. Jackson, dated April 21st, 1874. Reports were sent in by Mr. Bateman and by Mr. Hawksley, the former recommending a supply from Ulleswater and the latter a supply from the river Wyre, and in this supporting Mr. Jackson. Mr. Bateman's estimate for a supply from Wyresdale was £2,141,000, as against Mr. Jackson's estimate of £1,679,528, and Mr. Hawksley's estimate of £2,000,000, all for twenty million of gallons. The distance to Wyresdale is not much more than half that to Ulleswater, but Mr. Bateman's estimated cost for forty millions of gallons from this source was only £2,421,000. Mr. Bateman proposed that Manchester and Liverpool should combine to obtain eighty millions of gallons from Ulleswater, which would reduce the cost to Liverpool to £1,987,860. No action was taken on any of these reports, but a sub-committee was appointed by the Water Committee in 1876, and again in 1877, to report a new scheme for water supply. The report of this sub-committee took the form of an introduction to two reports by Mr. G. F. Deacon, the first, dated November, 1877, being an examination of the Haweswater scheme, as modified in a proposal by Mr. Job Bintley. The Haweswater scheme, as compared with many of those previously suggested, had the advantage of giving a high fall, so that as a gravitation scheme it would have cost less for conduit; but although the water is good in quality, its quantity is not enough to have warranted the expenditure by a large growing town on such a distant and yet limited source. Mr. Deacon's second report proposed a supply from the upper waters of the Vyrnwy in North Wales, and described the scheme at length. The river Vyrnwy is a tributary of the Severn, and rises in the east of the Berwyn range, within 45 miles in a direct line of Liverpool, though the aqueduct will be in all nearly 68 miles. The valley affords a splendid site for a reservoir, and was formerly no doubt a lake, the only work necessary to reconstitute it being the dam, which we illustrate,[1] across a narrow ravine between the steep hills which bound the catchment area. This area is about 18,000 acres, and the dam converts the bottom of the valley into the reservoir, having a capacity, as first proposed, of 8,000,000,000 gals. This lake is shown in plan by the map above. The surface of the reservoir will be 825ft. above the sea, and into it it will be easy to divert by short tunnels the water from the Afon Cowny gathering ground of 3000 acres, and that of the Marchnant stream comprising 2200 acres. In the whole area of 1115 acres to be submerged there is but one small hamlet, including a small church and less than forty cottages, the rateable value of which is only about £73. This hamlet, named Llanwddyn, as seen on the plan above, is very prettily situated, and some very charming photographs have been taken of it from different points by Messrs. Robinson and Thompson, of Liverpool, from whom also were obtained the photographs from which the large engraving of the dam in progress published in our last impression was prepared.

In this report Mr. Deacon estimated the cost to be less than from either of the previously proposed gravitation schemes. In August, 1878, Mr. Deacon presented a second report on the Vyrnwy scheme, in which he entered into more detail, and amongst other things proposed an increased height of dam, raising the contents of the reservoir to ten thousand millions of gallons, and giving results of special surveys of the line of the aqueduct and conduit, ordnance surveys not having

[1] See also The Engineer, 5th February, 1886, and 7th January, 1887, page 10.

been made of the country traversed. The opinions of Mr. Hawksley and of Mr. Bateman were obtained concerning the so far matured scheme, and both were favourable, but that of Mr. Hawksley especially so. Reports were obtained from Professor Frankland and from Dr. J. Campbell Brown on the potable character of the water, which proved to be excellent. Other reports were obtained concerning the quantity of water available in the valley, the amount and the effect of the peat in the valley, all these being embodied in the third report of the special sub-committee, dated June, 1879. As a result of this investigation, Mr. Deacon prepared the preliminary plans and reports for the scheme for application to Parliament for the necessary powers, and completed plans were afterwards made and signed by Mr. Hawksley and by Mr. Deacon jointly as engineers. The necessary powers were duly obtained in 1880. During the discussions preceding the preparation of the parliamentary plans it was decided that the material of the dam should be the hard grey slate of the valley, instead of earth as previously proposed, and that its form should be as illustrated in our impression of February 5th last.

The preliminary operations in a work of this magnitude necessarily occupied considerable time; but in his first annual progress report Mr. Deacon was able to report that nearly 150,000 cubic yards of excavation for the trench, 555 yards of tunnel, and over eight miles of pipe line had been completed at the end of June, 1882. A similar report at the end of June, 1883, showed that great progress had been made on the whole of the works, and the same remark applies to the progress reports of 1884 and 1885, the whole of these showing further that all the arrangements had been most admirably organised for the most economical and simultaneous conduct of the operations throughout the whole line. Another report of 1885 gives a comparison of the cost up to that time—£1,044,489—as compared with the parliamentary estimate—£1,502,094—and gave the total probable cost as £1,773,508, which included the extra cost of the great masonry dam, instead of the earthen dam as proposed in the parliamentary estimates. The earthen dam was estimated to cost £311,410, and the masonry dam £650,527. This extra cost, however, secured a great addition to the capacity of the reservoir, and by other modifications an increase in the first instalment of water

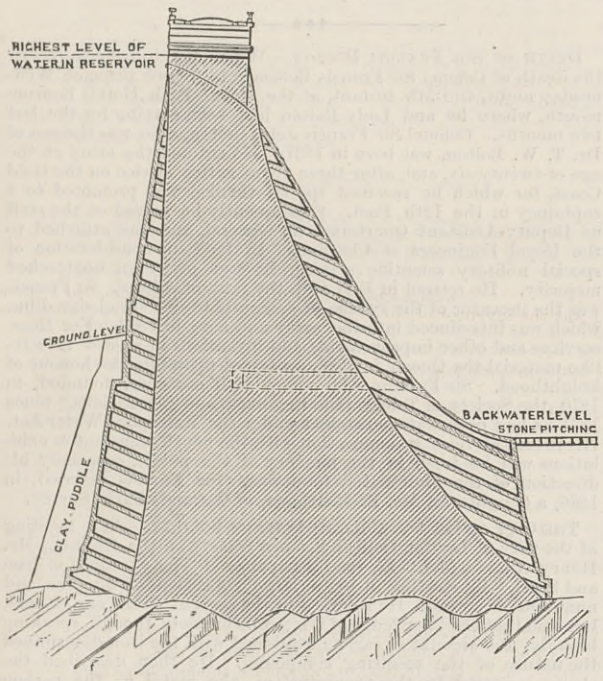


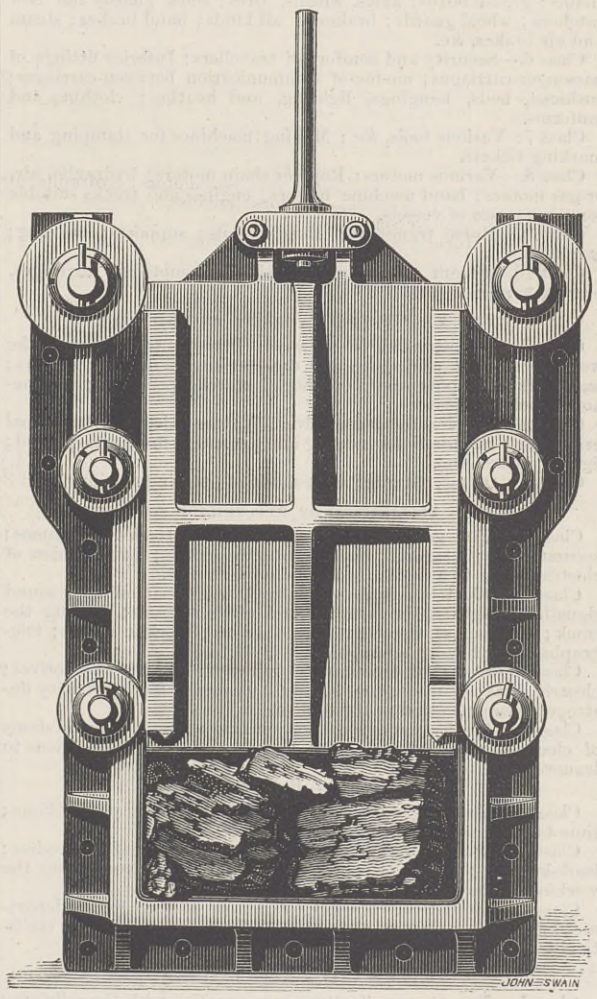
Fig. 1.—THE VYRNWY MASONRY DAM.

from thirteen millions to sixteen millions of gallons per day, and an ultimately higher increase on the total supply provided for thirty years hence.

The report last mentioned was followed by one on questions to which birth had been given by complaints made by Mr. Hawksley, and although it was very difficult to extract any tangible reasons for the complaints, it was very obvious that he did complain. One thing at least seemed specific, and that was dissatisfaction as to the effect on the stability of the dam of the method of its construction. Everything else as to reason for complaint seemed unintelligible, but it was remarked that Mr. Hawksley had not previously engaged on works to be carried out by himself and another engineer jointly, and that his dissatisfaction did not become known until the dam was well advanced, although he had long before spoken of retirement. With this matter we dealt in our impression for the 5th of February last, and expressed our conviction, though we did not then give Mr. Deacon due credit, that although there might theoretically be some grounds for the opinions Mr. Hawksley held as to the method of constructing the dam, there could be none for doubting its sufficient, and more than sufficient, stability. As a result, however, of the complaint on this score, the Water Committee called in General Sir Andrew Clarke and Mr. Russel Aitken to report upon the construction and stability of the dam. Their reports agreed that it was satisfactory in every respect, and confirmed the remarks we had previously made as to the absence of any necessity for investigation into the question of stability. Indeed, Mr. Aitken took the trouble to calculate the section of a dam with the usual factor of safety and to show by this how much the Vyrnwy dam is heavier than theory and experience dictated. Mr. Aitken's section is shown in Fig. 1, as placed upon the much larger actual section, the part shown by wide section lines being that adopted. With the opinions expressed in these two reports we dealt in our impression of the 4th June last, and were glad to be able to correct any false impression that might have existed as to the high character of the design and workmanship, on both of which subjects they thoroughly supported Mr. Deacon, and not less in respect of his method of construction than in other points.

WATER-TIGHT BUNKER DOORS.

THE accompanying engraving illustrates a water-tight bunker door made by Messrs. Cochran and Co., Birkenhead. These doors are arranged to be worked by screw from deck or any

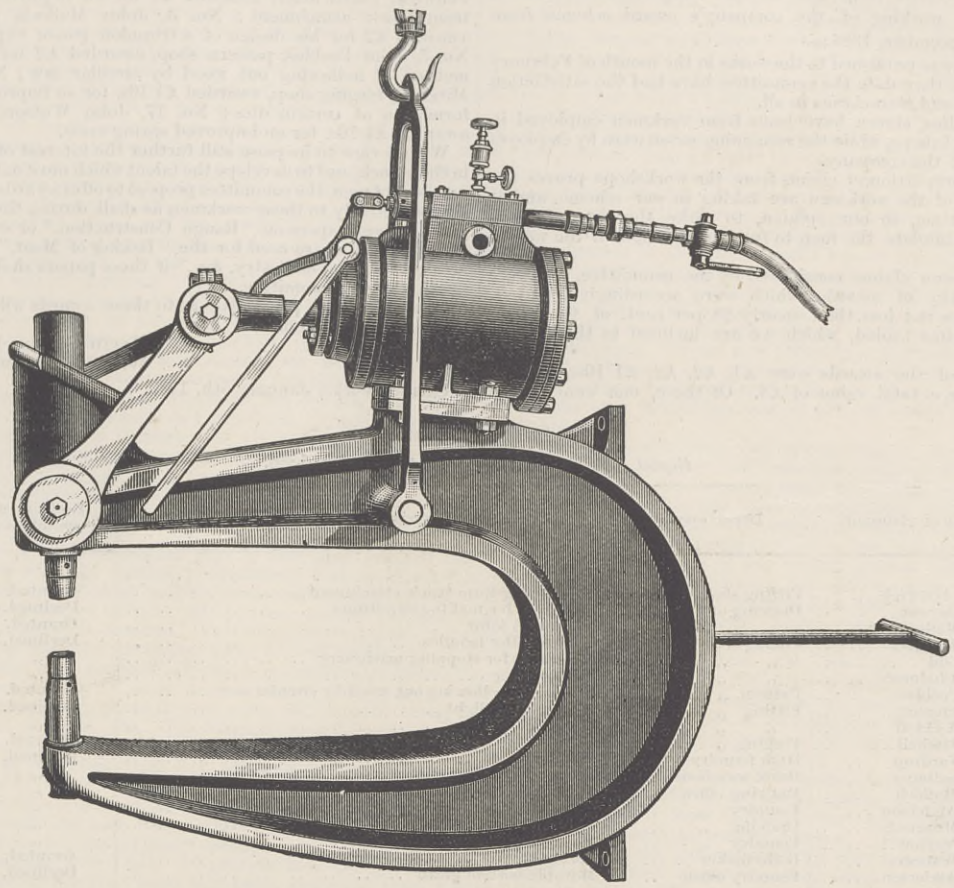


suitable position above, and can at any time close, making a water-tight door, and that without any clearing away of coal or cleaning out of slides. The door has a knife-edge on the bottom, which enables it to cut through the coal as it descends.

ALLEN'S PORTABLE PNEUMATIC RIVETTING MACHINE.

THE application of compressed air for operating machine tools has hitherto been handicapped by the serious objection that it could only be efficiently applied under very high pressure. This difficulty overcome, compressed air for portable machines at a moderate pressure has two very important advantages over those worked by hydraulic pressure, as it can be conveyed to any distant point through ordinary flexible tubing, and when it has done its work the air is at once set free, whereas when the water has done its work some means have to be provided for conveying it away, which is a very important consideration. The initial difficulty of working portable rivetting by compressed air at a moderate pressure has been successfully overcome by an American patent, of which we give an illustration, and which has been introduced to this country by Messrs.

ALLEN'S PNEUMATIC RIVETTING MACHINE.



De Bergue and Co., of Manchester, who have secured the sole right of manufacture. This machine has already been largely adopted by the leading bridge and girder makers in the United States, and Messrs. De Bergue subjected it to an extended trial in one of their own yards to satisfy themselves as to its merits. In our "Lancashire Notes" we have already briefly described the main points of the Allen pneumatic rivetter, but with the illustration we are now able to give a few further details will be of interest. The machine is constructed so that it can be adapted for rivetting all ordinary descriptions of girders, and as it can be suspended from any light travelling crane, it is readily handled and freely traversed at any convenient height from end to end of a long girder, heading all the rivets, not only in the flanges and those which secure the longitudinal irons to the webs, but also all the rivets in the vertical stiffeners. With a view to lightness and strength, the machines are made almost entirely of steel, and their action is extremely simple. The compressed air is admitted to the cylinder by a hand valve at each stroke of the header, and the pressure from the piston is conveyed to the vertical heading ram through differential levers, forming in combination a toggle joint, so that the pressure on the heading ram, moderate at first, attains its maximum the moment the operation is completed. By this arrangement, with a small cylinder of 10in. diameter, a pressure of about 50 tons can be exerted, and this can be obtained by compressed air conveyed at a pressure which does not need to exceed 70 lb. to the square inch. The heading ram descends in a direct line with the axis of the rivet, and, the machine being balanced, it will work either horizontally or vertically. The compressed air for operating the machine is supplied by a small air compressor, either driven by a belt or actuated direct by steam, which is also an American—Allen's—patent. The compressor, which has been specially designed for working the portable rivetters, and which is operated direct by steam, has two distinct features, which consist, first, in the use of positive moving valves in connection with the stroke of the air piston, instead of automatic poppet valves working loose in their seats, and secondly in having reciprocating parts in a straight line with the piston. By the use of positive moving valves any desired effective speed can be obtained, and the quantity of air compressed is always in direct proportion to the speed of the machine. Owing to the moderate pressure at which the rivetter can be worked, the compressed air can be distributed by ordinary flexible tubing, without leakage, to any point, however distant, and as compared with the hydraulic system of rivetters, the expensive accumulators are dispensed with altogether, with the complicated arrangement of swivels, slides, and folding pipes; and there is one important advantage, the immunity from freezing up or the bursting of pipes. We have had an opportunity of seeing one of these rivetters in operation at Messrs. De Bergue's works, and we are informed that the exhaustive trial to which it has been subjected has proved that the work done is equal to that of the best hydraulic machines, whilst the handiness of the machine enables a much greater quantity of work to be got through.

