THE DRAINAGE OF FENS AND LOW LANDS BY STEAM POWER.

By W. H. WHEELER, M. INST. C.E.

No. III.

IN further continuation of the remarks made in the previous number as to the difference of opinion which exists as to the comparative merits of scoop wheels and centrifugal pumps, attention may be drawn to the fact that in a recent number of THE ENGINEER, an account is given in one part of the paper of the removal of centrifugal pumps, which had been erected in Egypt by an English firm for lifting the water for irrigation purposes, and the substitution under the direction of a French engineer of scoop wheels; and in another part of the same number, of the intended removal of scoop wheels erected by Dutch makers for the drainage of land in the north of Italy, and a substitution of centrifugal pumps by English makers, because similar pumps working in the same neighbourhood had satisfied the authorities that they were the more efficient machines.

ENGINES USED FOR DRIVING WHEELS AND PUMPS.

In the early attempts to drain land by mechanical means wind power was entirely resorted to. Many of the old windmills driving scoop wheels still remain in use in the Fenland. In Holland, where this source of power is largely applied for driving machinery, the numerous windmills and pumps all over the country show that steam has not yet succeeded in displacing the more economical, if less efficient, source of power. On the old one-inch Ordnance map there may be counted five hundred windmills in the Fenland, which are in use now, or were at one time engaged in draining the land. In the Littleport and Downham district, in Norfolk, containing 28,000 acres, no less than seventy-five windmills were engaged in lifting the water off the land—work which is now much more efficiently done by two steam engines. In 1729 Captain Perry, an engineer who is known from his attempts to stop the breach in the banks of the Thames, erected a number of windmills for working scoop wheels for lifting the water out of Deeping Fen, in Lincolnshire. In 1824 the forty-four windmills which from time to time had been erected were replaced by one main pumping station, having two large scoop wheels driven by steam power, and the Fen, which previously had been only in a half-cultivated condition, became completely reclaimed.[1] Previous to the complete drainage of Lake Haarlem, the rainfall from 75,357 acres of Polder Land was lifted into the low part, or Boezem, by two hundred and sixty-one large windmills, of an aggregate force of 1500-horse power. The complete drainage of this lake was subsequently effected by steam power, a full account of which will be given further on. In 1776 the first attempt was made in Holland at using steam power in place of windmills for drainage purposes. A pumping station and steam engine was erected at Arkelschendam. As these engines consumed 31 lb. of coal per horse-power per hour, the use of steam did not extend much, as it was thought that steam could not be used economically. In 1825 steam power was used at Zuidplas to drive two Archimedean screws for lifting water a height of about 22ft. These engines consumed 22 lb. of coal per actual horse-power per hour. This lake was emptied by the united action of thirty windmills working scoop wheels and the two steam engines in 1840, and subsequently kept dry. Each steam engine raised the water from 2352 acres to a height of 3·28ft. Each windmill with its float wheel raised the water from 1898 acres for the first half of the upper lift to a similar height, and from 2656 acres for the second half. The annual cost of maintaining these thirty mills amounted to £60 per mill. These mills were superseded by steam in 1871.

Steam power as applied to Fen drainage in this country came into use about fifty or sixty years ago. In 1820 Rennie applied one of Watt's engines to the working of a scoop wheel for draining Bottisham Fen, near Ely. The success of the steam engine in draining water from the Cornish mines naturally led to the adoption for land drainage of the same type of machine as used for this purpose, and consequently all the old class of engines and boilers are of the Cornish type. The engines were massive and substantial condensing beam engines, working at a steam pressure of from 3 lb. to 5 lb. The structure consisted of heavy cast iron beams, working on girders resting on the walls, and supported by ornamental cast iron columns. The piston-rods were attached to crank shafts, on which were fixed pinions working into spur wheels, or into a toothed wheel running round the inside of the scoop wheel. The foundations for carrying these engines and for the bearings of the wheels, which often weighed from 20 to 50 tons, were necessarily of a heavy and expensive character, piling and planking having been almost universally resorted to. These massive engines seemed in character with the ponderous scoop wheels which were then universally used for lifting the water. Most of those in the Fenland bear on their framing the name of the Butterley Iron Company as makers, and the excellency of the workmanship is shown by the fact that after running for more than half a century, the greater part are still in use, some almost without alteration, but others with only slight changes to adapt them to a more economical use of steam. The engines more recently erected have been of various types, the descriptions of some of the best of which will be found in the descriptions of the drainage stations to be hereafter given.

Engines used for draining land should be of as simple a character as possible, and free from all complicated parts. The more nearly they approach the type of portable engine so largely used for agricultural purposes, the less difficulty will be experienced in obtaining experienced enginemen. The saving of coals by the use of condensing engines, or others in which complicated appliances are adopted for the same purpose, is not of so much importance in an engine used for the drainage of land as saving in first cost for machinery and foundations and for subsequent repairs.

The circumstances between engines used in pumping mines or for the water supply of a town or similar purposes and those used for the drainage of land, are so different that it is an utter mistake to take such engines as types. In the one case the engine is continuously at work with skilled mechanics at hand to carry out repairs and rapidly remedy defects. The saving in the cost of coals in such cases is far greater than the interest on the extra outlay for machinery and foundations, and forms the principal subject of consideration. Experienced men equal to meet all ordinary contingencies, can be employed, whereas, in the event of a mishap with a drainage engine, a messenger has to be sent from some out-of-the-way place to a distant town to obtain the services of an engine fitter. Most land drainage engines run for only a short period in the year—in dry seasons, perhaps, for only two or three weeks in a twelvemonth. The saving of coals as between a complex and a more simple machine does not therefore compare so favourably with the annual payment for interest on the extra cost of the more expensive machine. The fewer parts of a simple machine also reduce the risk of breakdowns, and drivers of the agricultural class have generally sufficient intelligence to deal, at least for a time, with such accidents as may happen. Drainage engines should therefore always be of the simplest type, but of the best workmanship and ample strength. The latter quality is one that should always be insisted on. The extra cost of the metal required in making a strong and substantial machine as compared to one beautifully finished but so lightly constructed that it is always shaking itself to pieces, forms so small a portion of the whole cost that it ought never to influence a maker.

Where the area of land is small, say not exceeding 2000 acres, and therefore not sufficient to warrant the cost of brick buildings, the most economical arrangement is to use a semi-portable engine driving a centrifugal pump, the whole enclosed in a galvanised iron shed. The cost of foundations and erection of a chimney is thus avoided. The pump can be driven by belt or by direct gearing from the crank shaft.

THE MANAGEMENT OF DRAINAGE ENGINES.

Although the saving of coals as between one type of engine and another may not be of such consequence as in engines used for commercial purposes, yet the total consumption is a matter which ought to engage the most serious attention on the part of the managers, as on this principally will depend the annual cost of the pumping station and the amount of taxes required to meet the expenses. The fuel should bear a direct proportion to the amount of water lifted. If more than is necessary is used it is due to the fault of either the engine man, the engine, or the pump. The excess has to be paid for. As regards the first, the engine man, too great caution cannot be exercised in selecting a steady, careful, and economical man. The best men can only be secured by paying good and sufficient wages. A good engine man may save his wages many times over by careful stoking; an incompetent man may not only run up the coal bill, but do irreparable damage to the machinery by ignorant management. The difference of the consumption of coals due to good and bad stoking is strikingly shown by the trials of engine men at the agricultural shows. It may be assumed that the men who enter for these competitions consider themselves as superior to the ordinary men, or they would not enter for the competition. Selecting two of these competitions as samples, with an interval of ten years between, it will be seen that there was a marked improvement on the part of the men in the work done. Some portion of the quantity may be due to the difference in the engines, but this would not amount to much; and it is fair to presume that the managers would take care that the engine provided for the trials should be a competent machine.

At the trials at the Lincolnshire Agricultural Show at Spalding in 1872, with an 8-horse power portable engine, fifteen competitors entered the list. The best used coal at the rate of 7·86 lb. per horse-power per hour, the worst 20·2 lb., the average of the whole being 11½ lb., a difference of 61 per cent. between the best and the worst.

At Gainsborough in 1883 there were nineteen competitors. The best man ran the engine with a consumption of coal at the rate of 6·77 lb. per horse-power per hour. The worst used 8·95 lb. The average of the whole was 7·69. There was thus a difference of 2·18 lb. of coal per hour in the driving of this engine by picked men. Taking the ordinary type of drivers of agricultural engines, it may safely be taken there would be a difference of at least 10 lb. of coal per horse-power per hour. With an engine running at 10-horse power, this would amount to over a ton in twenty-four hours. Beyond this would be further waste in oil and damage to machinery by want of skill or carelessness.

With regard to the quantity of coal consumed, the Dutch engineers in their contracts generally stipulate that this shall not exceed 6·60 lb. of coal per horse-power per hour of water actually raised. Some of the best pumping engines for land drainage purposes in this country consume from 4 lb. to 4½ lb. of coal per indicated horse-power per hour, which is above the Dutch standard. At the trials of the engines and pumps put up at Fos, Bouches de Rhone, the consumption of coal was at the rate of 4·45 lb. per H.P. of water lifted.

The conditions of trial in some of the competitions for pumping machinery in Holland are that on the completion of the contract for the erection of the machinery there should be two trials, one carried out by the enginemen of the contractors, and the other by those of the purchasers. Both trials to last over a considerable period. In the event of the consumption of coals exceeding that guaranteed by the contract, the contractor has to pay three-fourths of the capital sum which would have to be paid by the purchasers to provide the additional coal.

Insurance.—A very considerable saving in the management of drainage engines might be effected if the Commissioners in charge of them were to avail themselves of the advantages to be derived from the regular inspection which is undertaken by the boiler insurance companies. The primary object of these companies is to insure the owners of boilers against the damage arising from explosion, but the greatest advantage derived is from the periodical inspections by their agents, who furnish reports after each visit as to defects, whether arising from bad setting or from wear or corrosion. By the timely detection of defects, many explosions are averted, and the reports of the inspectors as to the general condition and management of the engines and boilers should prove a useful check on the manager, and will frequently be found to result in a considerable saving in the amount of coals consumed.

[1] "The Fens of South Lincolnshire." By W. H. Wheeler. 1868. Simpkins and Co.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

No. VI.

Russian trade for 1885.—The value of British imports into Russia decreased from £12,311,800 for 1884 to £9,459,300 for 1885, a diminution of £2,852,500, or 23·17 per cent. The falling off was in copper, iron, cast and wrought, lead, and steel, while there was an increase in coal. The decline of the foreign trade of Russia arises from a general state of economic depression resulting from the concurrent operation of many causes. In addition, the decrease in the import trade is greatly influenced by the commercial policy of the Russian Government manifested in imposing very heavy and almost prohibitive duties on foreign goods. In 1885 the tariff, which had been previously greatly raised, was further increased by 20 per cent., and a duty imposed on agricultural machinery, which was up to that time admitted free. No favourable change in the commercial relations between Great Britain and Russia can soon be expected. The Russian Government does not exhibit the least tendency to modify its strongly protective policy; on the contrary, it seeks by indirect means to realise this policy in a manner which seriously affects the interests of trade. A measure of this description is the scheme of the Government for controlling and fixing the rates of railways carrying goods, especially those of non-Russian origin. Private railway companies could regulate their rates of carriage at their own discretion. With the increase of duties the traffic of foreign goods on some of the railways diminished, and to counteract this decrease some private railway companies lowered their rates of carriage for such goods. The Government, however, resolved to establish and exercise the power of regulating the railway rates for the transport of foreign goods. This measure has another object, the maintenance of the importance of St. Petersburg as a sea port, and the increase of the revenue of the Grand Society of Russian Railways. Private railway companies established such low rates of carriage on their lines that goods from abroad for Moscow and the adjoining provinces were carried to their destination from Libau, Revel, or Riga, instead of being landed at St. Petersburg; and even goods for that city were frequently landed at Revel and brought on by rail, thus affecting the interests of the Grand Society of Russian Railways and imperilling the future of St. Petersburg as a port. The new railway rates will cause all foreign goods for Moscow and district to be landed at St. Petersburg and transported thence by the Moscow section of the Grand Society's railways. The measure will benefit St. Petersburg, and the above railway, but is certain to check foreign imports and diminish the importance of Revel as a seaport. The new railway tariff, in spite of opposition, is to come into operation early in the present year.

A marine canal with a uniform depth of 22ft. was constructed from Cronstadt to the mouth of the Neva in 1885. Vessels can now proceed direct to St. Petersburg without discharging their goods into lighters at Cronstadt, as was previously the case; but St. Petersburg still lies under the disadvantage of not having a sufficiently extensive harbour. The accommodation now afforded by the Gutuyeff and Putiloff ports at the terminus of the canal, and which are connected with the Baltic, Moscow, and Warsaw Railways, is not sufficient for the requirements of the trade. The canal was originally intended to form part of a comprehensive scheme with an extensive harbour at the mouth of the Neva. Through want of funds the harbour has been only partially constructed. Plans for its extension are under consideration, and when the work is completed probably Cronstadt will cease to exist as a commercial port. The construction of the Matko Ozero Canal from near Viterga, forming part of the Martinsky water system, along which grain is carried in large quantities to St. Petersburg, was also completed in 1885, and the dangerous navigation of the Matko Ozero Lake avoided. Works are also carried on at Revel for deepening and extending the harbour.

The most important manufacturing districts of Russia are Moscow, Nijni Novgorod, and Vladimir. Notwithstanding the excessive protective duties, the manufacturing industries of Russia, instead of developing and prospering, are at present suffering from great depression. The causes may be said to be decrease of the purchasing power of the population in consequence of impoverishment and excessive production. Another cause is the inertness of the Russian manufacturers, who, owing to the peculiarity of the national character, do not readily adopt improvements and employ new processes. Of the methods of production and their quality an opinion may be formed from the standard of technical education of those employed as foremen, overseers, &c., in industrial establishments. From the results of a recent inquiry into the technical training of Russians in posts of responsibility for manufacturers in the consular district of St. Petersburg, it appears that in 3476 manufactures the number of native foremen with technical training was 228 against 3115 without, or less than 7 per cent. of the former. These figures are almost alone sufficient to account for the inability of the native manufacturer to compete with those of other countries without the assist-

ance of protection. In those establishments and works where foreigners possessing technical knowledge are employed, there is not much need of protection. Though the Russian manufacturers are protected against foreign competition by heavy duties, they are unable to struggle successfully against the internal competition of the German cotton mills at Looz, in Poland, and have appealed for further protection, either by imposing high rates of duty or a special tax on the manufactures of Poland, but no decision has been arrived at. In 1885 the Government issued regulations prohibiting the employment of children and women at night, and appointed inspectors to exercise control in all matters relating to the employment of workmen, hygienic condition of manufactories, &c. These regulations excited such great discontent among the Russian millowners, that their operations in some places had to be suspended. Strikes, which are prohibited by Russian law, took place in some manufacturing districts, but their spread was energetically arrested by the authorities. In several cases serious outbreaks took place among the workmen, the causes of which were inordinate fines, irregular modes of payment, reduction of wages, and the truck system maintained by some millowners.

The condition of the agricultural class continues to be very depressed in most of the provinces, and taxes are collected from them with difficulty. The Government was obliged to lighten their burdens by abolishing the poll tax in May, 1885.

WAGES IN GREAT BRITAIN.

No. VI.

Kidderminster.—Kidderminster at an early period had a large manufacture of broad-cloth, but it is now chiefly celebrated for its carpets. There are, in addition, iron foundries and tin-plate works, but both are comparatively unimportant. The habits of the artisans are generally trustworthy and steady, as the existence of numerous building and land societies, to which weekly and monthly payments are made, testifies. The working classes generally, where they are fairly careful, are comfortably dressed, fed, and housed. The tendency of the artizan class of late years has been to expend money on from Saturday to Monday excursions rather than in public-houses, owing to which cause the latter interest has become much depressed. There is in the borough an industrial co-operative society, mainly supported by the working classes. It is in a flourishing condition, possesses a bakery and butchery establishment, a large room for entertainments and meetings, extensive shops, and a tavern. Through the competition of co-operative stores several tradesmen have reduced their prices, so that the general public share in the reduction. Strikes have been frequent, and Kidderminster has earned an unenviable reputation for violence in connection with disputes about labour and wages. An association of weavers has existed for some years, possessing large capital, and exercising great influence upon, if not entirely controlling, the carpet trade of the town. In some firms, no man who is not a member of the association is allowed to be employed. If this rule is infringed, the whole of the hands belonging to the society are withdrawn.

Wages Paid per Week of Fifty-six and a-half Hours in Kidderminster.—General Trades.

	Average. s. d.
Bricklayers	31 9
Carpenters	32 11
Masons	34 2
Blacksmiths	30 7
Strikers	18 10
Horseshoes	27 1
Ironmoulders (Worcester)	31 9
Millwrights	42 4
Labourers	16 8

Wages Paid to Members of Trades Unions.

	s. d.
Bricklayers per hour	0 6¾

Wages Paid per Week of Fifty-six Hours in Carpet Factories in Kidderminster.

	Lowest. s. d.	Standard. s. d.	Highest s. d.
Blacksmiths	30 5	—	40 6
Engineers	—	78 6	—
Foremen	30 5	40 6	60 7
Loom turners	40 6	40 6	60 9
Machinists	30 5	—	40 6

Wages Paid per Week of Fifty-six Hours in Employ of Corporation of Kidderminster.

	s. d.
Driver of steam roller per week	26 1
Engineer ,,	49 0
Assistants ,,	28 2
Stokers ,,	18 3
Street foremen ,,	28 2
Turncock ,,	26 1

Houses occupied by artisans are of two classes. The first class, occupied by ordinary weavers and labourers, contain a cellar, two rooms on the ground floor, and two bed-rooms, with the use of a wash-house in common to four houses. The rent is from 4s. to 4s. 6d. a week. The second class contain a cellar, two rooms and a wash-house on the ground floor, with three bed-rooms above. The rents of these houses are from 5s. 6d. to 7s. a week. Coal is from 10s. to 20s. a ton; gas is from 2s. 6d. to 2s. 8d. per 1000 cubic feet.

Leeds.—For manufacturing purposes the situation of Leeds is highly favourable, as it occupies nearly the centre of the railway system of England and Scotland, and is in the midst of an extensive coal and iron district. All the advantages for the successful production and working of machinery are therefore within reach, hence several important industries are carried on in the town and its immediate vicinity. The staple trade of Leeds is cloth, but it is probable that the iron trade in its several branches, including the casting of metal, manufacture of machinery of every description, mechanical tools, steam engines, and steam ploughs, gives employment to a larger number of persons within the borough than any other branch of industry. The trades carried on here are so various that often the whole of a family obtains employment in them, the males working in the building trades, iron foundries, machine shops, &c., while the women and children are engaged in cloth factories and woollen mills. Since 1864, when the union of the ironworkers was broken up, with the exception of a strike in the engineering trade for a fixed minimum rate of wages, Leeds has been comparatively free from labour disputes, and the relations of employer and employed are less strained. A remarkable feature is the high rate of wages paid in the glass bottle factories, the average earnings of a bottle blower and maker for a week of forty-eight hours being 40s. and 46s. respectively.*

Wages Paid per Week of Fifty-four Hours in Leeds.—General Trades.

	Lowest s. d.	Standard. s. d.	Highest. s. d.
Bricklayers	31 6	33 9	36 0
Carpenters	33 9	36 0	38 3
Masons	31 6	36 0	40 6
Blacksmiths (Corporation employ) 48 hours	26 0	27 0	28 0
Strikers	—	20 0	—
Fitters (locomotive works)	21 0	—	32 0
Labourers	18 0	—	19 0
Ironmoulders	23 10	29 11	31 9
,, Barnsley	27 11	33 9	—
,, Cleckheaton	25 10	29 11	31 9
,, Dewsbury	27 11	29 11	—
Mechanics in worsted mills, 56 hours	—	28 0	—
Pipelayers (waterworks) 48 hours	24 0	—	28 0
Tinsmiths	—	28 0	—

Wages Paid to Members of Trades Unions.

	s. d.
Carpenters (Doncaster) per hour	0 7
,, (Harrogate) ,,	0 6½
,, (Shipley) ,,	0 6¾
Stonemasons (Doncaster) ,,	0 7
Amalgamated Engineers (Shipley) per week	28 6
Blacksmiths (Leeds) ,,	27 0
Boiler-makers (Stanningley) ,,	24 0—38 0
Ironfounders (Barnsley) ,,	33 9
,, (Halifax) ,,	34 8
,, (Huddersfield) ,,	22 6—31 6

Wages per Week of Fifty-four Hours in Foundries and Machine Shops in Leeds.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Brass-fitters	—	20 0	—
Core-makers	26 0	29 0	32 0
Fettlers	20 0	20 9	23 0
Fitters	24 0	29 4	32 0
Apprentices	7 0	9 6	11 0
Foundry blast tender	—	28 0	—
Foundry enginemen	—	21 0	—
Pattern-makers	29 0	30 11	33 0
Apprentices	5 0	8 10	12 0
Moulders'	29 0	31 7	34 0
Apprentices	4 0	8 4	12 0
Labourers	18 0	18 0	19 0
Painters	—	29 6	—
Smiths	27 0	30 10	36 0
Strikers	19 0	19 8	20 0
Turners	20 0	25 8	32 0
Apprentices	4 0	8 3	12 0
Labourers	14 0	19 6	24 0

Wages Paid per Week in Ironworks in Leeds.

	s. d.	s. d.
Boiler firers	—	20 0
Drillers	20 0	24 0
Engineman	26 0	30 0
Fitters	—	28 0
Slotters	20 0	24 0
Steam-hammer drivers, men	21 0	25 0
,, ,, boys	6 0	10 0
Turners	—	28 0
Labourers	15 0	19 0
Ball Furnaces.—Hammerman and furnaceman are partners, and take the work by the ton, their wages averaging per day	10 0	12 0
Underhand men	5 0	6 0
Bar Mill.—Roller paid by ton per week, less furnaceman	80 0	160 0
Furnacemen	48 0	54 0
Assistants	42 0	54 0
Labourers	24 0	30 0
Boiler-plate Mill.—Roller paid by ton, less furnaceman per week	160 0	200 0
Furnaceman	—	120 0
Under roller	—	120 0
Under hands	21 0	42 0
Drawing-out Hammers.—Head hammerman per ton, per week	160 0	240 0
Furnaceman ,,	80 0	100 0
Leverer ,,	24 0	30 0
Staffender ,,	30 0	36 0
Under hammerman ,,	48 0	60 0
Puddler. — Forehand puddler, by ton, per week	50 0	70 0
Forehand nobbler ,,	50 0	70 0
Middle hand ,,	—	24 0
Boy ,,	—	9 6

Rate of Wages paid for Making best Yorkshire Iron, Axle finishing at hammer. Price paid to Hammerman.

	s. d.
Large axles, 25s. a ton; small axles, 21s. 6d. a ton; out of this hammerman pays per day 41s. 6d. to	
3 firers, at 4s.	12 0
1 furnaceman	9 0
1 leverer	4 6
1 staffender	5 6
1 underhand	7 6
1 boy	3 0
Crank-making—price paid to crank-maker, 80s. per ton; out of which he pays, per day, 40s, to	
2 furnacemen, at 9s.	18 0
1 leverer	4 6
1 staffender	5 6
1 underhand	9 0
1 boy	3 0
Drawing blooms at hammer: Faggots for making into axles, 6s. 10d.; heated work (1) 2s. 9d.; (2) 4s. 3d.; (3) 4s. 9d.; (4) 6s.; tire blooms, 6s. 10d.; slabs to 700 lb. weight, 6s. 5d.; from 700 to 3000, 7s. 8d.; extra on slabs to 900 lb., 8d. each; above, 1s. 5d. each. The work is taken at above price by both furnace and hammermen, each paying their own assistants, together 40s. a day.	

* Since the above was written there is great depression in the glass trade in south and west Yorkshire.

	s. d.
Furnaceman pays per day 19s. 6d. to	
1 ball furnaceman	7 6
3 firers at 4s.	12 0
Hammerman per day 20s. 6d. to	
1 leverer	4 6
1 staffender	5 6
1 underhand	7 6
1 boy	3 0
Guide mill (per ton) not exceeding ⅜in. diameter or square 13s. 9d. above, and not exceeding ¾in. diameter or square, 9s. 9d. above	5 9
Puddling 10s. per ton, out of which puddler pays per day, 6s. to	
Middle hand	4 0
Boy	2 0
Refining iron 1s. 8d. per ton, out of which refiner pays per day 6s. 9d. to	
1 man	4 0
1 boy	2 9
Rolling bar iron, flats, rounds, and squares any size 5s. 6d. per ton, angle and T iron 7s. 3d. per ton, out of which roller pays per day 31s. 3d. to	
1 bolter	6 0
2 catchers at 4s. 6d.	9 0
1 furnaceman	8 0
3 boys at 2s. 9d.	8 3
Tire rolling 5s. 8d. per ton, roller paying all out.	