CONVERSION OF COMPOUND ENGINES TO TRI-COMPOUND.—The R.M.S. Athenian, built by Messrs. Aitken and Mansel, of Glasgow, and originally engined by Messrs. J. and J. Thomson of the same city, for the Union Steamship Company's Cape of Good Hope Mail Service, has had her engines converted from the compound to the triple expansion type, by Messrs. T. Richardson and Sons, of Hartlepool, and has been supplied with new boilers working at a pressure of 160 lb. per square inch. The diameters of the new cylinders are 36, 58 and 94in. respectively, and the length of stroke 54in. The Athenian went out for her trial trip at Stokes Bay on Saturday, the 8th inst. She attained a mean speed of 14·73 knots per hour, and indicated 4606-horse power, her engines working at 70 revolutions per minute with a steam pressure of 160 lb. to the square inch. This shows an increase in speed of 1½ knots per hour and an additional 1400 indicated horse-power, as compared with the Athenian's original trial trip with the compound engines. The adoption of the triple expansion engines will add greatly to the comfort of passengers through the decreased vibration, while the economised consumption of coal will be advantageous to the proprietors. The Spartan, which vessel's engines were similarly converted a few months ago, has just returned to England from her first voyage with the triple expansion engines, and the results have been very satisfactory. The Trojan will shortly have her engines converted in a similar manner to those of the Athenian and Spartan, and the extension of the principle to other steamers of the company will probably follow. The Athenian sailed from Southampton for the Cape of Good Hope on 13th inst., and Spartan will sail on 27th inst.

REWARDS TO INVENTORS.

We have received from the Carron Company the following report on the working of the company's award scheme from February to December, 1886:—

This scheme was published to the works in the month of February last, and since that date the committee have had the satisfaction of considering eighteen claims in all.

Of these claims, eleven have been from workmen employed in the various workshops, while the remaining seven were by employés in the offices of the company.

This large proportion of claims from the workshops proves the interest many of the workmen are taking in our scheme, and it only requires time, in our opinion, to make the interest more general and stimulate the men to further exertion in the way of improvements.

Of the eighteen claims considered by the committee, five were adjudged worthy of awards, which were accordingly granted. This represents not less than nearly 28 per cent. of the whole number of claims tabled, which we are inclined to think quite satisfactory.

The values of the awards were £1, £2, £2, £1 10s., £1 10s. respectively, or a total value of £8. Of these, one went to the offices and four to the works, showing that the claims of the workmen as a whole were most deserving of merit.

The names of the successful claimants are:—Claim No. 1, James Fenwick, grate fitter, awarded £1 for an improved self-locking tram truck attachment; No. 3, John Malloch, draughtsman, awarded £2 for his design of a trunnion steam expansion joint; No. 7, John Peebles, pattern shop, awarded £2 for his proposed method of hollowing out wood by circular saw; No. 10, George Mitchell, forging shop, awarded £1 10s. for an improvement in the formation of certain dies; No. 17, John Watson, boilermaker, awarded £1 10s. for an improved spring cress.

With a view to increase still further the interest of the workmen in their work, and to develope the talent which must exist among such numbers of men, the committee propose to offer awards of £5, £3, and £1 respectively to those workmen as shall during the ensuing year give the best papers on "Range Construction," or such apparatus or appliances as are used for the "Baking of Meat," "Roasting of Meat," "Baking of Pastry, &c.," if these papers shall be adjudged worthy by the committee.

Conditions and particulars as to these awards will be posted in the works in due course.

David Cowen, President.
W. S. Malcolm, Secretary.

Carron Works, January 5th, 1887.

Award Scheme.

Report of all Claims up to 31st December, 1886.

No. of claim.	Name of claimant.	Department.	Description of claim.	Decision of committee.	Amount of award. £ s. d.
1	James Fenwick	Fitting shop	Self-locking tram truck attachment	Granted.	1 0 0
2	D. Finlayson	Drawing office	Appliance for making cup lifters	Declined.	—
3	John Malloch	,, ,,	Expansion joint	Granted.	2 0 0
4	Alex. Douglas	Fitting shop	Garden roller handles	Declined.	—
5	Jas. Todd	,, ,,	Apparatus for stopping machinery	,,	—
6	Thos. Chalmers	,, ,,	Belt fastener	,,	—
7	John Peebles	Pattern ,,	Method of hollowing out wood by circular saw	Granted.	2 0 0
8	Jas. Fenwick	Fitting ,,	Hinge for skylight	Declined.	—
9	Wm. Waddell	,, ,,	Tram rail sweeper	,,	—
10	Geo. Mitchell	Forging ,,	Improved dies	Granted.	1 10 0
11	Geo. Wardrop	High foundry	Belt fastener	Declined.	—
12	H. Woodburn	Brick warehouse	Proposed hoist for cupola scrap	,,	—
13	John Malloch	Drawing office	Automatic timekeeper	,,	—
14	John Anderson	Foundry ,,	Open and close fire arrangement	,,	—
15	John Munnoch	Drawing ,,	Tram truck weighing arrangement	,,	—
16	Geo. Pearson	Foundry ,,	Movable bottom grate	,,	—
17	John Watson	Boilermaker	Spring cress	Granted.	1 10 0
18	John Anderson	Foundry office	Movable bottom grate	Declined.	—
			Total amount		8 0 0

David Cowen, President.
W. S. Malcolm, Secretary.

Carron Works, January 5th, 1887.

THE RAILWAY EXHIBITION AT PARIS.

An Exhibition of Railway Appliances will be held in Paris this year, from May to November. The exhibits will be grouped, classified as follows:—

Group I.

Class 1.—History of railways: Maps, drawings, models, &c.; collection of locomotives, wagons, &c., showing examples from earliest construction.

Class 2.—Instruments for surveying, levelling, &c.; mode of laying out, plans, working, drawings, &c.; geological studies as regards railways and public works; photographic apparatus for transfer of plans and for the reproduction of drawings, &c.; photo-lithography.

Class 3.—Architecture: Projects of termini and stations; designs, drawings, and models of terminal and other stations.

Group II.—Railway Construction.

Class 1.—Earthworks: Cuttings and embankments; formation earthworks; ballast wagons; dredging machines; machines; general rolling stock and fixed plant required on public works; repairing works.

Class 2.—Works of art: Tunnel work; boring machine, ventilation; aqueducts; stone bridges and viaducts; bricks, rubble stone work, ashlar work, freestone, cements; brick-making machines; mortar-mixing machines; stone-cutting machinery; various systems of iron bridge work; curved work, straight, parabolic, and arched bridges; iron piles and cylinders; steel girder bridges; shaping, drilling, rivetting machinery; travelling crane, derrick cranes, and sundry lifting machinery.

Class 3.—Protection of slopes and roads: seed grass, turfing; tree planting; various descriptions of fencing, boundaries.

Class 4.—Gates and level crossings: various descriptions of swinging, sliding, rolling gates; gates worked from a distance.

Class 5.—Descriptions of permanent way: Broad gauge; normal gauge; narrow gauge.

Class 6.—Ballasting: Grinding and reducing machines; tip wagons.

Class 7.—Sleepers: Wood sleepers, with their preparation and laying; plant for preserving sleepers; iron and steel sleepers; glass sleepers.

Class 8.—Permanent way: Iron and steel rails; models of rail-making; small plant; rail-sawing machines; testing machines; rail-bending machines; various types of rails; connections; fish-plates; spikes, bolts.

Class 9.—Plant for roadway: Points and crossings; turntables; traversers; wagon lifts; lifting and weighing machinery.

Class 10.—For working the line: Fixed and movable signals; semaphores; distance recorders; buffer stops; gradient indicators; movable notices or ground signals.

Group III.—Terminal and other Stations.

Class 1.—Passenger stations: General arrangement; interior fittings; furnishing, sanitary arrangements; lavatories; watchmen's boxes; watchmen's houses; working of passenger traffic.

Class 2.—Goods stations: Working of goods traffic; platforms and cranes; siding for marshalling of trains; sorting station; roofs, awnings, ropes, weighing machinery, &c.

Class 3.—Refreshment rooms: various installations and utensils; management.

Class 4.—Protection of station from fire—fire engines: Hand, steam, and portable fire engines; extincteurs: hand grenades; fire-escapes; floating fire engines.

Group IV.—Rolling Stock.

Class 1.—Engines and tenders: Boilers and fittings; steam gauges; alarm whistles; pistons and fittings; couplings; connecting-rods; cranks; coupled axles; tenders; locomotives with one or more coupled axles; tank locomotives; auxiliary starting engines; donkey engines, Frielen locomotives.

Class 2.—Passenger carriages: Construction of carriages; carriages with compartments; carriages on American system; first-class and saloon; sleeping cars; Pulman cars; Post-office wagons; fittings for taking up and dropping letter bags; luggage and guard vans; types of passenger train.

Class 3.—Goods wagons: Open trucks; covered trucks; types of cattle trucks; types of wagons for carrying fresh and prepared meat, &c.; types of wagons fitted with refrigerators; goods trains.

Class 4: Railway material for war service: Composition of a military train, ambulances, beds, dispensary; armour-plated locomotives and trains; repairing railway and works of art destroyed by an enemy; portable or flying bridges; technical section.

Class 5.—Outside fittings of locomotives and wagons; couplings and modes of coupling; automatic couplings; buffers; safety chains; grease boxes; axles, wheels, tires; snow guards and cow catchers; wheel guards; brakes of all kinds; hand brakes; steam and air brakes, &c.

Class 6.—Security and comfort of travellers: Interior fittings of passenger carriages; modes of communication between carriages; cushions, beds, hangings, lighting, and heating; clothing and uniforms.

Class 7: Various tools, &c.: Making machines for stamping and marking tickets.

Class 8.—Various motors: Rope or chain motors; hydraulic, air, or gas motors; hand machine motors; engines and trucks suitable for conveyance of vessels.

Class 9.—Horse tramways: Roads; rails; supports; crossing; carriages.

Class 10.—Steam tramways: Frielen locomotives, carriages, brakes, various apparatus.

Group V.—General Working of Railways.

Class 1.—Management of railways: Documents relating to the working staff of workshops and depôts; engine drivers; stokers; managers of depôts and workshops; storekeepers, &c.; engine-house tools and plant.

Class 2.—Supplies for locomotives: Water; injectors; fuel; coal briquettes; machines for mixing and pressing; fire grates; wood; lignite; petroleum.

Class 3.—Oiling: Grease; oils; mode of greasing or oiling.

Group VI.—Application of Electricity to Railways.

Class 1.—The generation of electricity: Batteries; dynamos; accumulators; magnets; electro-motor machines; transmission of electric power to a distance; secondary batteries.

Class 2.—Electric signals — lighting: Sight signalling; sound signalling; lighting of terminal and other stations; lighting the track; lighting of the engines and trains; electric clocks; telegraphs; telephones; microphones.

Class 3.—Electrical traction for railways: Electric locomotives; electric brakes; utilisation in accumulators of the electricity destroyed by application to the brakes.

Class 4.—Application of electricity to tramways: Various systems of electrical machines; lighting, brakes, and other applications to tramways.

Group VII.—Publications.

Class 1.—Relating to railways: Books; various publications; time tables; guides; essays on railways.

Class 2.—Books on general management: Technical studies; book-keeping; books on general business; books respecting the working of the staff.

Class 3.—Statistics: Working expenses of locomotive department; working expenses of rolling stock; rates of freight; statistical tables; provident societies.

Group VIII.—Agriculture.

Class 1.—Report on agriculture in connection with the railways: Carriage of produce; freight.

Class 2.—Railways for agricultural districts: Various systems of engines and trucks.

Class 3.—Road locomotives; steam ploughing.

Information respecting the International Exhibition and Congress can be obtained, and applications for space are to be addressed to the Commissioner-General for England and the Colonies, New Broad-street House, E.C., London.

THE BLACK PROCESS.

A black process, which will compete for favour with the well known blue process, familiar to engineers and others, is given in the *Photocopie* of Mr. A. Fisch. The process is technically known as heliography, is simple, easy, and inexpensive, while the prints are ink-black, and are made from drawings or positives and negatives. We owe this process to Mr. Poitevin, but it has been slightly improved.

Sensitising solution,—Dissolve separately: (1) Gum arabic, 13 drams; water 17 oz. (2) Tartaric acid, 13 drams; water, 6 oz. 6 drams. (3) Persulphite of iron, 8 drams; water, 6 oz. 6 drams. The third solution is poured into the second, well agitated, and then these two solutions united are added to the first, continually stirring. When the mixture is complete, add slowly, still stirring, 100cc.—3 fl. oz. 3 drams—of liquid acid perchloride of iron at 45 deg. Beaume. Filter into a bottle and keep away from the light. It keeps well for a very long time.

Sensitising the paper.—Here especially it becomes necessary to select a paper that is very strong, well sized, and as little porous as possible. By means of a large brush or sponge apply the sensitising liquid very equally in very thin and smooth coats; then dry as rapidly as possible with heat, without exceeding, however, a temperature of 55 deg. Cent.—131 deg. Fah.—The paper should dry in obscurity, and be kept away from light and dampness; notwithstanding all these precautions it does not keep well long, and if it is desired to act with some certainty it is better to have a stock to last only a fortnight. Freshly prepared it is better than a few days afterwards. It should be of a yellow colour.

Printing.—The tracing, made with very black ink, is placed in the printing frame, the drawing in direct contact with the plate; then place over it the sensitised paper, the prepared side in contact with the back of the tracing. There is no necessity to make use of photometric bands, as the progress of insolation is sufficiently seen on the sensitised paper during the exposure. From yellow that it was, it should become perfectly white in the clear portions, that is to say, upon which there is no drawing of the transfer or positive cliche that is to be copied; this is ascertained by raising from time to time the shutter of the frame. The exposure lasts from ten to twelve minutes in the sun; in summer less, in winter more. When the exposure is ended remove the print from the frame, and it should show a yellow drawing upon a white ground. If in the sensitising bath a few cubic centimetres of a rather highly concentrated solution of sulphocyanide of potassium have been added, this bath becomes blood-red and colours the paper the same; in this case the print also whitens during exposure, but then the image, instead of being yellow, is red on a white ground. This substance, however, is, if we may so speak, inert, or without any other action; it is very fugitive, and even disappears in a short time in obscurity; it has no other use, therefore, than to render the drawing or the image more visible after exposure.

Developing the prints.—When the print has been sufficiently exposed it is taken from the pressure-frame and floated for a minute in the following solution, so that the side upon which is the image should alone be in contact with the surface of the liquid, avoiding air bubbles between the two surfaces. Otherwise defects would be found in the print; to ascertain this, raise in succession the four corners. The developing bath is composed as follows:—Gallic acid—or tannin—31 to 46 grs.; oxalic acid, 1¼ grs.; water, 34 oz. In this bath the orange-yellow or red lines are changed into gallate or tannate of iron, and form, consquently, a veritable black writing ink, as permanent as it. The print is then plunged into ordinary water, well rinsed, dried, and the print is now finished. The violet-black lines become darker in drying, but unfortunately the ground which appears of pure white often acquires, in drying, a light violet tint. For prints with half tones this is of no importance; but for the reproduction of plans, for example, it is very objectionable. By this process we have the satisfaction of obtaining a drawing in black lines similar to the original, and in most cases this is sufficient.