Rates of Wages Paid for Making Common Yorkshire Iron.

	s. d.
Puddling, per ton, 7s. 6d., puddler earns per day	9 5
Out of which he pays 1 hand	3 6
Bar mill, roller receives for angles per ton	7 0
,, ,, ,, bar iron ,,	6 0
,, ,, ,, T iron ,,	9 0
Roller pays per day for help	26 0
Two furnacemen receive 6s. in £ between them.	
Shingles, fagots per ton	1 4
Slabs	1 6
Fagot roller	1 4
Pays for help per day	11 0
Plate mill, plates per ton	10 0
Sheets ⅛in. up to 12 b.w.g.	12 0
,, 12 b.w.g. up to 14 b.w.g.	14 0
,, 14 ,, ,, ,, 16 "	16 0
,, 16 ,, ,, ,, 20 "	18 0
Furnaceman gets in £	7 0
Pays per day for help	8 6
Roller pays per day for help	18 0
Roller pays shearer per ton	2 0
Shearer pays for help per day	13 0

Wages Paid per Week of Fifty-four Hours in and in Connection with Coal and Ironstone Mines in the South and West Ridings of Yorkshire.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Banksmen	18 0	24 0	30 0
Boys	6 0	9 0	18 0
By workmen	17 0	24 0	27 6
Coal miner	—	29 6	—
Deputies	27 0	33 0	45 0
Engine tenters	30 0	31 6	36 0
Fitters	21 0	27 0	30 0
Firetriers	24 0	30 0	39 0
Hangers on	21 0	24 0	27 0
Jiggers	11 0	15 0	24 0
Off hands	18 0	24 0	27 0
Screeners	18 0	24 0	30 0
Trammers	21 0	27 0	30 0
,, ordinary	9 0	13 6	18 0
Underviewers	45 0	57 0	69 0

The condition of the working classes has improved without regard to the question of wages, principally by the actions of the sanitary authority and School Boards. The cost of living has hardly increased in the last seven or eight years, though beef and coals are slightly dearer. Thousands of houses, averaging in value £160 each, and amounting to over a million, are owned by the working classes through the agency of building societies. Rent is from 3s. to 5s. 6d. a week; coal from 8s. to 15s. a ton; that generally used from 10s. to 12s.; and gas, 1s. 10d. per 1000 cubic feet.

Examples of Cost of Living per annum in Leeds.

	Number in family. 5.	6.	6.	7.	Average, 6.
	£. s.	£. s.	£. s.	£. s.	£. s.
Bread and flour	16 15	—	19 0	18 5	—
Butter, cheese, coffee, milk, sugar, tea, &c.	48 13	—	47 1	41 19	—
Meats	15 19	—	11 0	19 0	—
Vegetables	—	62 8	—	7 1	76 15
Fuel and light	4 8	4 11	4 2	4 18	4 10
Clothing	10 7	*6 10	10 15	14 11	‡11 18
Rent	10 14	10 8	10 8	13 0	11 2
Incidentals	4 2	4 11	3 16	6 10	4 15
Total	110 18	88 8	106 2	125 4	107 13
Income	123 1	†116 11	126 6	130 19	124 4

* Shoes only. † Iron refiner at 8s. 4d. a day, works four days a week. ‡ Average of three families.

THE ELECTRIC LIGHT AT WHITELEY'S.

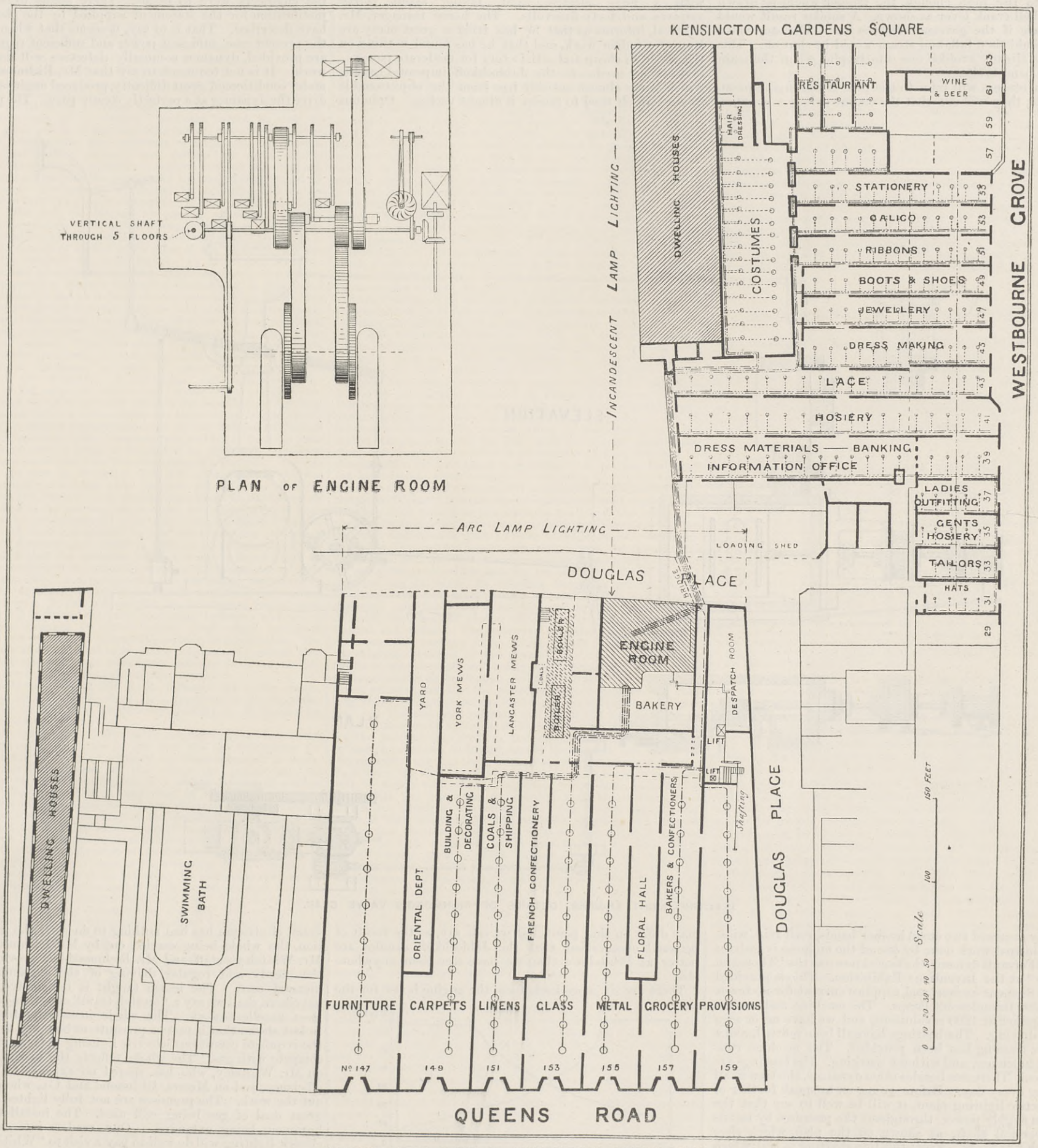
The instances in which the electric light has competed with gas and equalled it financially are extremely few; and the installation we are about to describe possesses special interest, not only because of its great magnitude, but from the fact that the light obtained by it is not more expensive than was the gas which it has replaced.

It is no figure of speech to say that the word "Whiteley's" is known all over the British Empire; but few persons have an adequate idea of the characteristics of the enormous establishment which the skill and energy of one man—William Whiteley—has built up in the course of five-and-twenty years at Bayswater. To a great many persons "Whiteley's" is simply a huge draper's shop or an enlarged "Stores." In fact, it is not only these things, but a great manufactory as well. Every pay-day several thousand hands receive their wages, and the dimensions of the premises in which they work can only be adequately expressed in terms of acres. On page 125 we give a ground plan, which will serve to make what follows more intelligible; and it will serve to impart some idea of the dimensions of the place if we say that

each of the long narrow shops opening on Westbourne-grove, and marked in our plan "Stationery," "Ribbons," &c., is 115ft. long. The large department, No. 39, is nearly 200ft. long by 26ft. wide. The premises facing on to Queen's-road are of even greater dimensions, and it must be remembered that the shops rise in some instances floor above floor, through several storeys; while in others the upper floors are workshops, where various manufacturing processes are carried on. The general arrangement of the premises is shown on the ground plan. The plan of the engine-room is drawn to a different scale. The room itself is situated in the basement.

To begin at the beginning is to begin with the boilers. These are two in number, of the Lancashire type, built under the special survey of one of the boiler insurance companies, by the Oldham Boiler Company, Oldham, Lancashire, and provided with every modern appliance which can ensure safety and efficiency. The whole of the plant has been supplied by Messrs. Joseph Richmond and Co., of Bow, and a very clever piece of work was done by the firm in providing space for the boilers. These are each 30ft. long, and 7ft. 6in. in diameter. The dead weight safety valves are loaded to 80 lb. on the square inch. When it was first proposed to introduce the electric light, it did not appear that there was any place available for the boilers. Mr. Richmond proposed to excavate a narrow mews, bounded on each side by lofty buildings, and this he actually did, with perfect success, and the two boilers now lie end to end with a stokehole between them under the mews, as shown in the plan; and no evidence of their existence there is visible, save a grating, down which the air necessary for combustion passes into the stokehole, at one side of which is a bunker, the base of the chimney being at the other side. The boilers are fed by pumps on the main engines, and a donkey pump drawing direct from the mains of the water company.

These boilers have to find a great deal of steam besides that taken by the main engines. They drive a pair of winding engines working a 1-ton hoist in the cabinet-making factory. They provide steam for fifteen great jacketted pans in the provision department, and for a multitude of purposes in several kitchens, where meals are daily prepared for many hundreds of *employés*. This work was done by gas before the boilers were put down. They also warm the floral hall and the zoological department, and various other parts of the premises. The feed-water is raised to a high temperature by the exhaust steam.



ELECTRIC LIGHT PLANT AT "WHITELEY'S"—GENERAL PLAN.

The engines are two in number. Their general arrangement will be gathered from the perspective view of the engine-room on page 129. They are horizontal, with cylinders 18in. diameter and 3ft. stroke. As shown in the plan they are placed side by side, and can be coupled or run separately at will. They are a very fine pair of engines, leaving nothing to be desired in design or workmanship. They run at eighty revolutions per minute. As will be seen further on, these engines have to supply a great deal of power to the various workshops, and the demands made on them vary continually as machines are thrown on and off. These are very trying conditions for engines intended also to drive dynamos. Mr. Richmond has got over the difficulty by a very admirable and, so far as we are aware, novel system of altering the point of cut-off. This we show in detail on page 126. In the engraving the governor balls, which are of very small size, are omitted, and only the spherical weight is shown. The governor is driven by bevel gear mounted on a short shaft, driven by a counter crank and drag link as shown. A second short shaft is fitted with a spur wheel gearing into another keyed on the first-named countershaft. On this second shaft is a sleeve, with studs, on which are mounted two bevel wheels. One of these studs is prolonged and coupled to the end of the governor lever. A fourth bevel wheel, also mounted on a sleeve, gears with the other two and is fitted with a small excentric. The whole makes a "Jack-in-the-Box," and is very clearly shown in the elevation and plan, page 126. The action is very simple. If, the engine being in motion, we suppose the stud uncoupled from the governor, then the intermediate bevel wheels would be carried round the shaft, and the small excentric would remain at rest, but being coupled to the governor, the studded sleeve cannot revolve, and consequently the excentric will make as many revolutions as the crank shaft. But it is clear that by just so much as the governor lever rises or falls, by so much will the little excentric be carried in advance of the engine crank or dropped behind it. The result is just the same as though an excentric was shifted round on the shaft to give more or less lead.

From the section of the valve chest it will be seen that a diaphragm is interposed between the main slide and the cut-off plate. The diaphragm is double-ported, so that a short stroke in the cut-off plate gives a large admission. The cut-off is actuated by a small double-acting steam cylinder, under which is a three-way cock valve. This cock is worked by the small excentric before

mentioned. Between the little cut-off cylinder and the main cylinder is an air dash pot. It will be readily understood that the moment steam is admitted to either end of the small cylinder, the cut-off plate is shifted and steam cut off; and the time of admission to the small cylinder is settled by the position of the cut-off excentric, which is in turn controlled by the governor. We give two reduced copies of diagrams, one with the load off and the other with it on. No better diagrams can be desired, unless, indeed, a very little more compression would be desirable. As, however, the engines run in perfect silence, without knock of any kind, change in this respect does not seem to be needed.

The engine is provided with runaway gear, very simple and efficient. The steam is admitted, as shown, through a stop valve controlled by a weighted lever B. This is held up on a trigger A. If the governor should run so fast as to rise high enough, the trigger would be drawn by the bell crank lever as shown. A similar result would take place if the governor fell too low. The stop valve lever would then fall, and steam would be shut off. This gear has already avoided one catastrophe, when the main driving band broke.

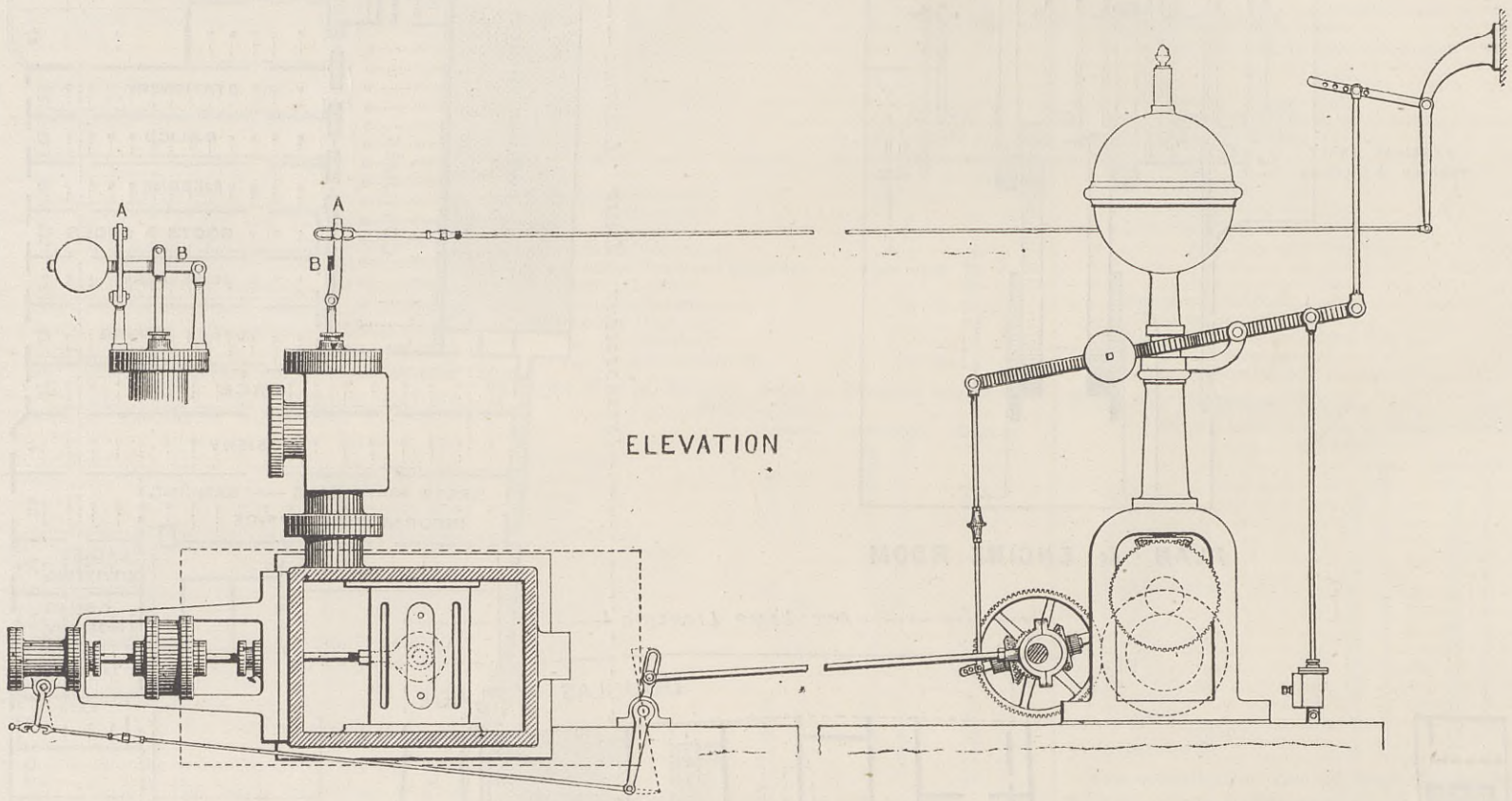
If our readers will refer to the plan of the engine-room, page 125, they will see that the engine drives a counter-shaft by means of two chain leather bands, each 18in. wide. The principal work done by one of the engines is to drive a great Ferranti dynamo, the same known as the "Thousand lighter" at the Inventions Exhibition. This is provided with a Siemens exciter, and supplies current for no fewer than 1300 incandescent lamps. The machine and exciter run together at 1200 revolutions, and we have never seen better driving. The bearings have all been refitted, and a massive framing has been provided. The machine runs almost in silence, and without sparking. The bearings are quite cool. There are besides other dynamos, thirteen in all running every day. Before going on to speak further of the electric lighting plant, it will be well to say that the engines supply power throughout the premises by means of a vertical shaft, as shown on the plan, which rises through five floors. From this line shafting is laid, which drives in the mineral water department nine machines; in the provision department, five machines—it may be mentioned that about two tons of sausages are made every Saturday—in the bakery, twelve machines; in the gas fitting shops, eight machines; in the building department, three wood-working machines; in the cabinet-making factory, six machines, including a large general joiner; in the pianoforte factory, three machines; in the printing office, fifteen machines; and in the wholesale grocery department, twelve machines. Besides all this there is a horizontal fan, shown on the plan, to keep the engine-room cool; chaff-cutters to provide food for the 300 horses employed by Mr. Whiteley in his delivery carts, one 2-ton hoist, one ½-ton hoist, one 1-ton outside crane, and one ½-ton lift in the forage department, besides great length of shafting scattered all over the building. The engines usually indicate about 190-H.P. each.

The general arrangement of the lights will be gathered from the plan. The Queen's-road shops are lighted, as shown by the circles, by Jablochkoff lights, seventy in number. The basement beneath is lighted by incandescent lamps run in parallel, current being supplied by Ferranti, Siemens and Jablochkoff machines. Incandescent lamps are also used in some parts of the ground floor, the floral hall, and the provision shop windows. There are 600 lamps in all in this part of the premises. The Jablochkoff lamps are run five in series, by 10 and 20-light Jablochkoff dynamos. Each lamp gives 370 candles—Board of Trade estimate. There are besides three large arc lamps, one in Queen's-road, one in Westbourne-grove, and one in Douglas-place. These are 1200-candle lamps. There are thirty leads from the engine-room for this installation, and over twenty miles of wire. We must not omit to state that there is at the top of the house a most complete photographic studio, fitted with a huge electric light, taking about thirty ampères and forty-five volts. The house manager, Mr. Percival, informs us that he has tried a great many arc lamps for indoor work, and that he has found nothing on the whole so cheap and satisfactory for moderate power—such as he needs—as the Jablochkoff improved candle, which burns almost entirely free from the objectionable colours which used to render it almost useless. Opinions may differ on this point, but we can say, as the result of personal observation, that the Jablochkoff candles are better at Whiteley's than we have seen them anywhere else.

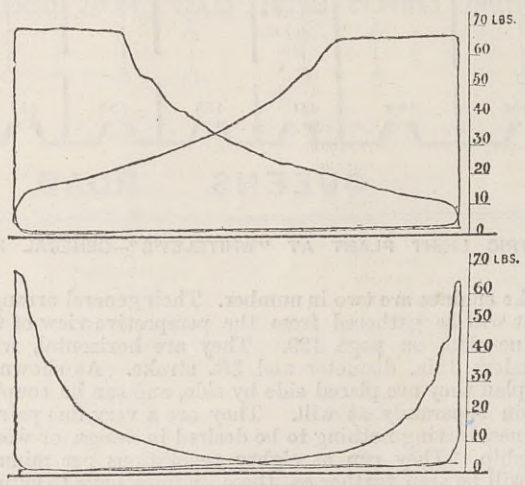
There are six more leads from the engine-house for the Westbourne-grove premises, two for the basement, two for the ground floor, and two for the first floor. On the last there are 300 incandescent lamps, and 800 on the ground floor, supplied with current by the great Ferranti 200-volt machine already noticed. Fifty volt lamps are used, four in series. The old gas fittings have been largely worked in to carry the lamps. The basement current is supplied by a smaller Ferranti with Siemens' exciter giving fifty-six volts. Sixty volt lamps are used in parallel. Of the six leads, four consist each of nineteen No. 12 wires, and two of nineteen No. 14 wires. The total length of wire used is fifteen miles. There are 300 lights in the basement. There are several other arc lamps in the basement not shown on the plan.

To sum up, there are in all 2000 incandescent and 100 arc lamps, and sixty miles of wire.

It is a noteworthy fact that so many types of dynamo should be used, and that all seem to give satisfactory results. From careful personal examination we can say that we have never seen better lighting, the incandescent lamps being without fluctuations of any kind. We have often heard hard things said of electricians, and have said them ourselves. The electricians have retorted that the engineers were to blame. There seems to be some justification for the statement supplied by the plant we have described. That is to say, it seems that when, as in the present case, sufficient power and sufficient regularity are provided, dynamos nominally defective will do good work. It is not too much to say that Mr. Richmond has, under conditions of great difficulty, produced engines which drive the dynamos at a perfectly steady pace. The professional electrician has had nothing to do with the installation, the whole being carried out by Mr. Richmond and Mr. Whiteley's staff, and Mr. Richmond has provided for the steady and regular driving of the dynamos with unusual care. The lesson taught is instructive. We have here, shall we say a "scratch team" of dynamos, doing most excellent work. The whole installation from first to last shows that if proper precautions be taken to secure the requisite conditions, electric lighting may be made to compete with gas. The whole reflects the utmost credit on Mr. Whiteley, who has spared no expense to ensure efficiency, and on Messrs. Richmond and Co., who carried out the work. The premises are not fully lighted now, a great deal of gas being still used. The installation is, however, being extended. Our readers interested in electric lighting will do well to pay a visit to "Whiteley's." They will find much to interest if not astonish them. The place is unique. It is somewhat outside our province to deal with what is to be seen, but this much may be said, that of the numerous descriptions of the place which have one time or another been published, not one gives an adequate idea of the magnitude and importance of an undertaking no parallel for which can be found in Paris or New York.



ELECTRIC LIGHT ENGINES, DETAILS OF RICHMOND'S VALVE GEAR.



DIAGRAMS FROM ELECTRIC LIGHT ENGINES.

Professor Ryan delivered a popular lecture on "The Life History of an Engine" in the Athenæum, Bristol, on Friday evening, February 11th. The lecture was illustrated by many experiments. Amongst others, model engines constructed at the Bristol University College were worked by steam and compressed air. A Savary engine constructed of glass was exhibited at work on the lecture table, lifting water into an overhead receiver. The condenser of Watt was illustrated by another glass engine, which worked successfully before the audience.

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE.—COURT OF APPEAL.

(*Before* LORDS JUSTICES COTTON, LINDLEY, *and* LOPES.)

THE EDISON AND SWAN ELECTRIC LIGHTING COMPANY *v.* WOODHOUSE AND RAWSON.