Death of Sir Francis Bolton.—We regret to have to record the death of Colonel Sir Francis Bolton, which took place on Wednesday night, the 5th instant, at the Royal Bath Hotel, Bournemouth, where he and Lady Bolton had been staying for the last two months. Colonel Sir Francis John Bolton, who was the son of Dr. T. W. Bolton, was born in 1831. He entered the army at the age of twenty-six, and, after three years' active service on the Gold Coast, for which he received special thanks, was promoted to a captaincy in the 12th Foot. Subsequently he served on the staff as Deputy-Assistant Quartermaster-General, and was attached to the Royal Engineers at Chatham. In 1868, in consideration of special military scientific service, he was given an unattached majority. He retired in 1881 with the rank of colonel. Sir Francis was the inventor of the system of telegraphic and visual signalling which was introduced into the army and navy in 1863. For these services and other improvements and inventions in regard to war-like material the Queen, in 1883, conferred upon him the honour of knighthood. Sir Francis, who was a civil engineer, founded, in 1870, the Society of Telegraphic Engineers and Electricians. Since 1871 he had been water examiner under the Metropolis Water Act. His recent services in connection with the South Kensington exhibitions will be fresh in the memory of the public, especially his direction of the illuminated fountains. Sir Francis married, in 1866, a daughter of Mr. R. Matthews, of Oatlands Park, Surrey.

The City of London College Science Society.—At a meeting of the City of London College Science Society on the 4th inst., Mr. Henry Adams, M.I.C.E., read a paper on "The Strength of Iron and Steel," illustrating it by a large collection of samples and numerous diagrams. He referred to the present as the age of steel, but said that our knowledge of it is yet incomplete, though, speaking broadly, the amount of carbon combined with the iron determined the nature of the resulting compound. He then described the changes caused in the properties of the metal as the carbon increased from *nil* to 5 per cent., steel occupying a place midway between wrought and cast iron. Formerly the great cost of steel was a bar to its adoption; now, owing to the application of science to its manufacture, the cost, strength for strength, although not quite weight for weight, has been brought down to that of wrought iron. As steel is intermediate in its constituents so it may be made by adding carbon to wrought iron as in blister steel, or burning some of the carbon out of cast iron as in Bessemer steel. The effect of impurities was noted, particularly of phosphorus and sulphur, and cases mentioned in which iron containing these could be used with the minimum of inconvenience. The various kinds of stress and strain were then explained, the load being the external cause, the stress the internal resistance, and the strain the external result. Diagrams were then exhibited showing the various forms in which samples were prepared for testing, the mode of testing was described, and also the manner in which the measurements were taken. At first sight it would appear that the material which would bear the greatest steady stress before breaking would be the safest and most trustworthy, but this would be a misleading conclusion, as in many cases this apparent strength is due to a want of elasticity, and a very slight jerk, or sudden application of a small stress, would cause fracture. When the failure occurs without much stretching, the pull acts through an extremely small distance, and therefore the mechanical value, or work done in producing rupture, is also small, although the pull itself may be of considerable magnitude. The toughness, which is after all the chief quality to aim at for structural purposes, depends as much upon the elasticity as upon the ultimate tensile stress. Several tables were then given, showing the ultimate or breaking stress per square inch, and safe working load under various conditions, including iron and steel for use in machinery under variable loads. Typical specification tests were described and the reasons shown for some of the safeguards which were provided. Some of the illustrations of modes of fracture were very interesting, and among the examples one piece of wrought iron, known to have been in use as a lever for fifty years, was remarkable from the very large and perfectly formed crystals appearing over the whole section. Selections were made from Hodgkinson's experiments, and some illustrations of the fracture of test bars which appeared a few years ago in *Iron* were reproduced. An explanation of these forms was suggested, but the subject requires further consideration. The mode of testing girders and bridges for deflection was described, and the curves obtained were shown upon the diagrams exaggerated three hundred times to emphasise their peculiarities. After a few remarks from the chairman, Mr. C. E. Grove, upon the gradual elongation of iron under tensile stress after the first great movement occurred, and the necessity for some fuller records of the secular changes of materials, a vote of thanks was passed to the lecturer for his very thorough and practical paper.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, Dec. 31st.

BROKERS in iron, steel, and metals, have about made up their minds that an advance will be made in January on first class material of all kinds. There will be some disappointment no doubt. The demand for iron and steel is certainly very heavy, and large consumers are without material to complete large contracts on hand. The greatest scarcity will be developed in the material intended for railroad construction. The contracts, according to the best authority, which have been placed, already foot up about 1,100,000 tons. The capacity of the country may be safely put at 1,700,000 tons, which leaves about 600,000 tons of capacity yet to be sold. Certain railroad schemes now on the market will call for one-third of this capacity if they go through, as they probably will, because they are backed by such railroad builders as Huntington and Gould. The requirements are urgent from their standpoint, as they contemplate building lines to head off other syndicates. Rails have advanced to 37 dols. nominally. Any further advance in Great Britain will be followed immediately by higher quotations on this side. The rail makers are not desirous of booking orders at any figure. A scarcity of small railway material, such as billets, nuts, and spikes, is reported from the West, where mills are oversold from two to three months. The development of cheap iron making in the South has attracted the attention of Pennsylvania capitalists to the possibility of making pig iron in Pennsylvania at 11 dols., and billets at 15 dols. to 16 dols. Natural gas is in abundant supply in this locality, and preparations have been made to erect furnaces both for iron and steel. The location is in Clarion County, 150 miles north of Pittsburgh. Other locations are also being developed, one being in the centre of the State about 200 miles from Philadelphia. Iron and steel-making companies are preparing to enter actively upon the production of iron and steel during the next year. Twelve companies in all have been organised to operate in the Northern and Southern States, with an invested capital of 7,000,000 dols. A good many companies have been started to manufacture agricultural implements and tools in the West. The extension of railroad construction throughout the North-west and West has brought new cultivation, and much additional agricultural area; and this is the basis of the present improving demand for implements and tools. The farming interests throughout the West are prospering better than a year or two ago, and emigration is resulting in the building up of an important agricultural community.

Bar iron is selling at 40 dols. per net ton for best, 38 dols. for medium, and 36 dols. for common. The car-builders are heavy buyers. The plate iron makers have heavy orders for shipbuilding and boatbuilding purposes. The production of puddle bars at Pittsburg is 1800 tons per day. All of the rolling capacity throughout the country is oversold from two to four months. Pig iron is selling at 20 to 21 dols. for No. 1 foundry; Bessemer, at 19 to 20 dols.; steel rails, 37 to 37·50 dols. Southern coke iron is selling at 20 dols. at Louisville, and 18 dols. for neutral mill. In Western Pennsylvania there is great activity in charcoal and Bessemer irons. English iron is without sale there. All of the rolling mills are crowded with orders. The demand for steel is very heavy. Old rails are wanted in large quantities, but cannot be had fast enough to meet the urgent demands. Wrought iron pipe orders are crowding in, and mills are unable to accommodate all buyers. Crop ends are quoted at 24·50 dols. The Connellsville coke region is working full time, and the entire capacity is absorbed in Eastern and Western steel-making centres.

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

(*From our own Correspondent.*)

THIS has been the week of the quarterly meetings, and they have been marked by a very gratifying tone. The attendance at Wolverhampton yesterday, and in Birmingham to-day, were large, and the markets exhibited a good deal of animation. Iron and steel masters, merchants, and other buyers were present from the chief producing centres the kingdom over, and from London, Liverpool, Glasgow, Manchester, Bristol, and other ports. The views entertained of the probabilities of business this year were very buoyant. The reports brought from other parts of the kingdom were such as greatly strengthened the local market. The further advance of 2s. upon the week in Cleveland, and the continued strong upward movement in Scotland, had a particularly good effect. The heaviest business transacted was in pigs, though finished iron also showed increased activity.

It early became known that no change was to be made in marked bar prices. The Earl of Dudley, Messrs. William Barrows and Sons, and Messrs. Noah Hingley and Son—the three firms to whom the market looks for the initiative in any new departure in the matter of prices—adhered to the existing quotations of £7 12s. 6d. for his lordship's common bars, £7 for the first qualities of the other two houses, and £6 for the second qualities of Messrs. Hingley's and similar class firms. Earl Dudley's single best bars remained at £9, and double best £10 10s.

Messrs. Wm. Barrows and Sons quoted:—Bars, round, square, and flat, £7; best bars, suitable for chain making and other purposes, £8 10s.; double best, suitable for superior chains, bars, and the like, £9 10s.; plating bars, £7 10s.; best angle, tee, and rivet iron, £9; and double best, £10. Boiler plates the firm quote £8 10s., £9 10s., £10 10s., and £14 10s., according to quality; and sheets, £8 10s. for 20 gauge, £10 for 24 gauge, and £11 10s. for 27 gauge. Hoops quoted £7 10s., best £9, and wide strips £8 10s.

Messrs. John Bradley and Co., who, by reason of the exceptional character of their iron, are able to command more money than any other house in the trade, price all bars above ⅝in. £9 10s., which is £2 10s. above the price of the other marked bar firms. Hoops they quote £8 10s., which is £1 per ton advance on other firms; and sheets and plates £10, which is £1 10s. more than any other best makers are asking. Rounds and squares up to ⅝in. are quoted at £8, an advance upon the terms of other firms of £1 per ton. The bulk of the sales that the superior bar makers are effecting are for their second-class branded qualities, for which the quotation remains at £6. The Mitre iron of Messrs. Philip Williams and Sons continues an exception to the brands of most other firms, in that first qualities are quoted £6 15s., and second class £5 15s.

The contract for the supply of bar iron to the various dockyards of her Majesty's Navy has again been taken by the New British Iron Company, of the Corngreaves Iron and Steel Works.

One of the most promising features of the outlook at to-day's meeting was admitted by the continued revival in the American iron and steel industry, accompanied by increased U.S. orders for steel works in this country, not only in the form of valuable lines in steel blooms, billets, tin bars, steel wire rods, &c., but also in rails, &c. It is a significant fact that American ironmasters are still desirous of keeping themselves fully informed af every change in English steel and iron prices. The business which Staffordshire ironmasters are doing with the United States is increasing in thin sheets and best tin-plates, large rounds, and strips.

Medium and common bar makers strongly demanded an advance of 5s., and in some cases 7s. 6d., per ton upon the prices which prevailed before pigs began to advance. Plenty of orders were refused to-day for which buyers were at present unprepared to pay such advance. £5 was about the minimum for common bars, general merchant bars were £5 10s., and superior £6. For hoops and strips higher prices were also demanded by 5s. per ton, and the general quotation for the former was £5 5s., and for the latter £5. An informal meeting of strip makers advanced prices to this figure. Angles were also stronger.

The smaller output, which is now occurring in sheets, has largely improved the position of those firms who keep running. Galvanisers and merchants made excellent inquiries, and placed good orders forward wherever possible. Buyers are pressing for deliveries, and many of the mills are running to their utmost capacity to accommodate consumers. Prices were an advance of 10s. per ton upon three or four months ago, and some makers asked 15s. advance. Doubles for galvanising were £6 10s. to £6 12s. 6d. Lattens were fully £1 per ton additional. Further advances were spoken of as altogether likely in a short time.

Steel in all forms was in very brisk inquiry, and sellers were strong in price. Imported billets, blooms, and tin bars were 5s. to 7s. 6d. per ton advance over last quarter day, and Bessemer tin-plate bars were quoted firm at £5, delivered in this district from Welsh works; billets, £4 12s. 6d.; and blooms, £4 10s. Siemens steel bars were £5 7s. 6d., and blooms, £4 17s. 6d.

The pig iron market was excited, particularly as regards hematites and Midland pigs. Prices are being pushed up as rapidly as the market will at all permit. The unremunerative figures which have long prevailed are held to be justification for this cause.

Enquiries were on an extensive scale to-day. The prices demanded were, however, generally too high to encourage business; indeed, many sellers specially desired to postpone accepting contracts. Hematites were to be had at less than 57s. 6d. to 60s. delivered here, and makers expressed the opinion that 50s. will very soon be seen at furnaces in Lancashire. Prices of Derbyshire pig were quoted at a minimum of 40s. delivered to consumers' furnaces; while Northampton pigs were 39s. to 40s. Lincolnshires were strong, at 42s. to 42s. 6d.; and Wiltshires, at 38s. to 38s. 6d. These figures were advances over the October quarterly meetings of 4s. on Derbyshire and 3s. on Lincolnshire pigs, and as to hematites, some 5s. per ton rise.

The demand for Staffordshire pigs is such that makers cannot fill contracts with the needed promptitude, and are behindhand with deliveries. All-mine makers demanded an advance on last quarter-day prices of fully 2s. 6d. per ton, making the quotation for hot-blast sorts 55s. nominal. Part-mine pigs were also stronger by 2s. 6d. per ton, the quotation being 37s. 6d. to 42s. 6d. Common forge pigs were similarly advanced, making the quotation 30s., though it was not in all cases easy to obtain the advance. The Spring Vale Company quoted: Best sorts, 55s.; second sorts, 45s.; and common qualities, 35s. The company is well booked forward, and is not anxious to sell further. It is now producing some 1700 or 1800 tons per week from five furnaces. The Willingsworth native brand of pigs was quoted 32s. 6d. Messrs. G. and R. Thomas, of the Hatherton Furnaces, have just blown in another furnace, and the Pelsall Coal and Iron Company is also about relighting another furnace to supply its own wants.

The Galvanised Iron Trade Association met to-day, and it was reported that all the firms were very busy, and could readily book large orders ahead. The South American and South African demand was considerably increasing, and Australian orders were steady. In consequence of the advanced price of black sheets and spelter it was resolved to advance galvanised sheets 10s., making 24 g. £10 10s. to £10 15s., nominal, delivered Liverpool.

The local ironworkers have been given a month in which to prepare a statement, meeting that of the employers issued a short time ago, with reference to the "extras" paid in the Staffordshire mills and forges. The employers endeavour to show that they are handicapped by those extra when compared with other districts, but the men plead special circumstances which demand a continuance of the custom. When the statement has been prepared, the matter may be considered by the Iron Trade Wages' Board.

The Staffordshire Steel and Ingot Iron Company, Bilston, has determined to increase its present plant, which consists of three converters upon the basic principle, by the erection, in the ensuing few months, of an open hearth basic furnace of 8-ton capacity. The steel produced will be made from a mixture of native common pig iron, scrap, and a little ore. The plant will be partly manufactured by the company themselves, and the ironwork for the furnace will be supplied by the Patent Shaft and Axletree Company, Wednesbury. Profiting by the successful experiments which have been made with basic slag as an agricultural manure, the company have determined to convert their refuse into a marketable commodity. Special plant, supplied by Messrs. Morris Bros., engineers, of Doncaster, is to be erected for grinding and pulverising the slag, which will be reduced to the fineness of flour. The valuable constituents of the slag are about 15 to 20 per cent. of phosphoric acid and 40 per cent. of lime.

It says much for the quality of the steel now being turned out by this company that in the engineering sections which they are rolling, channel ingot iron or steel as large as 15in. by 6in. occurs, and that sectional iron is being built into columns of 14in. diameter for bridge erections in India and South America.

Messrs. Hatton, Son, and Co., Bradley Iron and Tin-plate Works, find that sheet consumers are more than ever preferring steel to iron, alike in the form of black thin sheets, tinned sheets, and tin-plates. Their steel plant, which is upon the side-blown fixed converter principle, under the firm's own patent, is at present turning out an average of some 250 tons of ingots per week. This output, if required, can be greatly increased. The Siemens gas reheating furnaces at these works will accommodate ingots up to two tons weight. The ductility and fibre of the metal produced is of much excellence. Steel sheets are being rolled down to 40 b.g.

Ironmasters express satisfaction this week that the country's export trade in manufactured iron and steel shows up better for the past year than had been anticipated, business having pulled up considerably in the last two or three months. The total exports for the twelvemonth were 3,389,197 tons, as against 3,130,682 tons in the previous year. The value was £1,487,222, as against £1,027,460. The increase was mainly in pig iron, telegraphic wire, old iron, and steel unwrought. The figures for the several descriptions were as here:—Pig and puddled iron, in 1886, £2,252,944, as against £2,029,816 in 1885; bar, angle, &c., in 1886, £1,378,065, in 1885 £1,620,484; railroad iron, £3,688,733 in 1886, £3,905,259 in 1885; cast and wrought iron, £3,879,241 in 1886 £4,013,108 in 1885; hoops, sheets, &c., last year £3,058,703, in 1885 £3,268,143; old iron, £388,376 in 1886, £261,435 in 1885; steel, unwrought, in 1886, £1,487,222; in 1885, £1,027,460. The chief markets for bar, angle, bolt, and rod iron were, it is interesting to note—Australasia, which took £265,561; the British East Indies, £261,536; British North America, £150,743; the United States, £22,444; Turkey, £35,429; Italy, £74,129; Germany, £21,433; Holland, £17,036; Russia, £9289; and France, £1940. Other countries purchased to the extent of £518,525. In hoops, sheets—iucluding galvanised sheets—boiler and armour plates, the chief buyers were:—Australasia, £768,036; Russia, £405,650; British East Indies, £357,287; British North America, £142,141; United States, £127,904; Italy, £79,358; Germany, £56,486; Spain and Canaries, £38,650; Holland, £33,312; and France, £20,489. "Other countries" are set down for £1,029,390.

What promises to be one of the largest central electric lighting stations at present in England is about to be erected at Leamington. Negotiations have been completed with Messrs. Arthur Chamberlain and George Hookham, the founders of the company of Messrs. Chamberlain and Hookham, Birmingham, who, on their own responsibility, have agreed to lay down the necessary plant and machinery. Powerful machinery will be put down immediately, and all of it will be in duplicate, so as to avoid the risk of stoppage through a breakdown. Storage batteries will not be used, unless in the meantime a new form may be invented which will be less expensive than continuous steam power. The dynamo is an important feature of the new plant. Taking the first requirements of the borough to be 5000 incandescent lamps, the charge would be no more than one farthing per lamp of 18-candle power per hour. There would be other incidental expenses, such as the rent of meters and the charge for lamps. The acting consulting engineer to the contractors is Dr. John Hopkinson, F.R.S.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The upward movement in the price of pig iron, to which I referred last week, continues quite as strong as ever, and during the past week there has been a further considerable advance. The present course of the market is, however, viewed with a good deal of distrust by buyers here, the advance which has been going on in prices being considered as due more to speculation than as the legitimate result of increased requirements for actual consumption. It is true that there has been a good deal of buying recently for forward delivery both by consumers and merchants, but this has been chiefly in anticipation of a rise in prices; in the principal iron using branches of industry in this district there is no present appreciable improvement to bring consumers into the market for any materially increased weight of iron, and it is significant that the advance in the raw material has so far not been followed by any corresponding upward movement in the price of finished iron, whilst founders have still to compete for orders at prices quite as low as ever. The result is that forge proprietors and founders, where they have not been able to cover themselves at something like old prices, are just now placed in a very awkward position, and in some instances I have heard them declare that they will prefer to close their works rather than to seek after orders under the conditions upon which business at present seems only to be practicable.

Although there was a very strong tone on the Manchester iron market on Tuesday, an unsettled feeling seemed to prevail generally, and the advanced prices asked by makers had the effect of checking much actual business being done. At prices which would have been readily taken a couple of weeks back, there was, however, plenty of disposition to buy, but makers were indifferent about booking orders of any weight, even at their full rates. For delivery equal to Manchester, Lancashire pig iron makers are now quoting 39s. 6d. for No. 4 forge, and 40s. 6d. for No. 3 foundry, less 2½; about the same figures are also now being quoted for Lincolnshire forge and foundry qualities, whilst for Derbyshire and foundry iron 45s., less 2½, is being asked for delivery into this district. In outside brands offering in this market there has also been quite an equal upward movement in prices, and in the face of the advance which has taken place in warrants, many of the makers are very cautious about quoting at all.

Hematite makers appear to be in a very strong position; large sales have recently been made, chiefly on supposed American accounts, and I hear it stated that an increased make will be required to meet the present demand. The price of hematite ore has also gone up, and under all the circumstances makers are very indifferent about committing themselves to further engagements just at present. For mixed parcels of hematite delivered into the Manchester district about 57s. 6d., less 2½, has been quoted during the past week.

Whatever may be the result of the quarterly meetings which are being held this week, finished iron makers have so far been unable to follow the advance in the raw material. Except that there has been some stiffening in sheets, which have been quoted £6 15s. per ton for delivery equal to Manchester, prices have remained practically stationary. For good ordinary qualities of bars makers have not been able to get more than £5, and hoops have not averaged more than £5 5s. per ton delivered into the Manchester district.

The condition of the engineering trades remains without material change from what I last reported. Here and there the feeling is better and more hopeful, but the general outlook can scarcely be said to show any appreciable improvement, and in most branches of industry the year has been entered upon with only discouraging prospects.

At a meeting of the Manchester Geological Society held last Friday in Wigan some very pertinent remarks on the question of safety lamps were made by Mr. Hy. Hall, one of her Majesty's Inspectors of Mines. Mr. Hall exhibited and described a new safety lamp which he has himself designed; this lamp is the same in principle as the "tin-can" Davy, but glass is substituted for the tin-can shield, and there is also a smaller inner glass shield which prevents the air, which is admitted at the bottom of the lamp, coming in direct contact with the flame; if by any accident the outer glass shield became broken, the miner would still have the protection of an ordinary Davy lamp, whereas, with the glass lamps now largely in use, the breaking of the glass at once exposes the flame. In bringing this lamp before the members Mr. Hall expressed the opinion that it was questionable whether all the labour which had recently been bestowed on the improvement of safety lamps had been expended in a right direction; he thought so much attention had been bestowed in constructing lamps to withstand high velocities which were rarely if ever met with in a mine, that the requirements of the every-day condition of a mine had been overlooked. In all his experience he had only once seen an explosive current travelling quickly, but he frequently saw accumulations of gas in quiet parts of the mine. That being so, he thought they wanted a lamp that would be safe and suitable for working in quiet parts of the mine more than one simply adapted for meeting an explosive current travelling quickly, because the lamp had to go into quiet parts of the mine every day where gas might be collected, and the other circumstance might never occur in the history of the colliery. A great many colliery managers felt misgivings as to the lamps which were at present being introduced, and he heard them every day make remarks in the direction that they did not like trusting entirely to glass. The object he had in view in the lamp he had designed was to secure a simple lamp, giving a good light, and with which, in the event of the glass being broken, the miner would still have the protection of the gauze. Mr. Hall added that the lamp was not subject to any patent, and he should be gratified if anyone could improve upon it in the direction he had pointed out.

At the same meeting an interesting paper on "The Important Question of How to Deal with Dust in Coal Mines," was read by Mr. M. Mercer, of the Pemberton Collieries. The best and most practical method in the opinion of Mr. Mercer was the watering of the roads either by water-carts or the laying of pipes in the haulage roads and main air courses. There were several varieties of carts in use for this purpose, and a very ingenious cart had been constructed by Messrs. Smethurst for use in their mines at the Garswood Hall Colliery. In consisted of an ordinary water barrel mounted on tram wheels; at one end was fixed a hollow circular rose, perforated with small holes round its circumference, and connected by gearing to a toothed wheel on the axle of the tram wheels. The water was delivered into the centre of the rose or disc, which, revolving very rapidly when the cart was in motion, scattered the water by centrifugal force against the roof sides and floor of the roadways. The laying down of pipes, although costly at the outset, was a very effective method of watering the mine by a series of sprays along the length of the pipes, but there was the risk of the small apertures being choked by dust or dirt, and the danger of the pipes being broken by falls of roof and sides, or the lifting of the floor. As a means of minimising the danger arising from the unavoidable existence of dust in a mine, Mr. Mercer urged the advisability of hanging a sheet of brattice cloth, saturated with water, over and in front of all shots fired in the coal or metal; the advisability of reducing the velocity of the air in haulage roads by enlarging their areas or providing additional roads for the intake air, and the advisability of separating each district by means of lengths of arching to be kept quite free from dust by brushing and watering, so that an explosion would be confined to one district.

There is a fairly active business doing in the coal trade of this district, and all descriptions of fuel—house fire, steam and forge coals, and burgy and slack—are moving away freely, with pits fully employed, and a good deal of coal being taken out of stock. The demand is chiefly for house fire consumption, but this, with the extra requirements for gas-making coals as the result of the late

foggy weather, has tended to move away the surplus supplies of the commoner sorts of round coals, whilst with the colder weather there has been an increased consumption of engine fuel for mill purposes. Quoted prices are steady at about 9s. to 9s. 6d. for best coals, 7s. 6d. to 8s. seconds, 6s. to 6s. 6d. common house fire coals, 5s. to 5s. 6d., steam and forge coals, 4s. 6d. to 5s. burgy, 3s. 6d. to 4s. best slack, and 2s. 9d. to 3s. per ton for common sorts at the pit mouth.

For shipment there is a moderate demand, with prices firm at about 7s. to 7s. 3d. per ton for steam coals delivered at the high level, Liverpool, or the Gaiston Docks.

Barrow.—Hematite pig iron is in much brisker inquiry, and the market has received an improvement even on the satisfactory position which was experienced in October and November last year. The demand from all sources has increased, and the business doing on foreign and American account shows an increase all round, while the inquiries from colonial and continental sources is evidence that the requirements of consumers generally are on the increase, and that their requirements, at any rate during the spring and summer months, will be very considerable, while on home account the lookout is very cheering, owing to the heavy and increasing consumption on the part of steel makers. The market for Bessemer is, of course, more active than that for ordinary forge and foundry descriptions of metals. During the past few days an advance has been made in prices which is firmly maintained, and which in all probability will lead to still better prices before the month is out, because as a matter of fact the demand is greater than the ability of producers to compete with. Hence the energetic efforts now being made to put in blast several of the furnaces now standing idle. Prices are quoted now at 49s. 3d. per ton net at makers' works for Bessemer descriptions of iron in mixed parcels, and 48s. 6d. for No. 3 forge and foundry iron. The value of steel has also advanced, and ordinary heavy sections of rails are quoted at £4 2s. 6d. per ton net at makers' works, prompt delivery. There has also been an improvement in the demand and in the value of other descriptions of steel corresponding with that which has taken place in rails. Shipbuilders are likely to be busier, as one or two orders are on the point of acceptance. Engineers are not well employed, but they have a better outlook than has been before them for some time. Finished iron is in fair request. Iron ore firmer at from 9s. to 11s. 6d. per ton net at mines. The coal and coke trades are firmer, and better prices are expected.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

When the leading Sheffield firms engaged in the production of war material entered vigorously into extensions—the bulk of which will soon be completed—at a cost of over £250,000, it was understood here that Woolwich Arsenal would not be a competitor with the trade. It was freely stated at the end of last year that the Woolwich authorities were laying down plant for the production of 20-ton steel castings. The *Sheffield Telegraph* states, on the authority of a gentleman who recently visited the Arsenal to make inquiry on the subject, that no such plant is being provided, and that the greatest possible care is taken not to interfere with the trade. The furnace which is being erected, it is added, is one which was removed from an inconvenient site to a place where it will be more efficiently used.

The sudden change in the weather, from severe frost to thaw, has caused the skate makers to slacken operations. They admit, however, they have had a good "run," sufficient not only to clear the accumulations off their shelves, but to exhaust the stocks of merchants, who, in anticipation of a further frost, have been ordering pretty freely from local firms. It is a long time since the skate trade has had so good a turn.

In the coal trade there are no indications in the Sheffield district of any change in the quotations for household and other qualities, and it is not anticipated there will be any agitation in the mining districts with regard to wages, though the efforts to establish a sliding scale fell through.

Yorkshire collieries have done well with Hull during December, the total quantity forwarded by rail and river being 119,760 tons, an increase of 3856 over the corresponding month of 1885. The total tonnage to Hull for the year was 1,417,728, an increase of 91,176 tons over the quantity sent to that port in 1885. There were exported from Hull during the month 36,859 tons, against 34,997 tons for December, 1885; during the year 620,657 tons, compared with 633,139 in 1885.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

There was a large attendance at the quarterly meeting of the Cleveland iron trade, held at Middlesbrough on Tuesday last, including, as it did, several merchants from Glasgow, Manchester, and elsewhere. So far as pig iron is concerned, the market continues exceedingly strong. Buyers still show great anxiety to contract ahead, and consequently holders and makers are averse to sell, and have again advanced their prices. For prompt delivery, the price paid on Tuesday for No. 3, g.m.b., was 37s. 6d. per ton, that being an increase of 2s. on the price accepted the previous Tuesday. For delivery to the end of June, 38s. was freely offered, but few sellers were to be found, the majority expecting to obtain eventually at least 40s. The price of forge iron also has gone up to the extent of 2s. per ton, the figure at which it now stands being 35s. 6d. per ton.

Warrants are much sought after, especially by *bonâ fide* investors. In order to obtain them 37s. 9d. to 38s. per ton must now be paid. The stock in Messrs. Connal and Co.'s Middlesbrough store on the 10th inst. was 309,194 tons, which represents an increase of 1953 tons since December 31st.

The serious advance which has taken place in the price of forge iron has made matters worse than ever for the finished iron manufacturers. They have the greatest difficulty in obtaining orders at even 2s. 6d. per ton advance, whereas their cost of production must have risen 10s. per ton since July last.

Shipments from the Tees, since the commencement of the new year, have proceeded but slowly, the stormy weather being no doubt the principal obstacle. Only 10,904 tons of pig iron had left up to Monday night as against 21,795 tons during the first ten days of December.

The Cleveland ironmasters' statistics for December were issued on the 5th inst., they show that on the 31st ult. forty-nine furnaces were producing Cleveland, and thirty-six hematite and other kinds of pig iron; eighty-five furnaces in all were at work, as compared with ninety-eight at the end of 1885, and a total of 155 in existence. The make of iron of all kinds during December amounted to 193,293 tons, being an increase of 6600 tons over the output of the previous month. The total stock on December 31st was 652,445 tons, which represents a decrease of 15,327 tons since November 30th, but an increase of 134,957 tons over the stock held on the 31st of December, 1885. The output of Cleveland pig iron last year was less than in 1885 by 256,000 tons.