IT may be remembered that two actions were brought by the plaintiff company in respect of patents connected with electric incandescent lamps. They were both heard by Mr. Justice Butt, sitting in the Chancery Division. He decided in favour of the plaintiffs as to one patent out of three sued upon, viz., an Edison patent, in one action, and in favour of the plaintiffs as to the patent the subject of the second action. The defendants appealed in both actions. A short time since judgment by the Court of Appeal was given, affirming the decision of Mr. Justice Butt as to the Edison patent, Lords Justices Bowen and Fry concurring, but Lord Justice Cotton dissenting. To-day judgment was given, all the Judges concurring, in the second action, in favour of the plaintiff company. The patent in question relates to a process described by Mr. Justice Butt as one of singular beauty and efficiency. It is a process of preparing a fit substance for the illumination of a lamp—sometimes inaccurately called a burner; that is, a substance which is thrown into a glow of white heat by passing an electric current through it without its wasting. This patent was taken out in 1878 by Mr. Cheseborough in this country on communication from Messrs. Sawyer and Mann, patentees in America. Illuminators made out of any ordinary charcoal or carbon are liable in the most perfect vacuum to disintegration, both from the air or oxygen "occluded"—that is, shut up in its pores or in some way clinging to it—and also from want of homogeneity and uniformity of thickness. By Messrs. Sawyer and Mann's process these defects are cured, and a material exceedingly suitable in other respects is obtained. The patent claims both the process and the material produced by the process. The process is effected by subjecting the carbon material to heat in a proper atmosphere or liquid which contains carbon. The heat is obtained by passing an electric current through the material under preparation; the force of the current is increased during the operation. The effect of this operation is to cause a deposit of carbon in the pores of the material, and also to coat the material with such deposit. It seems that, from the carbonaceous preservative material which surrounds the carbon under preparation, some of the carbon nearest to it is evaporated and deposited in and on it like dew; the operation has the further beneficial result that the thin parts of the material under preparation become the hottest, because they offer the greatest electrical resistance, and because they are hottest they receive the greater amount of deposit. From this cause the illuminating conductor, when finally prepared, is not only solid throughout, but is of uniform thickness, a point of great importance in respect of the durability of the lamp, and furthermore the nature of the prepared carbon has become of a graphite character, and therefore specially suitable for incandescent lighting. The principal defence to the action was raised on an alleged anticipation by a certain experiment made by the well-known French chemist Despretz in 1849. Despretz was seeking to fuse and volatilise carbon, and in doing so failed, but he produced a material which must have been very like the plaintiff's material. On this part of the case an important and difficult question of law was raised—namely, assuming what Despretz produced was the same as Sawyer and Mann's, could such an experiment be considered an anticipation of the practical use to which the article has since been put, so as to avoid a patent? The point was not decided, as will be seen. A later experiment by one Sidot was also set up as a defence. Another point useful to refer to in anticipation of the judgment is that the patentee called the gas or liquid which he tells the public is to surround his material in process of conversion a "hydrocarbon," and it was said this was either too narrow or too wide. If it were limited to substances containing only carbon and hydrogen, it did not include the substances really used, whereas if it included substances containing hydrogen and carbon and other elements, it would include some which contained oxygen, and would itself destroy the material in preparation. The defendants also attempted to avoid the patent on the ground that the specification did not sufficiently indicate that the electric current was to be increased during the process.

The Attorney-General (Sir R. E. Webster, Q.C.), Mr. Aston, Q.C., and Mr. Fletcher Moulton, Q.C., appeared for the plaintiffs; Sir Horace Davey, Q.C., Mr. Macrory, and Mr. G. H. Rawson for the defendants.

Lord Justice LINDLEY delivered the judgment of the whole Court as follows:—The plaintiffs in this case sue the defendants for infringement of a patent obtained by Cheeseborough in June, 1878. For the purposes of this action the patent may be described as for the production of a carbon for use in electric lamps. The kind of electric lamp—that is, whether an arc lamp or an incandescent lamp—not stated, either in the title or claim, but in looking into the body of the specification it is reasonably clear that the patentee is referring to incandescent lamps, and those only. The patentee points out that nearly all obtainable carbon is open to objection by reason of its dissociated character, lack of homogeneity, and by reason of its occluding air or oxygen; in other words, by reason of its porosity. He points out that carbon of the ordinary sort, when heated by the electric current, presents points and lines of unequal brilliancy. He then shows how a carbon free from these defects can be obtained. His method is to heat a pencil of carbon by passing an electric current through it while in a hydrocarbon gas or liquid; he says that the heat required is as high as 7000 deg. Fahrenheit, and that carbon so heated decomposes the surrounding gas or liquid, the carbon of which enters and fills up the pores of the pencil and deposits a perfectly homogeneous layer, generally of a bright gray colour, upon the exterior surface. He says that carbons prepared by this process when heated by the electric current glow with a uniform brilliancy throughout. He says, further, that as the carbon increases in size more current is required to maintain its temperature, and that if the current is gradually increased in accordance with the demand for it there is apparently no limit to the increase in mass of the homogeneous exterior deposit, and that carbon pencils cut from this deposit on the original pencil may be used in the lamps. The patentee then claims the above method of preparing such pencils, and also the substance so prepared for electric lamps. Now it is not denied that pencils thus prepared are better than any before known for the purposes of incandescent electric lamps, and the defendants admit that they make carbon pencils for such lamps by electrically heating them while immersed in or surrounded by a hydrocarbon gas or liquid. The defendants do not admit that they keep up the temperature or increase the electric current, but the evidence shows that they cannot obtain what they want unless they do keep up the temperature and consequently increase the current. We therefore consider that the admission made by the defendants amounts to an admission of the infringement by them of the plaintiffs' patent, if that patent is good. The defendants, however, contend that the patent is bad on various grounds, but mainly on the ground of want of novelty both as regards the process described and the substance produced, and in support of this contention they rely on certain experiments by Despretz and by Sidot. It will be convenient to deal with this head of defence first. In 1849, M. Despretz, in attempting to volatilise carbon by means of electricity in an atmosphere of carburetted hydrogen, decomposed that gas, and carbon was precipitated on the carbon he was attempting to volatilise, and in the whole apparatus the carbon experimented upon and the lamps were covered with lampblack, which was deposited in flakes; on removing these the carbon experimented on was found to be smooth, bluish gray, and larger than before. Despretz further observed that sugar charcoal, which is light, black, dull, and fragile, became, when experimented upon as above, denser, harder, bright, and *assez solide*—that is, rather solid, or solid enough. In his experiments Despretz used a battery of enormous power—viz., a Bunsen's battery of 600 cells. The carbon experimented upon was of various kinds—viz., the charcoal deposited in gas retorts, anthracite, graphite, charcoal prepared by calcining sugar, and charcoal obtained from turpentine. It also appears that sometimes he united the poles of his battery by threads or rods of carbon, and that at other times he suspended similar threads or rods vertically between carbon points at the poles. It is not quite clear which method he adopted in his experiments with carburetted hydrogen. The scientific witnesses examined at the trial apparently thought or assumed that the thread or rod connected the two poles. In considering this experiment it is important to observe that M. Despretz was attempting to fuse and volatilise carbon, and not to produce it or to make it in any shape or form. With reference to his objects the experiment was a failure, and he treats it accordingly. He warns other persons desirous of pursuing his inquiries not to use carburetted hydrogen for the purpose. He pursued the matter no further. He gave no directions as to the best method of making carbon of any kind for any purpose, nor did he point out what precautions ought to be taken in order to avoid a general deposit of carbon over the whole apparatus. He saw that the carbon which he was trying to fuse and to volatilise became smooth, bluish gray, and larger, and that sugar charcoal became denser, harder, brighter, and more solid, but his observations as to the changes undergone by the carbon went no further. He did not examine the porosity of his product; he was not aware of the fact, if it be a fact, that the carbon experimented upon had become less porous, or had undergone any change which made it peculiarly useful for any purpose whatever. The fact, however, that the particular form of carbon called graphite had been obtained by Despretz, or could be obtained by means of a less powerful battery than was used by him, was subsequently ascertained by Boltendorf, as appears from the "Jahrsbericht" or annual report on the progress of chemistry in 1870. That publication gives no further information on the subject. The rest of the evidence relating to Despretz's process consists of the testimony of the scientific witnesses on behalf of the plaintiffs. It is worthy of remark that no carbon produced by Despretz's process ever appears to have been made. No one has ever seen it. The defendants did not produce any carbon so made. No one, in truth, knows anything more about it than Despretz himself published. The burden is on the defendants to show that Despretz's process is the same as the patented process, and to show that the substance obtained by him was in all respects the same as the substance claimed by the plaintiffs. The defendants have adduced no evidence to establish either of these propositions beyond what the plaintiffs' witnesses themselves stated on cross-examination. We have therefore only to examine their evidence, and we have carefully done so. Without referring at length to it, we consider—(1) that before the date of the plaintiff's patent no one had ever intentionally made or attempted to make carbon for any purpose whatever by Despretz's process; (2) that Despretz's process is not a practicable method of obtaining non-porous carbon for any useful purpose; (3) that so far as can be inferred without actually making carbon by Despretz's process the carbon experimented on by him must have been superficially charged with graphite similar in all respects to that obtained by the plaintiffs; (4) that there is no difficulty in making carbon fit for incandescent electric lamps by following the directions contained in the plaintiffs' patent; (5) that carbon made according to the plaintiffs' patent is better adapted for incandescent electric lamps than any other form of carbon known at the date of the patent, and that this fact was never known to or suspected by Despretz or any one else until discovered in 1878 by Sawyer and Mann, who communicated the discovery to Chesebrough, the plaintiffs' assignor. In this state of the evidence we can only come to the conclusion that for all useful and practical purposes the processes are different and the products are different. By following Despretz's process, carbon resulting from the decomposition of carburetted hydrogen is deposited over the whole apparatus, and is wasted; whereas by following the plaintiffs' process the carbon is deposited where it is wanted and utilised. The substance obtained by Despretz was a mere scientific curiosity of no known utility whatever; whereas the substance obtained by the plaintiffs is shown to be a valuable article of commerce, of great utility for the purpose of illuminating by incandescent electric lamps. It may be true that Despretz produced graphite, and that the plaintiffs produce graphite, and that long before 1878 graphite was used for incandescent electric lighting, but the fact still remains that of all the known forms of graphite that made by the plaintiffs' process was, in 1878, the best for the purpose they mention, and the carbon got by Despretz's process is not shown to be structurally the same as that made by the plaintiffs', nor that that which Despretz got was non-porous. Such being the view we take of the evidence, it becomes unnecessary to decide what the consequences would have been if the defendants had succeeded in showing that the material produced by Despretz was non-porous and in all respects the same as that produced by the plaintiffs' process. We express no opinion whether in the case supposed the plaintiffs' patent would be bad, inasmuch as it showed how to apply to a useful purpose carbon which neither Despretz nor any one else was aware had the specially useful qualities discovered by the patentee. When such a question arises it will be necessary to consider such cases as "Walton *v.* Potter" (1 Web. Patent Ca., 585), "Walton *v.* Bateman" (*ib.*, 613), "Muntz *v.* Foster" (2 Web. Patent Ca., 108), on the one side; and "Losh *v.* Haynes" (1 Web. Patent Ca.), and "Harwood *v.* the Great Northern Railway Company" (11, H. L. C., 654), on the other. As regards Sidot's process, little need be said. His process was entirely different, for he used external heat. The substance he produced, though in one sense the same as that obtained by the plaintiffs, was not so dense, and was very inferior to theirs for the purposes of illumination by an incandescent electric light. The difficulty in upholding the plaintiffs' patent turns entirely on Despretz's experiments and not on Sidot's mode of making carbon pencils for arc electric lighting. It remains to consider the objections to the specification and claim. One is that the expression carbon gas or liquid in the claim is ambiguous and too wide and misleading, and it is urged that the expression includes carbonic oxide and carbonic acid, neither of which will do. But every claim in every patent must be read and construed with reference to the specification, and not as if the claim were an isolated sentence having no connection with or reference to what precedes it. To see what is meant by carbon gas or liquid we must turn to the specification; and when we do so we cannot conceive that any one reading this patent fairly, with a view to understand it, would ever dream for a moment that carbonic oxide or carbonic acid could answer the purpose or could be meant by carbon gas. The specification clearly points out that carbon is to be deposited, and the presence of oxygen is to be avoided. Reliance was placed on an answer of Sir F. Bramwell. What he said in effect was, You had better put your question to the chemical witnesses and not to me. The chemical experts, as might have been expected, ridiculed the notion that any one would think of trying carbonic oxide or carbonic acid. In the body of the specification we find that by carbon gas or liquid is meant what the patentee calls a hydrocarbon gas or liquid, and he states that beeswax, balsam, most oils, if pure, operate satisfactorily, and that almost any hydrocarbon will answer. The appellants, on this, urge that beeswax and balsam and oils are not, properly speaking, hydrocarbons, and that the specification is inaccurate and misleading. The evidence shows that in its technical sense a hydrocarbon is a chemical combination of hydrogen and carbon, and nothing else, and that beeswax, balsam, and oils are not technically hydrocarbons. They contain hydrogen and carbon chemically combined with each other, but also with other substances. But the evidence also shows that, so far as is known, every substance which is a hydrocarbon either in its technical sense or in the looser sense in which the patentee uses the expression, does answer the purpose; and there is no evidence that anything which answers the description of hydrocarbon in either sense will not answer the purpose. In this state of the evidence it is impossible for the Court to say that the specification is open to serious objection, or is insufficient on this ground. The next objection that requires notice is that it is contended that the evidence shows that it is essential to success to increase the temperature gradually, and that the specification is insufficient because it does not point this out. Now the evidence certainly shows that the maintenance of a high temperature is that which distinguishes Chesebrough's process from Despretz's experiment, and although Professor Dewar points out the importance of a gradually increasing current, neither he nor any other witness says that the temperature ought to be low to begin with and be gradually raised. Their evidence comes only to this — that the temperature must be kept up and the electric current must be increased or the temperature will fall. But the patentee himself tells you this. He says that the temperature must be as high as 7000 deg. Fah., and the sentence in the specification "as the carbon increases in size more current is required to maintain the temperature," is shown by the evidence to be useless and an obvious truism to those who understand the subject, unless the sentence is understood to be a direction to keep up the temperature; and when we find that in fact no difficulty is experienced by reason of defective instructions on this point, the Court cannot hold as a matter of law that the specification is not sufficiently explicit. If the defendants had shown that the directions as to temperature were not practically sufficient to enable a competent person to make the patented articles the case would be very different; but they have not attempted to do this; they rely on the words used and on the evidence as to temperature already alluded to. This, in our opinion, is not sufficient for our purpose. If the language of a specification is clear enough to guide a competent workman and enable him to obtain the desired result, we cannot see how a Court can hold the language insufficient in point of law. No doubt it is for the Court and not for a workman to construe the specification; but if a workman says it is a sufficient guide to him and the Court believes him, the Court must hold that as regards clearness of description the specification is, in point of law, sufficient. For the foregoing reasons we are of opinion that there is sufficient originality and novelty in the patented process to support the first claim, and sufficient difference in the thing produced to support the second claim. The appeal is therefore dismissed, with costs.