The Cleveland ironmasters had a meeting yesterday at Middlesbrough, with representatives of the blast furnacemen employed by them. The offer made at a previous meeting had meantime been considered by the workmen throughout the district, and their representatives came to the meeting authorised to accept it. The threatened strike is therefore happily now averted, and industrial peace as regards this department of the trade has been secured for some time to come. Under the arrangement now signed, sealed, and delivered the old scale is renewed, and in addition to any advantages the operatives may gain thereby from any rise in the value of pig iron, they are to receive back over the ensuing nine months the reductions made in excess of the scale prices during the last nine months. About twenty of the blast furnace works in the North of England will be affected by the arrangement, the duration of which is fixed at eighteen months, or till June 30th, 1888.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The pig iron market has again been active this week, with a large speculative business. There was some further advance in prices early in the week, and this was succeeded by somewhat heavy realising transactions, which arrested the advancing tendency. There has again been considerable excitement on 'Change, and it is understood that the outside public are speculating in warrants to a greater extent than has been usual for a long time. Some additional orders are reported on American account, but there is a feeling that probably too much is made of the extra business from the United States. The stocks in the warrant stores, which had remained stationary for several weeks, now exhibit a small increase. The amount of the production is practically without change.

Business was done in the warrant market on Monday at 45s. 11d. to 46s. 11½d., closing at 46s. 9d. On Tuesday forenoon transactions occurred at 46s. 10½d. to 46s. 6½d., the price falling to 46s. 4½d. cash in the afternoon, and closing that day with buyers at 46s. 7½d. cash. On Wednesday the market was very excited, and warrants advanced to 47s. 8d. per ton, coming back to 47s. 4d. at the close. To-day—Thursday—the market was not so strong, business being done down to 47s. 2d., closing with buyers at 47s. 6d. cash.

There has been a further advance in the quotations of makers' iron all round:—Gartsherrie, f.o.b. at Glasgow, No. 1, is quoted at 54s.; No. 3, 46s. 6d.; Coltness, 57s. 6d. and 46s. 6d.; Langloan, 54s. and 46s. 6d.; Summerlee, 56s. and 45s.; Calder, 52s. 6d. and 45s. 6d.; Carnbroe, 50s. and 45s.; Clyde, 48s. 6d. and 43s. 6d.; Monkland, 47s. 6d. and 43s. 6d.; Govan, at Broomielaw, 47s. 6d. and 43s. 6d.; Shotts, at Leith, 52s. and 46s.; Carron, at Grangemouth, 52s. 6d. and 44s. 6d.; Glengarnock, at Ardrossan, 52s. and 44s. 6d.; Eglinton, 47s. 6d. and 43s. 6d.; Dalmellington, 48s. 6d. and 44s. 6d.

The week's imports of Middlesbrough pigs at Grangemouth were 6270 tons, as compared with 5190 tons in the corresponding week of 1886.

There is continued activity in the importation of Spanish ore from Bilbao to the Clyde, and the freights are now at 6s. 3d. a ton.

The malleable iron makers of Lanarkshire have advanced the quotations of common bars by 5s. a ton, in consequence of the rise in the price of pig iron. Bars and angles now range from £5 2s. 6d. to £5 7s. 6d. Iron plates are now in very poor request, being practically superseded by steel for shipbuilding and engineering purposes, but ship plates are quoted nominally at £5 5s. and boiler plates at £5 10s. per ton. Several steel makers who lagged behind the others in the matter of price have now advanced their rates, and merchants all over quote £6 10s. for ship plates and £6 15s. for boiler ditto, less the usual 5 per cent. discount.

The past week's shipments of iron and steel goods from the Clyde embraced locomotives to the value of £12,000 for Calcutta; machinery, £4500; steel goods, £8000; sewing machines, £3000; and general iron manufactures, £32,000.

The coal shipping trade was necessarily much curtailed in the past week by the holidays, and the shipments are small, amounting in the aggregate to 38,325 as compared with 38,583 tons in the corresponding week of last year. At Glasgow 20,126 tons were shipped; Greenock, 100; Ayr, 1546; Irvine, 1060; Troon, 1456; Burntisland, 9078; Leigh, 145; Grangemouth, 2572; and Bo'ness, 2242 tons. There is practically no change in the prices of coals, though some qualities are more in request than others.

The colliers have made another formal application to the coalmasters for an advance of wages, urging their case chiefly on the ground of a report that coals had been raised 3d. a ton at Burntisland. But unfortunately it turns out that the change in price is the other way, coals having been reduced 3d. a ton at the Fifeshire port in consequence of the falling off in the continental shipping trade.

Ii is estimated that the tonnage now being built in the Clyde shipyards amounts to 114,755 tons compared with 151,455 tons at the beginning of 1886.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

New industries for Wales are coming to the front with the new year. Amongst them the Lodge Brickworks, capital £10,000, near Carmarthen; the Pontyberem Coal Company, capital £100,000; a Cardiff Pontoon Dock Company, capital £50,000; and several large building and other schemes in which Cardiff is principally interested.

Swansea is making a good bid for the Harbour of Refuge, and an influential firm, Messrs. Cory, Yeo, and Co., undertake to supply fuel gratis to steamers assisting. The contest for the Harbour is between Cornwall and Wales. It must be borne in mind that our principal gales are south-westerly, and this would favour the Welsh side. Something must be done. The Bristol Channel is the great highway for a large proportion of English commerce, and fifty vessels lost during the last storm is too high a percentage to be borne.

Wales was fully represented at the Miners' Conference this week in Birmingham, but I see that the principal agreement was to recommend an occasional holiday, so as to reduce the output. It was scarcely necessary to go to Birmingham to further such a step. If orders are in hand, both coalowners and colliers will only too willingly keep the pits going to complete the orders. The only holidays taken, and now much too numerous, are when there are no orders.

The week has been a trying one. Large collieries in the Mountain Ash district are not doing half work, and there are few collieries that may be said to be fully employed. I hear of notices being in preparation in some districts intimating cessation of contract; but in one special case of an important colliery stoppage is not intended—only an alteration of arrangements.

Welsh coalowners are engaged in various ways in fighting a hard battle so as to keep their pits going. In some cases concessions have been obtained from landlords of 3d. to 6d. per ton in the royalty. Now an effort is being made to get a reduction of the railway rate, which interferes considerably with our coal traffic to London. Returns show a great falling off in tonnage to London, and an increase in that from other districts where the railway rate is lower. Wales pays 0·45d. per ton, yet the cost to the railway is only about one farthing. It is contended that with a lower rate the colliery owners of South Wales would do a larger metropolitan trade, as their coal is in good favour, and this would pay railways better.

House coal is in good demand, and prices are firm. Steam coal prices remain unaltered, though occasionally, under exceptional cases, there is a move of 3d. upward. Small steam is certainly advancing, as the patent fuel trade begins to look up, and I shall not be surprised to see it firm again at 5s.

The time is favourable for putting in orders for rails, as the tendency is decidedly upwards. The bad prices in operation last autumn are not likely to be renewed, and figures may go up. The lowest point reached for steel rails was £3 5s., and from that to £3 15s., but there was only a little done. In fact, so scarce was work at one time, that ironmasters would sell small "parcels" of rails at the lowest quotation, for local use—a thing almost unheard of. I hope soon to chronicle £5 as the figure. The tone of trade is decidedly better, and when, as in the present case, Americans or their agents are buying up everything that looks like a rail, good times may be regarded as at hand.

In the neighbourhood of the works on the "hills," traffic has been a good deal impeded, and only absolutely necessary labour could be done. The tinplate work is brisk. The Margam workmen have accepted the terms offered. At Pontypool, men have held meetings, and so far refuse all concessions. Other works are stopped, but the steady run of business now doing by the going works is not without its effect upon the men, and I anticipate a general giving way to the offers made.

Men are beginning to see that closed works tell proportionately worse upon masters than men, and that owners would give way to any reasonable demand rather than close, if they could afford it. For all brands, excepting charcoal the demand is good and in some cases supply is too little. This is the case with coke wasters, which are well looked after. Bessemers, steel cokes, and Siemens' plates with coke finish, are the favourites in the market, and all at advancing prices.

Coke wasters are worth 12s. 9d. Ternes range from 13s. to 14s. 6d., according to kind. Bessemers run to 14s., Siemens' to 14s. 3d. Lower quotations are given for ordinary kinds, but all sorts are moving up. Swansea cleared 41,000 boxes last week.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The iron markets all round continue to exhibit the same buoyant tendency as last week, with firm prices, and a further advance in them is expected during the coming months. Still, in spite of this, complaints are rife that, even where prices of finished articles have risen, the rise is not yet sufficient to cover the cost of production. Nevertheless, there can be no doubt that the iron industry enters the present year with far better prospects than it did in the one just closed. Two points, however, must be insisted upon, which if not guarded against will bring round the same unsatisfactory condition of things which has reigned throughout the past year. The first is that the gradual and healthy rise now going on must not lead to forcing prices to an undue height—a tendency to which has already shown itself in the pig iron market of the Siegerland; the second is, to avoid an unnatural and absurd competition between the works themselves. The various combinations will help to counteract this; but, as has always been experienced, these conventions do very well for a time, but the end is generally a relapse into former ways, and then the same old evils occur. There is a third point, and that is over-production, of which fears are already entertained, for as soon as it is certain that prices have neared a point where there is a profit, fresh works will be set on or increased production of those at work will be sure to follow, and the old state of things will be repeated. If it could be insured that these points would be duly taken to heart there is every prospect of a sound, healthy trade being done in this country for some time to come. The demand for ores has increased, and prices have again risen, and in consequence mines which have long remained idle in the Sieg, Lahn, and Dell districts are to be restarted. The requirements for pig iron have so much increased that now demand and production are keeping pace with one another, and no stocks are accumulating. The prices are rising, and beyond the end of the quarter the smelters are not inclined to contract. Forge pig commands M. 45 in Rheinland-Westphalia, and M. 41 in the Siegerland. Luxemburg forge is noted 39 to 40f.; spiegeleisen, M. 45 to 49, and higher when more manganese is present; Foundry pig for the three numbers, 46 to 53 M. p.t In bar iron the brisk demand is maintained at M. 100, ground price, whilst hoops and angles fetch M. 110 to 115, and girders 100 to 105 p.t. Thin black sheets are still in great request at M. 135 to 140, whilst plates of all descriptions are neglected at M. 140 to 145 p.t. for first quality, and 135 to 140 for second quality. The plate convention advanced a step on the 4th inst. at Essen, and it has been agreed to fix the lowest ground price now at M. 140 p.t., with a prospective rise very shortly. Wire rods are in very brisk demand for export, especially to America, where the price has gradually risen to 38½ per ton. Also for home consumption the requirements are satisfactory, and prices have risen up to M. 15 p.t. The competition from abroad keeps the steel rail industry at a low ebb, and the last foreign tendering at Berlin, mentioned in last report, brought down the price of the Westphalian lowest offer, which was M. 118·80, to about M. 100 p.t. at the works, the English tender being M. 118·32 at Stettin. A reciprocity arrangement has been again entered into between German and Belgian steel works not to compete against one another in their respective countries. It is also stated that a similar arrangement with English houses is near conclusion. If this be so, it is to be hoped that it will extend to the Colonies, so as not to have a repetition of the last tendering at Melbourne. *Apropos*, it is stated in a Belgian journal that the price Krupp is to receive for the rails delivered at Melbourne is £4 18s. 9d. When the freight of 14s. 6d. and the insurance of 1s. 9d. are deducted, there would remain £4 2s. 6d. per ton at Essen. The wagon works have received a few new orders, and it is not quite so difficult as it was for the machine shops to find a little more work.

The coal trade is in its normal state, and prices are unaltered. It is evident that sales enough cannot be made for the great development of the mines which has gradually taken place, and as much more coal could be brought to bank if the demand for it could be found, it naturally has a depressing influence on this industry. After the Railway Administrations have made repeated reductions in the normal tariffs of freights to further the coal industry, they seem now to turn a deaf ear to all the coalowners' petitions for relief in that direction, so it leaves nothing for them to do but to seek the easement they require by reducing the miners' wages, if they are to exist at all. It appears that the experiments instituted some year or two ago to force an export trade in rivalry with England have not been very successful. A hulk, as a coal depôt, was established off St. Vincent as a trial, but the colliery owners who inaugurated it are now lamenting that the Hamburg shipowners prefer to take in English coals abroad instead of Westphalian. Indeed, this creating of a competition against the old and firmly established English foreign coal trade the mineowners have found out would cost a very large capital outlay, and a long time to accomplish, cheap as the Westphalian coals are selling at the mines. One would also think quality had something to do with the matter, but nothing is ever said here about this important factor in the problem.

The improvement in the Belgian iron market continues; more, however, for the benefit of the blast furnaces and steel than the ironworks and machine factories. Pig iron is noted at Athus at 39f. and at Charleroi at 40f. At a tendering on the 27th ult. in Italy for 27,000 tons of steel rails, Bolckow, Vaughan, and Co. and the Ebbw-Vale Company each received one lot, whilst Cockerill and Co. got the third. Other orders have also come to the works, as permanent and rolling stock for 2½ million francs for the Congo Railway, twenty locomotives for Panama, waterworks' materials for two millions for the Congo, and so forth.

The Turkish Government had entered into a contract with the Germania Company for the construction of two vessels, but at the eleventh hour the contract, for some reason not made public was cancelled. The remark to this announcement was that, "notwithstanding this, the order will still be secured to Germany through the influence of the Foreign-office." It would not be worth while mentioning the subject were it not to again show how foreign trade and commerce are bolstered up by diplomatic pressure and Government interference.

An authoritative examination proves that, of 300 million marks of capital laid out in the iron industry of this country, 200 millions paid no dividend at all last year, and 100 millions less than 4 p.c., which latter is too little, considering that the usual interest of the country is considerably above this.

NEW COMPANIES.

THE following companies have just been registered:—

Beck Gas Engine Company, Limited.

On the 3rd inst. this company was registered, with a capital of £50,000, in £10 shares, to acquire the letters patent, No. 7427, dated 2nd June, 1886, granted to Arthur Rollason for improvements in gas engines. The subscribers are:

	Shares.
*D. Ford Goddard, Ipswich, gas engineer	1
*C. Perkins, Kirkley, Newcastle, coalowner	1
*C. E. Hunter, Newcastle, coalowner	1
W. Black, South Shields, ironfounder	1
H. T. Morton, Tence House, coalowner	1
J. Spencer, Newcastle, steel manufacturer	1
Walter Scott, Newcastle, contractor	1

The number of directors is not to be less than five, nor more than seven; qualification, 200 shares. The first three subscribers and Messrs. W. H. Makins, William Bell, and T. A. Wheatley are the first directors.

Bristol Grain Washing Company, Limited.

This company was registered on the 3rd inst., with a capital of £20,000, in £10 shares, to warehouse, wash, store, and carry wheat, and other grain at Avonmouth Dock, Bristol, or elsewhere. The subscribers are:—

	Shares.
W. Morgan, Nott, Bristol, corn merchant	5
*J. L. Turner, Bristol, corn merchant	10
*T. Pole, Bristol, corn factor	10
*G. E. Blood, Bristol, corn broker	10
*H. Fedden, Bristol, foreign and colonial broker	10
S. Tryon, Bristol, public accountant	5
J. Inskip, Bristol, solicitor	5

The number of directors is not to exceed seven; qualification, 10 shares; the first are the subscribers denoted by an asterisk; remuneration, £150 per annum.

Claviger Cycle Company, Limited.

This company proposes to trade as makers of bicycles, tricycles, and other velocipedes, and as electricians, iron and brass founders, and engineers. It was registered on the 1st inst., with a capital of £15,000, in £10 shares. An agreement of 30th ult. provides for the purchase of the business carried on by William Golding and Henry Parker Jones, at the Britannia Works, Moss Side, Manchester, for 500 "B" shares credited as fully paid up. Mr. William Golding is appointed managing director for three years, at a salary of £300 per annum, and will be further entitled to one-twentieth of the annual net profits of the company in excess of 15 per cent. upon the paid-up capital. The subscribers are:—

	Shares.
*W. Golding, Britannia Works, Manchester, bicycle manufacturer	1
*H. P. Jones, Stretford, Manchester, solicitor	1
T. W. Gillibrand, 50, George-street, Manchester, chartered accountant	1
Norman Gillibrand, Bowdon, Cheshire, clerk	1
W. Toplis, Chorlton-on-Medlock, foreman mechanic	1
*E. C. Mills, 49, Victoria-buildings, Manchester, engineer	1
G. F. Armitage, Altrincham, artist	1

The number of directors is not to be less than three, nor more than seven; qualification, 10 shares, or £100 stock; the company in general meeting will determine remuneration.

Electric Battery Brush Company, Limited.

This company was registered on the 31st ult., with a capital of £50,000, in £5 shares, to purchase the British, American, German, Belgian, and French patent rights of Miss Mary McMullin for improved electric brushes and composition of the exciting fluids, and all other patent rights——except for the Colony of Victoria—applied for or to be applied for in respect of the said invention. The subscribers are:—

	Shares.
Thomas Leonard, 5, Muschamp-road, Peckham, clerk	1
J. Murphy, Wood-lane, Highgate, manufacturer	
H. Govey, 52, Overbury-street, Clapton Park, clerk	1
W. Herbert, 4, Staples-inn	1
J. Bury, Devereux-chambers, Temple	1
H. Hinds, F.E.I.S., 58, Mall-road, Hammersmith, certificated teacher	1
Frank Griffiths, 13, Colebrooke-terrace, N., clerk	1

Most of the articles of Table A apply to the company. The remuneration of the directors will be £1 1s. for each attendance at a board meeting.

John Kirkaldy, Limited.

On the 1st inst. this company was registered, with a capital of £50,000, in £10 shares, to acquire the freehold and leasehold premises at or near East and West India Dock-roads, and the engine works, Albert Docks, where the business of John Kirkaldy is carried on, and also certain freehold land and premises at Burnt Mill, Essex, with a factory comprising foundry, smiths' shop, and other buildings now being erected by Mr. John Kirkaldy; and to carry on the business of marine, electrical, and general engineers, ship repairers and builders, steam and other engine boiler and condenser makers. The subscribers are:—

	Shares.
*Wm. Mactaggart, 34, Leadenhall-street, merchant	1
Henry Parkinson, 13, Bolingbroke-road, Sinclair-road, W., accountant	1
*J Rogers Pascoe, Morway Wharf, Limehouse, Government contractor	1
*J. R. Anderson, 4, St. Mary Axe, shipowner	1
*J. Kirkaldy, 40, West India Dock-road, marine engineer	1
E. Seabury, 10, Tabernacle-avenue, Barking-road, engineer	1
E. Chapman, 34, Great St. Helen's, metal merchant	1

The number of directors is not to be less than two, nor more than seven; the first are the subscribers denoted by an asterisk; qualification, 20 shares; remuneration, £200 per annum, and 10 per cent. of the net profits beyond 7 per cent. on the paid-up capital divided as for dividends. Mr. John Kirkaldy is appointod managing director, and until the 1st of January, 1894, will be entitled to a salary of £600 per annum.

National Condensed Milk Company, Limited.

This company proposes to establish and carry on in the United Kingdom and elsewhere the business of condensed milk manufacturers and merchants. It was registered on the 4th inst., with a capital of £20,000, in £5 shares. The subscribers are:—

	Shares.
Henry Kupper, 11, Charles-street, Limerick	1
*J. W. Abrahams, Tower-chambers, Liverpool, steamship owner	1
Campbell A. Blair, Harrington-street, Liverpool, metal broker	1
*W. H. Watson, Waterloo, Liverpool	1
*N. Lewis, 7, Victoria-street, Liverpool	1
J. G. Blissett, Liverpool, gun-maker	1
D. Davidson, 19, Brunswick-street, Liverpool, india-rubber merchant	1

The number of directors is not to be less than three, nor more than five; qualification, £100 shares, or £500 stock; the first are the subscribers denoted by an asterisk; remuneration, £100 per annum to the chairman, and £50 per annum to each other director.

Sheppey Glue and Chemical Works, Limited.

This company proposes to take over the business of manufacturer of and dealer in glue, soap, tallow, bones, and chemical manures, and of manufacturing chemists, carried on by Wm. Carr Stevens, trading as Stevens and Son, at Queenborough, Isle of Sheppey. It was registered on the 1st inst., with a capital of £30,000, divided into 1500 A preference shares, and 1500 B shares, of £10 each. The subscribers are:—

	Shares.
*W. Carr Stevens, 3, Savage-gardens, E.C., merchant	1495 A 1450 B
*J. W. Stevens, Queenborough, Kent, chemical factory manager	50 B
H. J. Moore, 33, Mark-lane, secretary to a company	1 A
A. H. Eve, Stanford House, Harrow	1 A
A. H. Church, Minster, Sheppey, superintendent of chemical works	1 A
L. J. Jacob, Buckhurst Hill, Essex, accountant	1 A
R. Jehu, 33, Mark-lane, solicitor	1 A

The number of directors is not to be less than two, nor more than seven; qualification, 300 shares; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

Wallsend Pontoon Company, Limited.

This company was registered on the 31st ult., with a capital of £50,000, in £25 shares, to construct and establish at Cardiff an iron floating pontoon dock. The subscribers are:—

	Shares.
*C. Mitchell, Newcastle-on-Tyne, shipbuilder	1
*Hy. Nelson, Westal, shipowner	1
C. S. Glanville, Newcastle, shipowner	1
T. G. Dunford, Newcastle, shipowner	1
*E. Stout, Newcastle, manufacturer	1
*W. Boyd, Newcastle, engineer	1
G. Rutherford, Cardiff, engineer	1

The number of directors is not to be less than four, nor more than nine; the first are the subscribers denoted by an asterisk, and Mr. R. Donkin; qualification, 20 shares; the company in general meeting will determine remuneration.

PUDDLING FURNACES.—The puddling furnace, as an appliance for freeing pig iron of its impurities, and converting it into nearly pure metallic iron, has had a long and useful career. Now, however, it seems to be slowly dying out, steel-making appliances being those whose competition is gradually killing it. At the end of 1885 the total number of puddling furnaces at work in England, Wales, and Scotland was 4059. At the end of last year this number had been reduced to 3723, or about 7½ per cent. less. The number of puddling furnaces idle at the end of last year was 1942, or about half as many as those at work. In other words, one out of every three puddling furnaces in existence are now idle. Probably this does not fully represent the falling-off; for of those returned as at work, few are continuously employed, and all are probably laid idle a considerable number of shifts during each month. Furnaces and converters used in steel-making, being much less dependent on the humours of the men, work much more regularly; and that is one of the principal causes why the wrought iron is gradually giving place to the steel manufacture.

THE CANADIAN IRON TRADE.—The value of iron and steel and their manufactures imported into Canada for consumption there during the last sixteen years, is over two hundred and thirty million dollars. This is shown by the following figures—taken from tables in Bartlett's Canadian "Iron Trade"—in which the trade is divided into seven headings, the value of imports under each from 1868 to 1884 being as follows:—

	Dols.
Iron	75,179,153
Steel	9,938,614
Rails	48,068,618
Castings and forgings	9,703,717
Cutlery and edge tools	10,742,331
Hardware and Manufactures	47,926,637
Machinery and Engines	29,182,414
Total	230,741,484

The total value of the importations under these headings in 1868 was 6,885,365 dols. The figure increased at a tremendous rate until 1873, when the total was over twenty-five millions. It then steadily decreased down to less than eight millions in 1879, since when it has gone up rapidly again, in 1884 being close on fifteen millions. The total imports under the headings alone of iron, steel, and rails in 1884, weighed 273,967 tons, and the annual import since 1875 has averaged over 200,000 tons. It might be supposed that a very considerable proportion of this weight is due to rails for the Canadian Pacific Railway; but apart altogether from the Pacific rails, there have been on the average over 64,000 tons of rails imported each year for the past ten years.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

4th January, 1887.

82. RAILWAY CARRIAGE AXLES, A. M. Clark.—(*W. J. Murray, United States.*)
83. VENTILATOR for SHIPS, H. T. Johnson, Urmston.
84. DABBING-BRUSHES, J. Holmes and J. Robertshaw, Halifax.
85. VENT-PEG, G. W. Ellis, Halifax.
86. SAFETY GEAR for ENGINES, S. G. Dingsdale and T. W. Redford, Bolton.
87. POTTERY-WARE, W. H. Hales, Cobridge.
88. LOCK FURNITURE, B. R. Gypson, London.
89. OPENING and CLOSING SKYLIGHTS, H. Owens, Birmingham.
90. ADMINISTRATION of GASES, A. King and H. A. Pain, Liverpool.
91. FIRE GUARDS, J. A. Macmeikan, London.
92. SUPPORTING MATTRESSES, S. Wilson, Birmingham.
93. PILE-DRIVING ENGINES, J. Garvie, London.
94. DRIVING DIAMOND DRILLS, J. Thom, Glasgow.
95. MOUNTING of SCREW PROPELLER SHAFT, J. Monteith, Glasgow.
96. HORSE-SHOE, W. Hanton, Glasgow.
97. DELIVERING ARTICLES, A. J. W. Johnson, London.
98. PIPES, J. Fex and V. Pardoux, London.
99. TRIANGULAR PACKING, S. and C. Lamont, Glasgow.
100. LOADING of AMMUNITION, R. Paulson, Nottingham.
101. HAT GUARDS, C. H. Eden, London.
102. BOILER PLATES, &c., R. Lord, London,
103. PERAMBULATORS, E. W. Cooper, Birmingham.
104. VALVES, R. W. Traylor, Richmond, U.S.
105. CONVERTERS, C. Parker.—(*H. L. Gantt, United States.*)
106. REVERSING BELT GEAR, A. H. Reed.—(*H. E. Smith, United States.*)
107. PAPER FASTENERS, A. H. Reed.—(*F. C. Hamilton, and W. G. Lilley, United States.*)
108. SAFETY HOOKS, J. A. Hallett.—(*H. B. Rooper, Bermuda.*)
109. DUPLEX PUMPS, J. H. Street, Middlesex.
110. BRAKE for PERAMBULATORS, G. H. C. Hughes, Middlesex.
111. ELECTROLYTE for VOLTAIC BATTERY, W. C. Quinby, London
112. BOOTS, C. Wright, London.
113. ROCKING CHAIRS, G. F. Hall, London.
114. DYNAMO-ELECTRIC MACHINE, W. A. Leipnir, London.
115. PORTABLE HOUSES, W. P. Thompson.—(*W. A. Ducker, United States.*)
116. FASTENING RUBBER TIRES to WHEELS, A. J. Boult.—(*J. A. Turner, United States.*)
117. VECTOR TIPS, A. R. Foote, London.
118. STAMP CANCELLERS, D. J. Harding, London.
119. INHALERS, A. R. Foote, London.
120. DECORATING of EARTHENWARE, W. H. Turner, Middlesex.
121. BOTTLE STOPPERS, A. J. Boult.—(*C. de Quillfeldt, United States.*)
122. EXTRACT of COFFEE, H. F. von Konitz and J. Zuntz, London.
123. DIRECT-ACTING ENGINES, P. A. Newton.—(*H. C. Sergeant, United States.*)
124. WIRE DOOR, &c., MATS, H. E. Newton.—(*J. Tye, Canada.*)
125. EXPLOSIVE GAS ENGINES, A. C. and J. Sterry, London.
126. PRODUCTION of COLOURING MATTER from CARBOLIC ACID, &c., H. J. Walder, London.
127. PRODUCING COLOURING MATTER from ANTHRAQUINONE, H. J. Walder, London.
128. NUT MACHINES, F. Lachner, London.
129. BLASTING COAL, &c., L. Plom and J. d'Andrimont, London.
130. RECEIVING VOCAL, &c., SOUNDS, R. Wreden, London.
131. EGG OPENER, H. H. Lake.—(*W. R. Hartigan, United States.*)
132. BUTTONS, W. Fraser, London.
133. COIN, &c., OPERATED LOCKING MECHANISM, W. Peake, London.
134. COMPOSITION, P. Greyson and A. Verly, London.

5th January, 1887.

135. MATTRESSES, E. J. Bates, Liverpool.
136. TRICYCLES, G. Hughes, Staffordshire.
137. CASED or COVERED TUBES, W. Allman, Birmingham.
138. TILES from CLAY, W. H. Blessley, Middlesbrough.
139. ADVERTISING, J. Townend, Sydenham.
140. UMBRELLA CLOTHS, W. Heron and E. A. Moon, Bradford.
141. MOUNTING of WHEELS and AXLES to VEHICLES, J. Sanders, Longton.
142. EXTINGUISHER for HYDROCARBON and other OIL LAMPS, F. R. Baker, Birmingham.
143. BOX IRON HEATERS, J. Ainsworth, Halifax.
144. LUBRICATING COMB MOTIONS for CARDING ENGINES, G. and E. Ashworth, Manchester.
145. SELF-EXTINGUISHABLE LAMP, G. T. Budd, Plymouth.
146. TAKING SOUNDINGS at SEA, &c., C. Weekes, Penarth.
147. SUPPORTING the SEATS of BICYCLES, &c., G. Illston, London.
148. MEASURING and REGULATING ELECTRIC CURRENTS, E. Desroziers, London.
149. SELF-FEEDING EYELETTING MACHINES, M. H. Pearson and C. Bennion, London.
150. WAGONS or LORRIES for SIDE TIPPING, H. Bracewell and J. E. Sawyer, London.
151. POINTS or CROSSINGS of TRAMWAYS, A. Dickinson, Birmingham.
152. LOCKS for LIDS of BASKETS, &c., T. Harden, London.
153. WATERPROOF BONNETS and HATS, A. C. Henderson.—(*C. J. Picard, Paris.*)
154. SAFETY OPENER for BOTTLES, C. H. Barker and H. Fennell, London.
155. EXTINGUISHING FIRE, E. Howarth and W. J. T. Goatley, London.
156. UTILISING WOOD for PAVING, F. B. Wade, London.
157. MITRE JOINTS for CORNICE POLES for BAY WINDOWS, C. W. Rees, London.
158. FILES for LETTERS, &c., S. Maier.—(*F. Soenneeken's Verlag, Germany.*)
159. SAFES or STRONG BOXES, E. Petit, London.
160. VELOCIPEDES, J. Asbury and J. White, London.
161. CAPS or STOPPERS for CLOSING BOTTLES, J. Deeks and T. E. Harper, South Weald.
162. RING SPINNING MACHINES, F. Fried, London.
163. AUTOMATIC CUT-OFF for GAS and other FLUIDS, E. C. Herbert, London.
164. GRAPE TRELLISES, W. Norris, London.
165. EXTRACTING FOREIGN SUBSTANCES from SUGAR SOLUTIONS by means of LEAD, C. D. Abel.—(*Messrs. Pfeifer and Langen, Germany.*)
166. TWISTING COTTON, &c., P. Hebbelynck, London.
167. HEELS, J. Walinne and J. B. Desirant, London.
168. ELECTRIC REGULATION, C. L. R. E. Menges, London.

6th January, 1887.