MR. MOON ON CONTINUOUS BRAKES.

AT the half-yearly meeting of the London and North-Western Railway on the 15th inst., Mr. Moon confided to the shareholders some further news about brakes. Earl de la Warr asked the President of the Board of Trade on the 14th inst. whether the Government intended to take any steps this session as to enforcing the conditions they consider essential for an efficient brake, and went on to make some strictures on the London and North-Western Company. The next day Mr. Moon made the following remarks:—

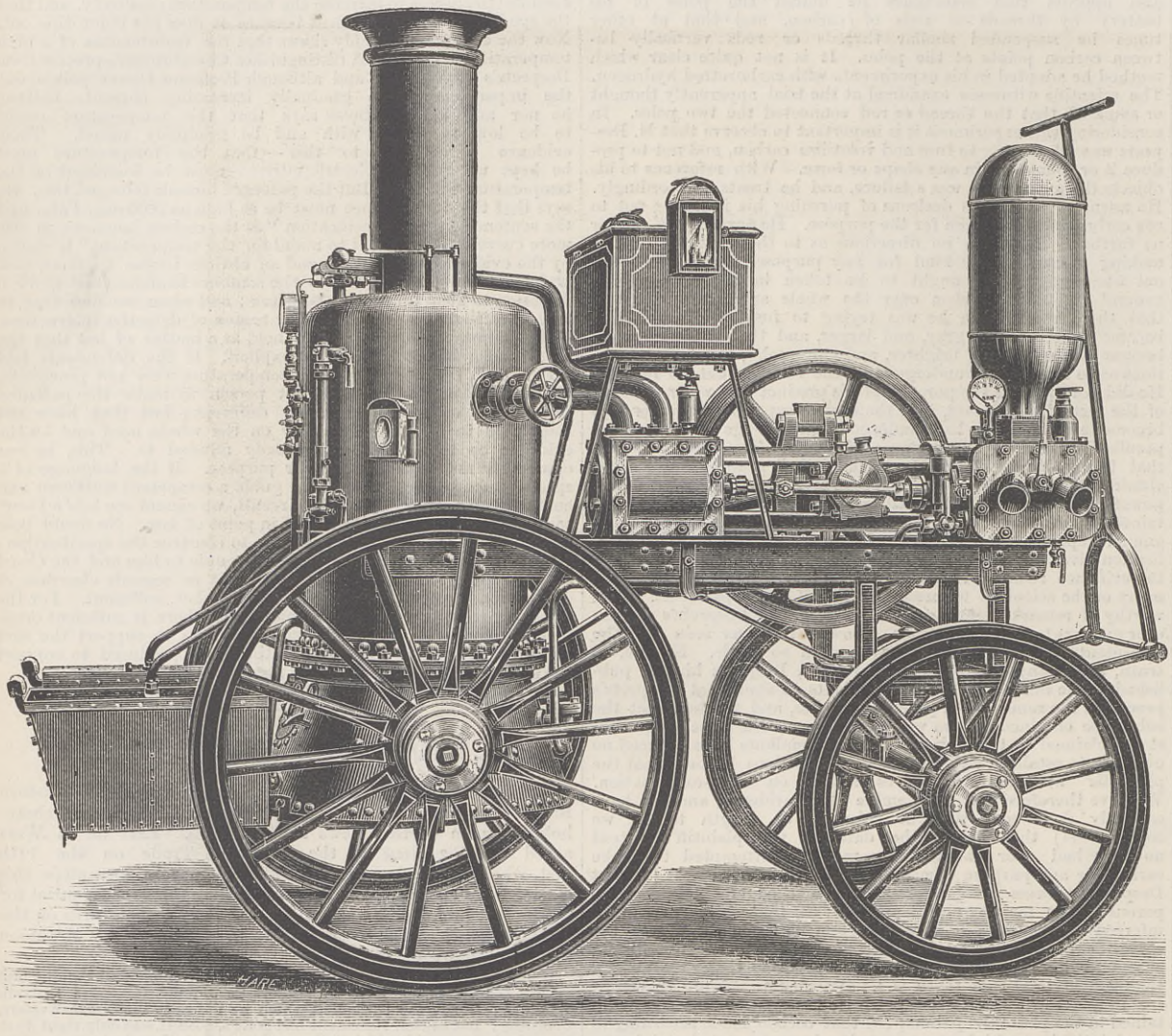
If Lord de la Warr had done the company the honour of coming and asking them a question on the subject, he did not think his lordship would have made the statement which he did as to the North-Western Company; but as that statement had gone abroad it was only right that he—the chairman—should tell the meeting what they had done. The brake of which his lordship had spoken so disparagingly as only used by one railway had been used for many years almost without a failure, and without the smallest complaint, and had worked admirably; but he—the chairman—had told the proprietors some time ago that, finding most of the large companies in their neighbourhood were using the vacuum brake, they had themselves determined to apply it, and that it would cost the company £110,000 to do so. They had applied it, and had more than half of their stock fitted with it. In addition, in deference to the wishes of some of the neighbouring companies, they had also agreed to instruct their officers to make the brake automatic, and that they were doing at a cost of £45,000. He would not, however, like them to run away with the idea that the continuous brake, which Lord de la Warr so strongly recommended, was to do away with all danger. On the contrary, it had its own special dangers. He—the chairman—was not in favour of it, but in deference to the general desire of the community and the wishes of the Board of Trade they were adopting it.

The reasons given for the above change certainly indicate a *rôle* not quite consistent with the antecedents of the London and North-Western Company. We call to mind that, notwithstanding the refusal of all the other companies to adopt the chain brake, the North-Western fitted it to all its stock. Only two or three years ago, under the supposed pressure from adjoining companies, they began to fit a non-automatic brake similar to that which failed so disastrously at Penistone, and which only one small line running in connection with it would adopt. This spirit of independent and of voluntary isolation has now been abandoned, it seems, and at the bidding of other companies the leading railway has consented, though with great unwillingness, to attach an automatic brake. People will, of course, put their own construction on all this. We remember Mr. Moon's repeated eulogies on the chain brake, which he described as the "best in the world," and the same words were used by Sir Edward Watkin regarding the simple vacuum brake, and are now confirmed and emphasised by Mr. Moon in the above extract. These "best" brakes have had to be discarded, though at a very heavy cost. The automatic vacuum, into which their last brake is to be converted, certainly, as Mr. Moon says, has its own special dangers; and we venture to prophesy that Mr. Moon will some day remind his shareholders that he told them "he was not in favour of it." Recently Mr. Laing, the chairman of the Brighton Company, told his shareholders that the Westinghouse brake had "paid its expenses five times over in the money question, to say nothing of the humanity in saving life." Yet everyone knows that neither Mr. Moon nor Sir Edward Watkin would touch the Westinghouse brake if it were given them, merit having long since ceased to be a factor in this important question.

THE 110½-TON GUN.—The proof firing of this gun was continued on the afternoon of Thursday, February 10th. Our issue of February 11th gave only the result as actually read off without waiting for correction. Thus, the velocity we gave of 1685ft. at the point measured, implies 1699ft. per second at the muzzle. We also find that the four charges spoken of as 112lb. each, were actually 112¼lb. These four, with one of 150lb., bring the total firing charge of the first round up to 600lb. exactly. The pressures were 9·6 and 9·7 tons per square inch—that is, 9·65 average. The second and third rounds were fired in the afternoon. The charge of the second round was 700lb., the muzzle velocity 1843ft. per second, and the pressures 12·3 and 11·8 tons, giving a mean of 12·05 tons per square inch. The recoil on the pistons was about 4ft., and the carriage ran back about 69ft. on the rails. The third round was fired with a charge of 800lb. The muzzle velocity was 2007ft. per second, the pressures were 15·0 and 15·2 tons, or 15·1 tons average pressure. The recoil on the pistons was about 5ft. Westphalian powder was used for this charge. A fourth round was fired on Wednesday, February 16th, in the presence of the Director of Artillery and departmental officers, with a charge of Westphalian brown prism powder of 850lb., made up in seven sections. The velocity was 2078ft., the pressure was about 18 tons per inch. The gun recoiled 4ft. 6in. on the piston of the recoil press, and the carriage ran back about 78ft. on the rails. The firing is intended to be continued, increasing the charge up to 950lb.

COMBINED IRRIGATING AND STEAM FIRE ENGINE.

CONSTRUCTED BY MESSRS. SHAND, MASON, AND CO., LONDON.

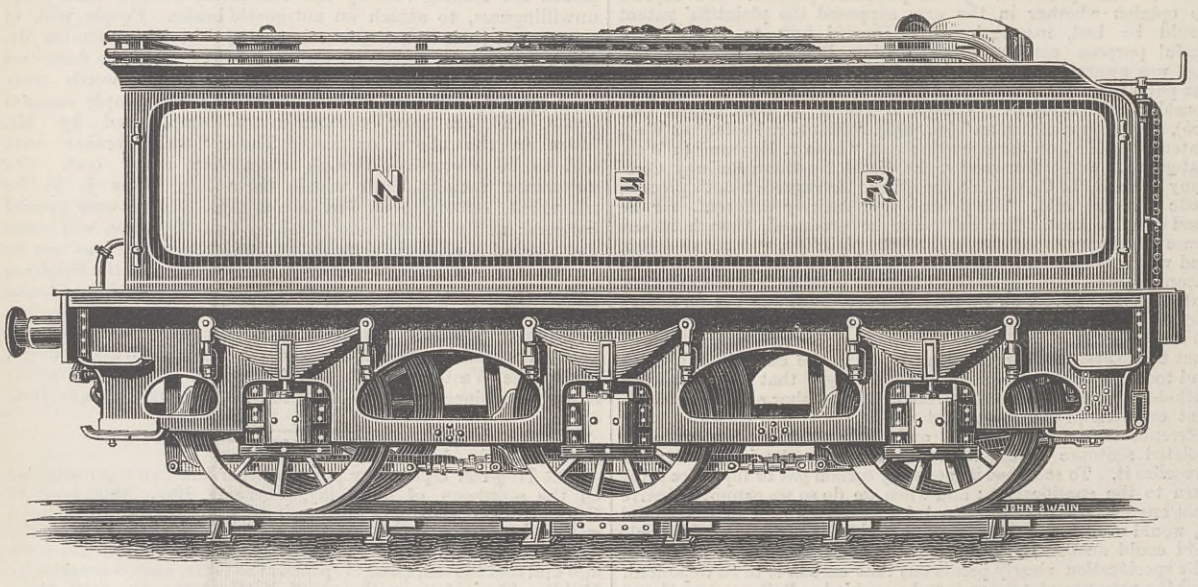


COMBINED IRRIGATING AND STEAM FIRE ENGINE.