169. STEADYING MARINE STEERING WHEELS, T. G. Stevens, Dartford.
170. MEASURING, &c., the HEIGHTS of PERSONS, A. M., E. K., and J. D. Coates, Sheffield.
171. DYNAMO, &c., MACHINES, H. C. Gover, London.
172. CIRCULAR KNITTING MACHINES, J. H. Cooper and W. J. Ford, Leicester.
173. GUARDS, G. Clegg, J. Thomas, and W. H. Harrison, Halifax.
174. WASHING, &c., WOVEN FABRICS, W. Birch, Manchester.
175. ROLLERS, &c., E. Platt, Manchester.
176. VENTILATING APARTMENTS, T. S. Wilson and H. T. Johnson, Manchester.
177. EXTINGUISHER, W. Sandbrook, London.
178. DEVICE APPLICABLE to BRUSHES, T. Murgatroyd and J. Turner, Yorkshire.
179. ADJUSTABLE NECK BEARING, W. Burrell and R. Carver, Manchester.
180. GOVERNING the SUPPLY of STEAM to STEAM ENGINES, J. S. Pullan, H. Tuke, and R. Lancaster, London.
181. AUTOMATICALLY OPERATING BAR, T. Murgatroyd and J. Turner, Skipton-in-Craven.
182. OIL PRESS WRAPPERS or ENVELOPES, W. K. Marsden, Halifax.
183. ICE GRIPPER or CREEPER, H. James, Sheffield.
184. SPRINGS, J. Wroe, Manchester.
185. LUBRICATING CANS, J. A. Harrison, Birmingham.
186. COUPLINGS for TAPS, &c., T. Dipple, Birmingham
187. DYNAMO-ELECTRIC MACHINES, G. Hookham, Birmingham.
188. FIRE TELEGRAPHS, W. E. Heys.—(*J. W. Frost, U.S.*)
189. RAISING, &c., VENETIAN BLINDS, J. S. Orton, Birmingham.
190. OIL or SPIRIT LAMP, W. Thompson, Buckingham.
191. COMPENSATING the EXPANSION and CONTRACTION of WIRES, M. Elliott, Mallow.
192. PREVENTING OVERSTRAINING of SHIPS' CABLES, J. J. Morrison, Birmingham.
193. BREAKING, &c., FLAX, &c., J. O. Wallace, Liverpool.
194. BILLIARD TABLE, T. Sanderson, Liverpool.
195. DRAW-BARS or COUPLINGS for RAILWAY ROLLING STOCK, T. D. Swift, Liverpool.
196. STEAM BOILER FURNACE, E., E., and A. W. Bennis, Liverpool.
197. PACKING NAVY CUT TOBACCO in PACKETS, J. Player, London.
198. DEODORISING and DISINFECTANT OIL, M. Mackay, London.
199. ROTARY MUSIC STAND, P. Mansfield, London.
200. EXTRACTING FERRULES, &c., A. S. Williams, London.
201. FIRE-LIGHTERS, J. F. Wiles, Kent.
202. TOAST STANDS and STOOLS for FIRESIDE PURPOSES, R. Rowbotham, London.
203. TIPS or FERRULES of UMBRELLAS, &c., J. H. Brownson, London.
204. ENABLING FIREMEN, &c., to BREATHE FREELY in PLACES FILLED with SMOKE, F. Bosshardt.—(*J. Rudolfy, Hungary.*)
205. ELECTRICAL COMMUNICATING APPARATUS, W. Chadburn, Liverpool.
206. HANDLES for BAGS, F. and L. Marx, London.
207. ARRANGING AERATED WATER and BEER BOTTLING FACTORIES, J. McEwen, London.
208. EVAPORATING and CONDENSING APPARATUS, W. F. Pamphlett, London.
209. PREPARATION of DISTEMPER, R. J. Worrall, London.
210. VELOCIPEDES, C. K. Welch and F. B. Bale, London.
211. TELEPHONIC APPARATUS, The Stanhope Company and G. L. Anders, London.
212. LAMPS for BURNING HYDROCARBON OILS, F. Grant, London.
213. TUBULAR RECEIVERS or PIPES, J. Aird, London.
214. TWO-WHEELED VEHICLES for COMMON ROADS, J. N. Davies, London.
215. WOOD SCREWS, H. D. and A. B. Cunningham, London.
216. COMBINING an ELECTRIC LAMP with a TABLE, R. E. Henry, London.
217. LEAVES of MUSIC, J. Dowling, London.
218. STOPPER and BOTTLE for BEERS, &c., H. Hunt, London.
219. DUMB WAITER or OCCASIONAL TABLE, H. E. and E. J. Emanuel, London.
220. LIQUID METERS, S. A. de Normanville, London.
221. MEASURING the PIVOTS, &c., of WATCHES, L. E. Junod, London.
222. INTERLOCKING GEAR for the LEVERS of HYDRAULIC WORKING VALVES for GUN MOUNTINGS, A. Noble, London.
223. FREEZING and REFRIGERATING MACHINES, H. A Fleuss, London.
224. RAILWAY CHAIRS, W. H. Lindsay, London.
225. ELECTRO-DYNAMOMETERS, S. Pitt.—(*J. Cauderay, France.*)
17,067. OPENING BOTTLES, A. C. Farrington, Spa.

* NOTE.—This application having been originally included in number 15,016, dated 19th November, 1886, takes, under Patents Rule 23, that date.

January 7th, 1887.

226. BOXES, T. Archer, Gateshead-on-Tyne.
227. LACE and TAG, T. R. Weston, London.
228. PROJECTILES, G. Siddell, Sheffield.
229. BEEHIVE, S. Simmins, Rottingdean.
230. INCANDESCENT BURNER, J. I. Ryder, Derbyshire.
231. FURNACE BAR, G. M. Page.—(*D. Morgan, South America.*)
232. WORING KNITTING MACHINES, J. Smith, Lancashire.
233. MILL for GRINDING COLOUR, M. Garfitt, Oldham.
234. NON-REVERSIBLE HOODS, R. Nichols, Manchester.
235. LAYING of WOOD BLOCK FLOORS, S. Shields, London.
236. FLEXIBLE METAL HANDLE CRICKET BAT, A. E. Brown, Isle of Wight.
237. DEVICES for ILLUMINATIONS in OILS, &c., E. Dipple, London.
238. LISTING EDGES of WOOL, T. Barron, S. Barron, and J. Chambers, Birstall.
239. PAPER FOLDING MACHINES, R. Cundall, Halifax.
240. UNLOCKING a LATCH, A. Pickard, W. Pickard, W. Hallam, and J. Scott, Leeds.
241. FILLING BOTTLES with LIQUIDS, S. Bunting, Dublin.
242. ATTACHING and DETACHING CRAB of CARRIAGE POLES, H. Wyman-Jeffryes, Halifax.
243. KNOT DETECTOR, G. Stibbe, Glasgow.
244. PRINTING MACHINERY, S. Wood, Lancashire.
245. ATTACHING BUTTONS to CLOTH, C. F. Nokes, Birmingham.
246. FOOD, W. Olsson.—(*G. Bergman, Sweden.*)
247. LAMPS, R. Riley, Lancashire.
248. FUEL, A. Chadwick, Manchester.
249. COUPLING, R. W. Rundle and T. Allen, London.
250. PACKING, C. McLaren, Manchester.
251. LAMPS, H. Davis and A. Davis, London.
252. WEAVING, E. N. Molesworth-Hepworth, Manchester.
253. STEERING, J. Gravell, Newcastle-on-Tyne.
254. COMMUNICATING APPARATUS, W. Chadburn, Liverpool.
255. BOW RUDDER, G. T. Haigh and J. Green, Liverpool.
256. PASTE, W. Powell and E. Powell, Liverpool.
257. LININGS for HATS, D. W. Wall, London.
258. PIPES, &c., W. L. Cooper.—(*A. Howatson, Belgium.*)
259. OBTAINING STAMPS, D. W. Curphey, Lee.
260. REDUCTION of ORE, J. Nicholas and H. H. Fanshawe, London.
261. BOATS, W. Taylor, London.
262. PREVENTING BOATS from OVERTURNING, &c., T. Nugent, Walthamstow.
263. SURGICAL BANDAGES or SUSPENDERS, W. T. and A. H. W. Brown, London.
264. PRINTING BLOCKS or TYPES, H. J. Haddan.—(*E. D. Laraway and E. Bridge, United States.*)
265. DISTILLING, P. C. Vivien and A. Lainé, London.
266. ELECTRIC TELEGRAPHS, E. Edwards.—(*D. Kunhardt, Germany.*)
267. WARMING, &c., of DWELLING HOUSES, J. H. Gamble, London.
268. DRAIN TRAPS, —. Cabuy and E. Lamel, London.
269. MEDICINE CHEST, T. J. Hutton, London.
270. REGENERATIVE GAS LAMPS, S. Chandler, sen., S Chandler, jun., and J. Chandler, London.

271. REGULATING, &c., the BURNING of CANDLES, W. W. Martin, London.
272. FUSEES, &c., H. E. Harris, London.
273. CLAW CLAMPS for UNITING, &c., CORNERS of BOXES, &c., J. Scherbel and T. Remus, London.
274. COPPER and other TUBES, T. B. Sharp, Smethwick.
275. EFFECTING the DISTRIBUTION of CURRENTS of ELECTRICITY, R. E. B. Crompton and J. H. F. Soll, London.
276. SOLUTIONS for SANITARY REAGENTS, C. T. Kingzett, London.
277. ILLUSION APPARATUS, G. W. Cramp, London.
278. PURIFICATION of SEWAGE, J. Wohanka and K. Kocian, London.
279. JOURNAL, &c., BEARINGS, H. H. Lake.—(*M. Randolph, United States.*)
280. HANSOM CABS, J. C. Robinson, London.

8th January, 1887.

281. GRAIN, &c., DRYING MACHINE, J. Black and R. Hamilton, Dumfries.
282. ORNAMENTATION of ASHPANS, &c., J. T. Johnson, Manchester,
283. PIERCING the TIPS of CIGARS, E. F. Openshaw, Manchester.
284. CARBURETTING APPARATUS, J. and J. Parkes, Birmingham.
285. OBTAINING SILVER from ORES, &c., B. Hunt.—(*G. Thomas, United States.*)
286. AUTOMATIC BLIND MOUNTINGS, J. Brownrigg, Windermere.
287. SLATE MILLING, &c., W. Lewis, Tanygrisian.
288. DOUBLE ARCHED SOUNDING BOARDS, P. H. Zeidler, London.
289. POUCH, G. F. Lewin, Springfield.
290. METALLIC SLEEPERS, W. Little, Glasgow.
291. AUTOMATICALLY SHARPENING SAWS, E. Phillips, Birmingham.
292. MEASURING &c., GRAIN, &c., W. J. Radford, Liverpool.
293. COLLAPSIBLE SUSPENDED FRAMEWORK, H. Barret-Lennard and D. J. Caddy, London.
294. CONDIMENT HOLDERS, D. L. Brain, Ryde.
295. DOUBLE-JOINTED HINGES, T. H. Lee, Skipton-in-Craven.
296. COMBINED LATCH and BOLT, H. Francis and A. E. Carey, Liverpool.
297. ROTARY ENGINES, A. F. G. Brown, Glasgow.
298. FORGING ARTICLES, &c., T. Allen, Reading.
299. HOLDING SHEETS of MUSIC, &c., J. F. Crowton, Birmingham.
300. JACQUARD CARD PUNCHING MACHINES, E. Daveniere and J. R. Hancock, London.
301. SEWING MACHINES, W. Leffler, London.
302. PILE DRIVING APPARATUS, J. Garvie, London.
303. SEWING MACHINES, J. M. O'Kelly and H. S. Russell, London.
304. TREATMENT of REFRACTORY ORES, O. Zadig and E. Feldtmann, London.
305. SECONDARY ELECTRICAL BATTERIES, O. Zadig and E. Feldtmann, London.
306. FIRE-ESCAPES, &c., G. Bray, London.
307. AUTOMATIC DISTRIBUTING APPARATUS, J. Allard, London.
308. DOBBY MACHINE for POWER LOOMS, R. Livingstone and J. Skinner, Glasgow.
309. SLIDE VALVE ARRANGEMENTS for STEAM ENGINES, H. Skinner, Gravesend.
310. COMPOUND LOCOMOTIVE ENGINES, R. H. Lapage, London.
311. PRESSING LAND for PLOUGH WHEELS, R. H. Williams, Liskeard.
312. CUTTING the TEETH of FILES, H. Theaker, Sheffield.
313. SETTLING and PLANKING FELT HAT BODIES, J. and O. Oldham, London.
314. BAKERS' TROUGHS, P. Pfleiderer, London.
315. IRON CEMENT, G. G. M. Hardingham.—(*P. J. Grouvelle, France.*)
316. AIR SHIPS, H. J. Haddan.—(*A. de Baussett, United States.*)
317. INSIDE WINDOW BLINDS, J. Auld, Burlington, U.S.
318. CYLINDER PRINTING MACHINES, A. Parrizy, Paris.
319. CHIN RESTS for VIOLINS, R. Moore, London.
320. OVERALL or INVALID BOOT or SHOE, E. M. Bull, London.
321. BOXES from CARDBOARD, W. P. Thompson.—(*J. Geiger, Germany.*)
322. MACHINES for the CONSTRUCTION of BOXES from CARDBOARD, W. P. Thompson.—(*J. Geiger, Germany.*)
323. FASTENING NEWSPAPERS, &c., on to HOLDERS, A. J. Boult.—(*F. Mueller, Germany.*)
324. SUPPORTING TOILET GLASSES, &c., S. Jacobs and J. A. Jacobs, London.
325. ADJUSTMENT of SAW-BLADES in SAWMILLS, A. J. Boult.—(*W. Geissler, Germany.*)
326. LAMPS, H. D. Cunningham, London.
327. GAS ENGINES, A. Ashby, London.
328. MALT KILNS, B. J. B. Mills.—(*C. Brada, United States.*)
329. SULPHO-PHOSPHATES of AMMONIA and POTASSIUM, O. von Gruber, London.
330. CONTROLLING TORPEDOES, E. Donn, London.
331. STEEL PROJECTILES, J. Vavasseur, London.

10th January, 1887.

332. DENTAL SPITTOONS, W. Dall, Glasgow.
333. HANDLES, J. Shelvoke and G. Shelvoke, Birmingham.
334. LIDS for METALLIC DRUMS or CASKS, J. Simpson, Liverpool.
335. BICYCLES, &c., C. Neesom, J. Neesom, and H. James, Bradford.
336. EXPANSION ROLLERS or DRUMS, J. Holt, London.
337. SELF-RIGHTING PROPERTIES of the LIFEBOAT, R. Harburn and G. Hudson, Sunderland.
338. KEEPING MATCHES ALIGHT in ROUGH WEATHER, A. P. Hodgson, London.
339. SPINNING JUTE, &c., A. McCulloch, A. Carrie, and D. Ogilvie, Dundee.
340. WATERPROOF CAPES, T. Hutchinson, London.
341. FEEDERS of OIL CANS, &c., J. M. Timmis, Birmingham.
342. LOCK-UP LIQUOR FRAMES, &c., H. Clive, Birmingham.
343. SAUCEPAN LIDS, J. Brookes and T. Rosethorn, Longsight.
344. DISTRIBUTING SALT on TRAMWAY RAILS, &c., I. F. Cuttler and R. Bury, jun., Bradford.
345. BAND BRAKE, J. Sanders, Longton.
346. DISPENSING with the CHECK STRAPS of LOOMS, J. Marshall, Halifax.
347. DOBBIES for LOOMS, W. Hoyle and G. Burbery, Manchester.
348. COMBINED HYDRAULIC PLATE, &c., MACHINE, J. W. T. Stephens, Cardiff.
349. MEDICATED CONFECTIONERY, F. W. Warrick, London.
350. RAILWAY FISH-PLATES, S. W. Smith, Coventry.
351. VERTICAL STEAM GENERATORS, W. Garner, Liverpool.
352. CLOTHES PEGS, G. Myers, Keighley.
353. CUTLERY, &c., C. H. Wood, Sheffield.
354. GLASS BOTTLES, &c., D. Rylands and B. Stoner, Barnsley.
355. HEAT ENGINE, J. Tennent, Grangemouth.
356. PICKING ARMS for LOOMS, G. Malcolm, jun., and A. Johnston, Glasgow.
357. HANGERS, &c., J. Gregson, London.
358. NEW SHAPE for SHIPS, W. R. Bigsby-Chamberlain, Eastbourne.
359. PROPELLING SHIPS, W. R. Bigsby-Chamberlain, Eastbourne.
360. LUBRICANT, A. G. Wass, London.
361. SAFETY VALVE for DOMESTIC BOILERS, S. J. White, London.
362. COATED PILLS, &c., W. L. Howie, Eccles.
363. WASHING APPARATUS, F. W. Minck, London.
364. TAPS for CONTROLLING the SUPPLY of GAS, G. W. Younger, London.
365. PLATE RACK, W. Ham, London.
366. VENTILATING ROOMS, T. Sterné, London.
367. PREVENTING PARTICLES of TEA or COFFEE PASSING through the SPOUT of TEA or COFFEE POTS, W. H. Stockham, Lee.
368. BICYCLES, G. J. Chapman, London.
369. PRINTING FRAMES, J. Y. Johnson.—(*J. C. A. Hermite, France.*)
370. STEAM GENERATORS, W. S. Hide, London.
371. REGULATING the PRESSURE in GUNS, H. E. Newton.—(*A. Nobel, France.*)
372. TELESCOPIC AXLES for TRICYCLES, H. Jelley, London.
373. TREATING FINNER WHALEBONE, &c., E. Rosenwald and E. Rosenwald, London.
374. FINISHING the BLADES of SCREW PROPELLERS, R. P. Doxford, London.
375. SASH-FASTENER SECURERS, E. Sayers, Worthing.
376. FOUNTAIN or RESERVOIR PEN, T. Lockett, London.
377. RAILWAY SIGNALLING APPARATUS, H. J. Pryce, London.
378. COUPLING APPARATUS for RAILWAY CARRIAGES, &c., F. H. Cheesewright, London.
379. EMBROIDERING ATTACHMENTS for SEWING MACHINES, V. Rost, London.
380. BRACES, &c., B. May, London.
381. DISINFECTANT, J. C. Stevenson and J. G. Tatters, London.
382. REDUCING METALLIC OXIDES, T. C. Sanderson, London.
383. POLISHING IVORY, &c., A. de Pont, London.
384. TICKET PERFORATING and REGISTERING APPARATUS, H. Pottin, London.
385. CLEARING AWAY SNOW, J. W. Martin, London.
386. FORMING SLIVERS of JUTE, &c., H. H. Lake.—(*H. P. Garland, United States.*)
387. HAND BAGS, &c., B. May, London.
388. AUTOMATIC BOLT, A. Beauvais, jun., London.
389. NECKTIES, &c., B. May, London.
390. COMPOSITION for POLISHING COPPER, &c., H. H. Lake.—(*P. Lagourgue, France.*)
391. IGNITING FUSES, W. Bickford-Smith and G. J. Smith, London.
392. STOPPERS for BOTTLES, J. C. Cushion and G. F. W. Powell, London.
393. IGNITING FUSES, W. Bickford-Smith and G. J. Smith, London.
394. POLISHING METAL OBJECTS, C. Möllmann, London.
395. INDUCTION COILS or TRANSFORMERS, C. Zipernowski, M. Deri, and O. T. Blathy, London.

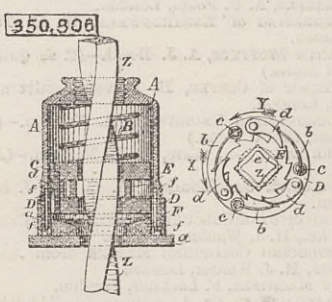
SELECTED AMERICAN PATENTS.

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

350,806. EXTENSION GAS CHANDELIER, *Bartholomew Churchill, New York, N.Y.—Filed October 16th*, 1885.

Claim.—(1) The combination, with an extension gas chandelier, of the ratchet case constructed with discs C D, ratchet wheel *e*, pawls *d d d*, posts *c c c*, springs *b b b*, sliding rod Z, substantially as herein described, and for the purposes set forth. (2) The combination, with an extension gas chandelier, of the ratchet case constructed with discs C D, ratchet wheel *e*, pawls

350,806

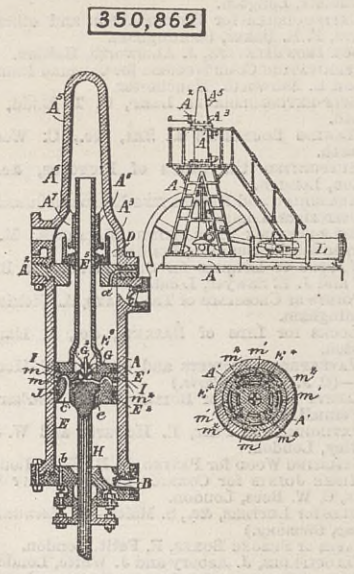


d d d, posts *c c c*, springs *b b b*, sliding rod Z, the friction box *a*, having grooves f^1, and the washer F, provided with projections or lugs *f*, registering with and sliding in said grooves, the whole operating in the manner and for the purpose herein shown and described.

350,862. GAS COMPRESSOR, *William Bowers, New York, —Filed November 20th*, 1885.

Claim.—(1) In a double-acting gas compressor having an upright cylinder, A^1, and a piston, E, having two packings I and J, and an annular oil reservoir, *m*, between them, the passages e^1 m^1, arranged as shown, so as to take in oil from the reservoir below at each descent of the piston, and thereby supply the reservoir *m*, as herein specified. (2) In such gas compressor, the piston E, having the pages e^1 m^1 m^2, arranged as shown relatively to each other and to the annular reservoir *m* and discharge chamber *e*, so as to afford a clear space for the escape of gas through the passage m^2, while the

350,862

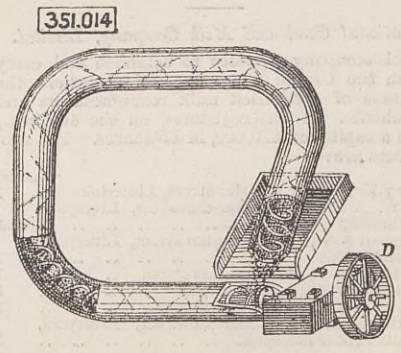


oil is received through the passages e^1 m^1, all substantially as and for the purposes herein specified. (3) The double-acting gas compressor described, having a piston E, with the chamber *e*, as shown, in combination with the cylinder A^1, and with the piston-rod H and its head H^1, allowed to move to a limited extent in said chamber, and with the tubular extension E^5 and valves D and G, arranged for joint operation as herein specified.

351,014. CONVEYOR, *Aaron Wissler, Brunersville, Pa. —Filed January 11th*, 1886.

Claim.—(1) As an improved article of manufacture for transportation of materials adapted thereto, a continuous bar or wire coil of suitable metal, constructed with a differential pitch at curves in its inclosing case, and with a uniform pitch of coil at all other points intermediate thereto, in combination with a short driving shaft having pulley D, and a collar E, to which one end of the coil is secured, substantially as and for the purpose set forth. (2) As an improved article of manufacture for transportation of materials adapted thereto, a coil of suitable metal of a differential pitch at respective points, and of a uniform pitch between the same, in combination with a case adapted to receive the same, carried from the receptive to the discharge point in an unbroken straight or curved

351,014

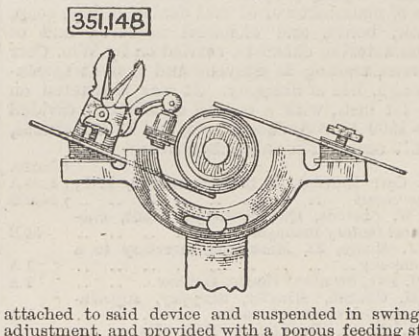


course, or combination of the same, whereby the articles transported may be delivered at right angles with the line of departure or returned to the same point with but one driving shaft and single connection with the motor, substantially as and for the purpose set forth.

351,148. LUBRICATORS for COMMUTATORS, *Thomas E. Adams, Cleveland, Ohio.—Filed June 22nd*, 1886

Claim.—The combination, with a brush supporting device of a dynamo-electric machine, of a lubricator

351,148

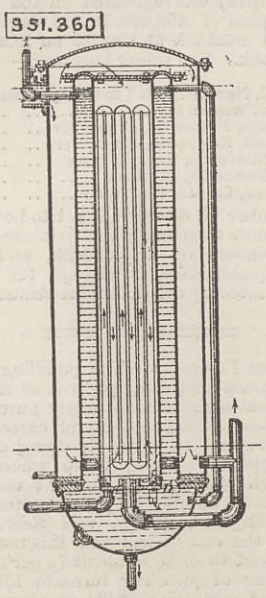


attached to said device and suspended in swinging adjustment, and provided with a porous feeding strip or block rigidly secured to the lubricator and adapted to feed the lubricant to the commutator, substantially as set forth.

351,360. WATER-FEED HEATER, *Edward G. T. Colles, Chicago, Ill.—Filed June 16th*, 1886.

Claim.—The annular water chamber connected to the mud drum by an annular opening at its base and by a circulating pipe with bottom and top. In a feed-water heater, the annular water chamber connected to the mud drum by annular opening D^1, the heating coil, and feed-water pipe, arranged substantially as shown, in combination with the outlet pipe L, passing through

351,360

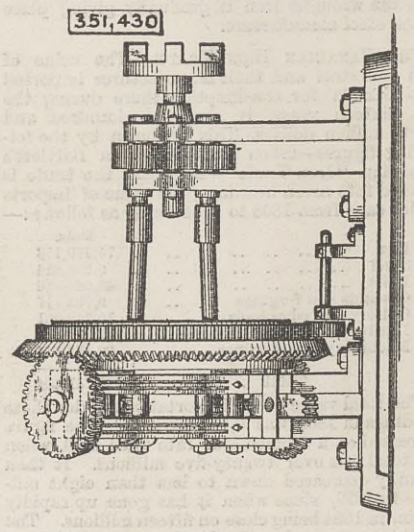


the steam-inlet pipe M, as and for the purpose herein specified. The combination, in a heater having an annular water chamber surrounded substantially by steam, of the mud drum connected to said chamber by annular opening D^1, and a circulating pipe arranged to create a circulation of water and to remove the surface scum, as herein specified.

351,430. MACHINE for ROLLING CAR WHEELS, *Hervey W. Fowler, Chicago, Ill.—Filed October 16th*, 1885.

Claim.—(1) In a machine for rolling the treads of car wheels, the combination, substantially as hereinbefore described, of a set of circularly-arranged, positively-driven, and radially-adjustable rolls, each having

351,430

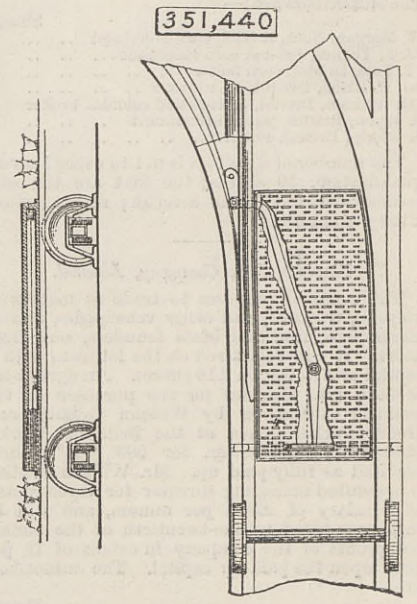


flanges or collars for laterally embracing the rim of a car wheel, and a rolling face corresponding in contour with the flange and tread of a car wheel, and screws for moving all of said rolls toward and from a common centre. (2) The combination, substantially as hereinbefore described, of a set of circularly-arranged and positive-driven rolls, each having a rolling face corresponding in contour with the flange and tread of a car wheel, and adjusting screws, the gears on said screws, and the one controlling gear meshing with all of the screw gears. (3) The combination, substantially as hereinbefore described, of a set of oppositely-located, circularly-arranged, positively-driven, and radially adjustable rolls, each having a rolling face corresponding in contour with the flange and tread of a car wheel, and a central guiding spindle, whereby a car wheel blank is centrally located while its rim is being operated upon and said blank revolved by said rolls. (4) The combination, substantially as hereinbefore described, of a set of positively-driven, circularly-arranged, and radially-adjustable rolls, each having a rolling face corresponding in contour with the flange and tread of a car-wheel, and a detachable clamp for laterally supporting the web and internally supporting the rim of a car wheel while its tread is engaged by said rolls. (5) In a machine for rolling car wheels, the combination of a set of rolls positively-driven, circularly-arranged, radially-adjustable, and each having a rolling face corresponding to the tread and flange of a car wheel, and flanges or collars for embracing the side edges of a car wheel, substantially as described, and a housing for said rolls, which is open centrally for enabling a wheel blank or car wheel to be inserted or removed in a sidewise position.

351,440. AUTOMATIC SWITCH for STREET RAILWAYS, *John Hope, jun., Providence, R.I.—Filed March 25th*, 1886.

Claim.—(1) The combination, substantially as described, with a pivotted switch tongue, of a slide having a boss or projection arranged transversely in the line of that rail to which the switch tongue is pivotted, and adapted to be moved outwardly from said rail by the flange of that wheel of a car approaching the switch which is nearest said switch tongue, and a lever connected with the switch tongue and adapted to be operated by the slide, for the purpose

351,440

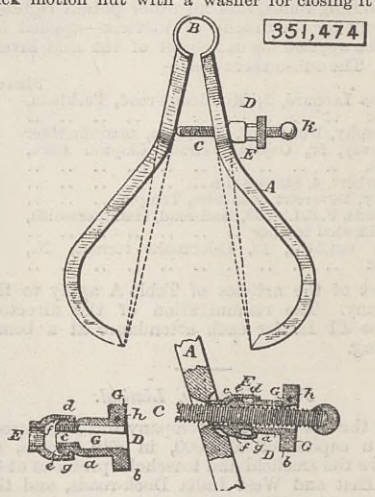


set forth. (2) The combination, substantially as described, with a pivotted switch tongue located at the junction of a main and a side track, as specified, of a slide bar arranged across the main track and having a projection or boss at each end, one or the other of which normally projects inwardly from the tread of the contiguous rail, as specified, and a pivotted lever connected with the switch tongue and adapted to be operated by the slide bar, for the purpose specified.

351,474. RAPIDLY ADJUSTABLE NUT for CALIPERS and DIVIDERS, *Joshua Stevens and Oliver D. Warfield, Chicopee Falls.—Filed June 12th*, 1886.

Claim.—(1) The combination, with a quick motion nut, of a washer for closing it upon the screw connected to it, substantially as described, whereby it moves with the nut as the latter is slid along the screw. (2) The combination of a quick motion nut with a washer for closing it upon the screw, and shoulders on said nut and washer, respectively, reciprocally engaging each other, whereby the washer is caused to move with the nut. (3) The combination of nut D, having shoulder or projection *d*, with washer E, having internal shoulder or flange *g*, enclosing the end of the nut and engaging the shoulder *d* thereon, substantially as set forth. (4) The combination of a quick motion nut with a washer for closing it upon

351,474



the screw, enclosing its end, engaging a shoulder or projection thereon and inseparable therefrom while the nut is on the screw, substantially as set forth. (5) A washer for a quick motion nut, formed to enclose the end thereof, and having an internal flange or shoulder, *g*, substantially as and for the purpose specified. (6) A quick motion nut D, consisting of a section G, with a head at one end and a screw-thread at the other, and recessed along one side, with a jaw G^1, pivotted to it at said head and filling said recess, in combination with a washer engaging the exterior of the section G and jaw G^1 at their threaded end, substantially as set forth.