WE illustrate above a light and compact engine, designed by Messrs. Shand, Mason, and Co., to supply an increasing demand for a cheap engine to be used for irrigating purposes, more especially in hot countries, and in case of emergency to be equally efficient as a steam fire engine. The primary qualities of such an engine are simplicity and strength in construction. The pump must be of good design, not easily clogged, and with valves easy of access, while the boiler should be capable of using the poorest classes of fuel, such as straw, rough wood, and vegetable refuse, as also coal when developing the maximum power.

The boiler of this engine is on Shand, Mason, and Co.'s inclined water-tube principle, of similar design to that used in their steam fire engines, and is readily accessible for inspection and cleaning, and raises steam rapidly and in great volumes. Steam of 100 lb. pressure can be raised from cold water in from seven to seven and a-half minutes. The engine is placed in front of the boiler, and over the front wheels. The piston-rods of the steam cylinder and pump are united in a crosshead, with sliding block communicating rotary motion to the crank shaft, on which is the excentric for working the slide valve and feed pump, and also a fly-wheel. The pump is double-acting, and all the valves can be inspected and renewed on removing the cover, on which are the delivery outlets for attaching hose. The running wheels and locking gear are such as are used for an ordinary portable engine. The engine, as illustrated, draws its water from a depth of 20ft. to 25ft., and delivers it through hose or pipes to a distance of a mile or more. When it is necessary to draw from a greater depth than 25ft. from the surface, the design is somewhat altered. An engine such as this must commend itself to the cultivator and breeder in such countries as India and Australia, where water supply is the all-important object to obtain. The latest engine of this description has been supplied to the Imperial Japanese Government.

COMPOUND GOODS ENGINE TENDER.



COMPOUND GOODS ENGINE.

IN our impression for January 14th we gave an external elevation of the compound goods engine constructed by Mr. T. W. Worsdell, Locomotive Superintendent of the North-Eastern Railway. Above we illustrate the tender of this engine, and we publish a two-page supplement, which explains itself. The engine was constructed in the shops of the company at Gateshead. In a succeeding impression we shall give a cross-section, showing in detail the starting-valve. The engine has run regularly the heaviest goods trains for the last three months, and ten more are now being constructed in the shops of the company. We gave the complete list of dimensions of the compound goods engine on page 24. Its regular work is on the fast goods service between Newcastle, York, and Leeds, the average train being forty loaded wagons, but it has frequently taken fifty in the regular time allowed. The engine works freely, maintains steam fully, and is well master of its loads, starting from any point easily and with as great facility as any ordinary engine. The amount of coal used for one month averages 6 lb. per mile less than all the engines on the same work, and when the train weight is the same average. This represents just 15 per cent. of gain in fuel alone. A special two days' measured trial for consumption in the engine and the best ordinary engine on the same service, resulted in the compound engine hauling 16 per cent. more trucks with a consumption of 18 per cent. less fuel, the same proportion of loaded and unloaded trucks being taken, than the ordinary engine. The weather was the same for each. There is no doubt therefore of a saving of from 15 to 18 per cent. of fuel being realised in compound engines on this principle. It is found that each main line goods engine in steam consumes annually about 800 tons of coal. If 15 per cent. of this is saved it amounts to, say, 120 tons per annum; an item of importance on any line, even where coal is cheap, but much more where the coal is high in price—as at 10s. per ton the saving in coal alone would be £60 per engine per annum.

There are one or two special features in this engine; perhaps the most observable is the form and size of the cab. This has been designed with a view to more complete shelter and comfort, owing to the exposed working on so much of the lines on the east coast. The sides are of iron, the roof is of wood; the glass windows slide so as to open, and there is as ample a look-out as in any other engine. We have ridden on this engine, and are sure the drivers well appreciate the ample and comfortable shelter provided. It will also be seen that Mr. Worsdell has made a new departure in the crank axle. Finding that the best form in use heretofore was an oval or ellipse, on which a strong hoop could be firmly shrunk, he had special machines designed for shaping both the cheeks and the hoops truly to each other This was a costly process. It struck him that greater strength could be obtained with nearly the same weight if the cheeks were perfectly circular and not hooped—the whole crank could be turned up in a lathe, requiring no special finishing machine and no extra work in hooping. The result is so satisfactory that he has twenty engines running with these cranks, and is applying them to all new main line and other engines. We believe this is the first application of this form of axle. The strength is more than one-half more than the ordinary hooped axle, and is enough to admit of the cheeks being made thinner, and so longer bearings can be obtained. The working parts of this engine are all massive in their construction. The valve gear is Joy's. The wheels and motion plate, and all brackets, &c., are of cast steel; all the working parts have large surfaces, and everything has been arranged with a view to keep out of the repairing shops as long as possible. We hope to give diagrams off the high and low-pressure cylinders in a short time. The working boiler pressure is 160 lb. per square inch. This is the first compound goods engine that has been used on an English line. In other countries there are several goods engines compounded on the same principle—Worsdell and Barnes'—having two cylinders only.

It should be remarked that in Mr. Worsdell's compound engine there is no re-arrangement of parts, the same engine, identically in all its parts, does for either a compound or an ordinary goods or passenger. This is a very important feature, and is not, so far as we know, accomplished in any other design of compound engine.

TORPEDO BOAT FOR TURKEY.

ON the 9th inst. the official trial took place of the first of two special class torpedo boats which have been designed and constructed for the Imperial Ottoman Government by Mr. G. F. G. Des Vignes and Messrs. Maudslay, Son, and Field, who conjointly carry out the work. These vessels present several very noteworthy features. They are 126ft. long and 15ft. beam, and are thus of 2ft. more beam than any high-speed torpedo vessels yet made. This great beam secures seagoing qualities and crew accommodation, which are obvious, without in any way affecting the high speed, as will be seen from the figures below. The boats are very strongly built, the plates being $\frac{1}{4}$in., $\frac{5}{16}$in., and $\frac{1}{8}$in. in thickness. They are divided into compartments by eight bulkheads, and are fitted with three cylinder compound engines. The cylinders are all fitted with equilibrium valves, and are high-pressure, 20in. diameter, two low-pressures 25in. diameter, the stroke being 14in., and the boiler pressure 120 lb. The fan, circulating and feed pumps are driven by a separate engine, and the bilge suction valves are controlled from the deck. Most satisfactory runs were made at the measured mile at Long Reach, and were carried out without any hitch, the vessel being free from vibration. The mean of the runs on the measured mile gave a speed of 21·7 knots, equal to 25 miles per hour. The highest speed reached was 23·4 knots, equal to 27 miles per hour, with a fair breeze of wind and slack tide. One noticeable feature in the boats is that, while carrying a ram bow, they have overcome the nuisance of the wave thrown on the forward part of the vessel, and consequently their bow torpedo tubes can be worked while running at any speed. There were present on board as representing the Admiralty, and on behalf of the Turkish authorities, Commander Egerton, R.N., and Mr. Shapcott, R.N., the Naval Attaché from the Ottoman Embassy, and other Turkish gentlemen, also the builder and engineers.

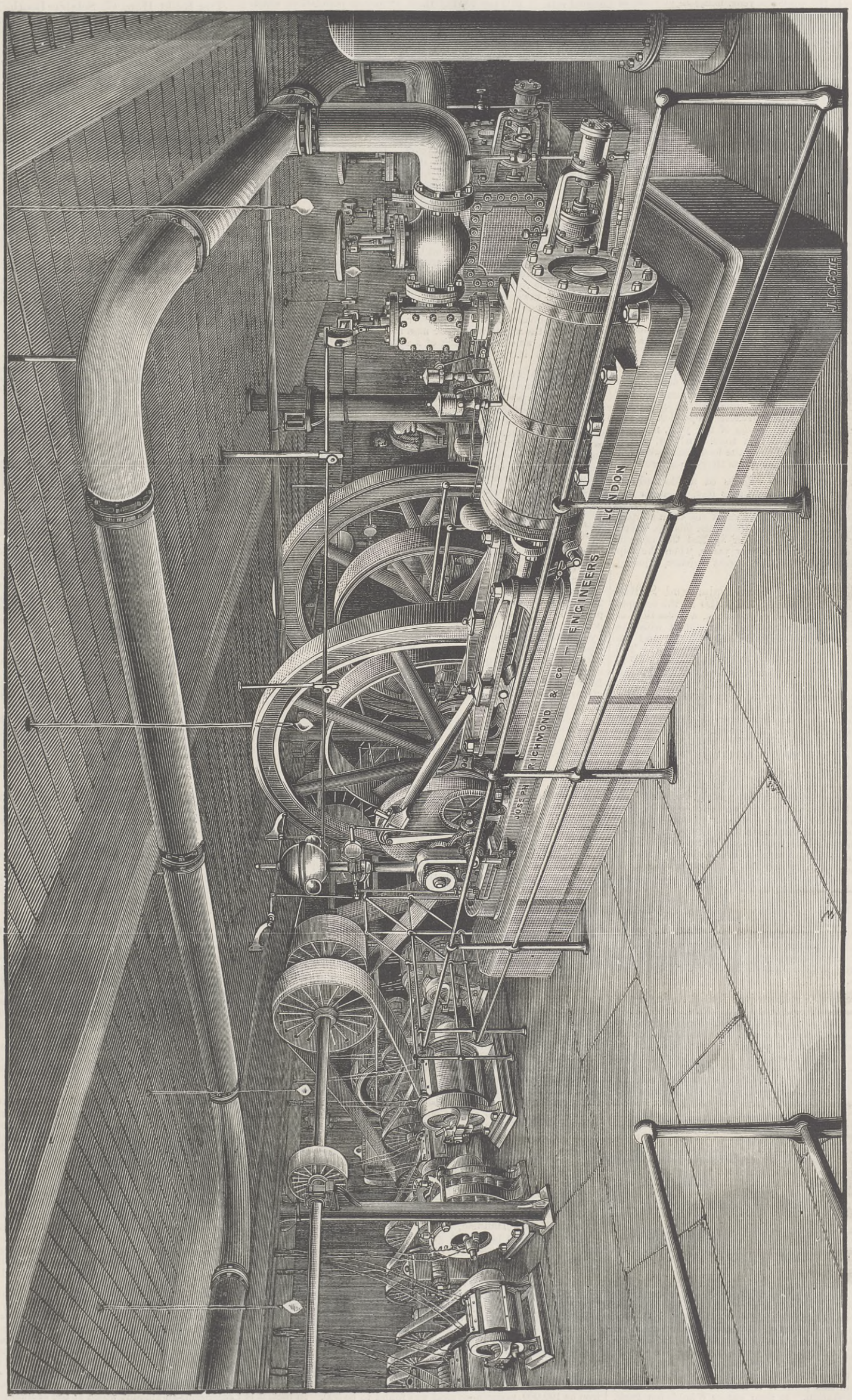
INTERNATIONAL EXHIBITION OF MACHINERY AT MILAN.—Preparations are being made at Milan for the International Exhibition of machinery for grinding corn and making bread.

THE SOCIETY OF ENGINEERS.—The first ordinary meeting for the present year of the members of the Society of Engineers was held on Monday evening, February 7th, at the Town Hall, Westminster. The chair was first occupied by the retiring President, Mr. Perry F. Nursey, who presented the premiums of books awarded for papers read during the past year. These were—the Bessemer Premium, to Mr. Percy Tarbutt, for his paper on "Liquid Fuel;" the President's Premium, to Mr. G. B. Jerram, for his paper on "River Pollution caused by Sewage Disposal;" and a Society's Premium to Mr. E. S. Bellasis, for his paper on "The Rourkee Hydraulic Experiments." The retiring President then introduced the President for 1887, Professor Henry Robinson, who proceeded to deliver his inaugural address. He dwelt at some length on the essential conditions that had to be observed in preparing and training a young man for the engineering profession. The next subject touched was railway engineering, and light lines, or tramways—either horse, steam, or cable—were advocated under certain conditions. The prospect of railways being shortly adopted in China was spoken of with confidence, as also the extension of the existing Burmese Railway from Rangoon to Mandalay, by which both commercial and political advantages would accrue to this country, especially with reference to the Chinese Empire. He pointed out how much more frugal foreign workers were than our own, enabling the plant and machinery of a manufacturer to be utilised longer on the Continent than in this country. He described how water pressure was adopted to power co-operative purposes, and as evidence of this, mention was made of the success of the first works of this nature, which were those he had carried out at Hull, and which were being followed by similar ones in other towns. Compressed air was also relied on as an excellent means of transmitting power on the co-operative system, and the large works which are now being carried out at Birmingham by himself and Mr. Sturgeon were mentioned. Reference was next made to the establishment of county boards, a difficulty to be overcome being the administration of urban and rural affairs by one central authority. Sufficient agreement now exists in reference to much-needed amendments of the Public Health Act of 1875, and of the Rivers Pollution Act of 1876, to enable them to be carried through Parliament without difficulty if only an opportunity was given. The most recent experiences in the questions of water supply and sewage disposal were touched upon.

ELECTRIC LIGHT INSTALLATION AT "WHITELEY'S," BAYSWATER.

MESSRS. J. RICHMOND AND CO. NEW SUN WORKS, BOW, ENGINEERS.

(For description see page 124.)



RAILWAY MATTERS.

The new branch of the North-Eastern Railway, which is to unite Wooler with Alnwick, is rapidly approaching completion.

The total tonnage in the down goods shed of the South Western Railway, Nine Elms, for the year 1886 was 113,268 tons, as against 106,900 tons in the previous year, being an increase of 6368 tons. In consequence of agricultural depression, the inwards traffic did not give so satisfactory a return.

In a report on a collision which occurred on the 10th ult. at Aboyne station, on the Dee side branch of the Great North of Scotland Railway, Major Marindin says:—"The collision would probably not have been so trivial an affair if the train had been without a good continuous brake—the Westinghouse—which in this case did good service."

The Indian railways will shortly afford some important work to constructive and other engineers. Tenders are invited on behalf of the Indian State railways, for plate girders of 40ft. spans; and likewise for girders and joists for superstructure of a screw pile wharf. The Indian Midland Railway Company is also requiring forty-two locomotives, together with a supply of iron bridgework.

For real stick-in-the-mud conservatism one must look to a go-ahead country like the United States. There they fix the legs or arms of men and women and then slowly roast them to death. This is what they do every time their trains have a collision. If in England any such spectacle of weddedness to an old and vile custom could possibly be seen, Americans would in plenty say, "Of course, you don't improve much."

Mr. John E. Wootten, general manager of the Philadelphia and Reading Railroad, has resigned his position, owing to ill health. Mr. Wootten is well known as the inventor of the "Wootten" fire-box for locomotives, which has been so widely adopted. The fire-box was designed to meet the necessity of meeting the demand for increased power from the boilers by increasing the grate area. It is especially adapted and used for anthracite and small coal requiring a large thin fire.

It is understood that efforts will be made to secure the order for Glasgow for the forty-two locomotive engines and tenders that are wanted by the Midland Railway of India. All the locomotive works are exceedingly slack, and the greater proportion of the workmen have been idle since the beginning of the year, many of them having been discharged before that time. In fact, a considerable series of years have passed since the locomotive works of Glasgow were so poorly supplied with work as they are at present.

A curious illustration of the effects of a too sudden application of brakes was afforded the other day, when, as the north express was passing Warrington Junction on the Great Northern Railway, a slip carriage in the rear of the train became detached. Some platelayers standing by, seeing the mishap, waved a red flag to the driver to stop. The driver applied the vacuum brake, pulling up the express within a few yards, when the slip carriage ran into the rear of the train with great violence, injuring several passengers.

At the meeting last week of the London and South-Western Railway Company, an increase of £25,000 in the receipts and a decrease of £19,000 in the expenditure, a reduction of £22,000 in the renewal suspense accounts, coincident with the maintenance of forty-nine additional miles of railway, and the running of 143,000 additional train miles were reported. The reduction in the percentage of working expenses from 55·07 to 52 97 per cent. is evidence of the care with which the administration of the business of the company is conducted. A dividend of 6½ per cent., with £11,800 carried forward as against 6¼ and £5800 balance last year, must have been somewhat of a surprise to those of the proprietors who had previously lamented the heavy and increasing burden of capital charges. As compared with last year the capital has increased £1,519,000. The additional charges make up a total of £32,700, the whole of which is borne by revenue.

The American railway accidents in December include 65 collisions, 46 derailments, and 4 other accidents—a total of 115 accidents, in which 35 persons were killed and 129 injured. As compared with December, 1885, there was an increase of 41 accidents, and of 4 persons killed, but a decrease of 24 in the number injured. These accidents are classed as to their nature and causes by the *Railroad Gazette* as follows:—Collisions: Rear, 46; butting, 16; crossing, 3; total, 65. Derailments: Broken rail, 5; broken or defective frog, 5; broken switch-rod, 1; broken bridge, 3; spreading of rails, 5; broken wheel, 5; broken axle, 3; broken truck, 1; accidental obstruction, 1; cattle on track, 1; runaway train, 1; misplaced switch, 6; unexplained, 9; total, 46. Other accidents: Boiler explosion, 2; broken parallel-rod, 1; broken axle not causing derailment, 1; total, 4. Total number of accidents, 115. Nine collisions were caused by failure to use signals promptly; four by trains breaking in two; three by fog; two by snow; two by misplaced switches; one by a car left standing on main track. All three of the broken bridges reported were wooden trestle bridges.

Interesting railway relics have just found their way to the Birmingham Reference Library, in the shape of a volume of early prospectuses of local railways. Some of the provisions in the prospectuses sound somewhat strange now. The Birmingham and Liverpool Railroad Company, 1824, promises "to transport heavy goods at the rate of at least eight miles an hour," and states that "passengers may also travel with perfect security at the rate of at least twelve miles an hour, but to this the company will not pledge themselves." The same company in 1830 informs the public that "engines with passengers have frequently been known to exceed the velocity of thirty miles per hour, but a rate of from ten to twenty miles per hour has been established as safe in operation and certain of attainment. This extraordinary rapidity is accompanied with a motion so gentle and easy as to excite no alarm even in the most timid." The "London and Birmingham Railway Company's plan," issued in 1832, shows that the journey from Birmingham to Coventry may be accomplished in one hour, and that from Birmingham to London in five hours and a-half; and their prospectus issued in 1833 states that their ordinary rate of travelling was from fifteen to twenty miles per hour.

A new railway route will shortly place the inhabitants of Wimbledon and the district surrounding in more direct communication with Kensington and the West-end. The works on the line, which was originally promoted by the Wimbledon and West Metropolitan Company, but subsequently transferred to the London and South-Western Company, are to be immediately commenced by the last-named body in accordance with the provisions of the Act of Parliament obtained two years since. The line commences by a junction with the Putney Bridge Station of the Metropolitan District Railway. After leaving the Putney Bridge Station the line crosses over the Thames by a lofty iron bridge of five arches. It then proceeds in a south-westerly direction, passing through Putney, and over the Richmond and Windsor section of the South-Western line, and from this point it is continued to Southfields, where will be the first station. It then enters Wimbledon Park, through which it passes, proceeding directly south, the next station being in Wimbledon Park, a short distance to the west of Merton-road, to Wandsworth. Proceeding over the London and South-Western main line, it then forms a junction, on a descending gradient, with the company's Tooting, Hayden's-lane, and Wimbledon loop line, by which it arrives at the Wimbledon Station. In anticipation of the opening of the line a greatly enlarged station at South Kensington is contemplated for the joint traffic of the South-Western and Metropolitan District Companies.

NOTES AND MEMORANDA.

The six healthiest places in England and Wales last week were Nottingham, Leicester, Derby, Leeds, Sunderland, and Brighton.

The deaths registered during the week ending February 12th in 28 great towns of England and Wales corresponded to an annual rate of 19·5 per 1000 of their aggregate population, which is estimated at 9,245,099 persons in the middle of this year.

Lake Tahoe, long regarded as the deepest fresh-water lake in the United States, must now take the second place. Captain C. E. Dutton, of the U.S. Geological Survey, made, in July, 1886, a series of soundings at Crater Lake, Oregon, with unexpected results. The mountain wall that surrounds the lake is 900ft. high, the average depth is 1500ft., and the maximum 1996ft.

In London, 2563 births and 1418 deaths were registered. Allowance being made for increase of population, the births were 457, and the deaths 605, below the average numbers of the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which has steadily declined in the five preceding weeks from 20·3 to 18·4, further fell last week to 17·6. During the first six weeks of the current quarter the death-rate averaged 21·1 per 1000, and was 3·3 below the mean rate in the corresponding periods of the ten years 1877-86.

Very remarkable illustrations of the difference in refractive indices in glass are made in the form of lenses which magnify, and yet are perfectly flat on both sides, constructed by Schott and Co., of Jena, the manufacturers of Abbé's optical glass. These lenses are mere curiosities. They consist of single discs of glass, such that the refractive index decreases in a regular manner from the surface inwards. A noteworthy comment on the invention is made by *Nature* as follows:—"The properties of this arrangement have been investigated by Professor K. Exner, of Vienna. It is very funny, the way in which one man invents and makes a thing or a discovery, and then another of a different sort comes along and 'investigates' it."

Mr. G. Maw has recently described some interesting experiments on the freezing of water containing air. A recapitulation of the experimental results gives:—(1) In a thin ice coating, the upper or surface half contains barely a trace of eliminated air, whilst its under or bottom half contained 0·08 cubic inch of air in each pound of ice. (2) A surface coating of ice 1½in. thick contained 0·15 cubic inch of air in each pound weight, whilst an entirely frozen mass contained 0·59 cubic inch of air in each pound weight. (3) The freezing of a limited body of water which had been first frozen over and the surface ice removed points still more strikingly to the concentration of air in solution; for this contained 0·89 cubic inch of air in each pound weight, compared with 0·15 cubic inch in surface ice, and 0·59 cubic inch in an entirely frozen mass. The water employed in these experiments was from the East Surrey Waterworks.

A mixture of 70 parts of either infusorial earth, charcoal, or sawdust with 30 parts of nitro-glycerine is inexplosive, yet either of the following mixtures is explosive: Nitrate of soda, 75 40 parts; charcoal, 10 parts; nitro-glycerine, 15 parts; sawdust, 20 parts. Another mixture also explosive: Gunpowder dust, 90 parts; nitro-glycerine, 10 parts. It is a well-known fact that gunpowder is more effective when exploded by percussion caps than by simple fuse. Some consumers—contractors—always use percussion caps for that purpose. For the same reason, caps are better to explode Neptune powder, but Neptune powder is largely used by some parties and exploded—without cap—by fuse alone. In such use, the powder of the Neptune powder explodes the nitro-glycerine of the Neptune powder in the same manner as indicated in the Nobel patent.

A note on the tenacity of spun glass was read at the last meeting of the Physical Society by E. Gibson and R. E. Gregory. The authors have experimented on the tenacity of glass rods and fibres made from the same piece of glass. The fibres varied from $\frac{1}{75}$ to $\frac{1}{50}$ mm., and the rods from about $\frac{1}{2}$ to 1 mm. in diameter. They find the tenacity per square cm. of rods increases as the diameter decreases as in ordinary wires, whereas with fibres this is not shown. Experiments were shown illustrating the methods of working, and the highest tenacity recorded was for a fibre of ·0340 mm. diameter, which gave 466 × 107 deg. per square cm.—a value about half as great as that for steel wires. The authors refer to Quincke's suggestion that the increased tenacity of small wires is due to surface tension, and may be represented by $W = A\,d + B\,d^2$, where W is the breaking weight and d the diameter, but their own results with glass do not agree with this formula. As, of course, every one is now carrying about with him a book to enable him to convert this jargon of the centimetre-gramme-second system, these figures are, of course, easily converted into intelligible facts.

In the manufacture of Vulcan powder, there is a combination of nitro-glycerine with absorbent substances which are the equivalents of infusorial earth; and this combination constitutes an explosive compound which has all the properties and qualities of the compound made by combining nitro-glycerine with infusorial earth in making dynamite or giant powder, or with mica scales in making mica powder, or with mealed gunpowder in making Vulcan powder. In the first place, each of the materials used as absorbents in the Vulcan powder is solid. In the next place, they are all free from any quality which will decompose, destroy, or injure the nitro-glycerine. They are capable of pulverisation. They are also dry, or may be made so. When pulverised, each of them alone, or all of them in proportions actually used, or in any other proportions, will absorb and hold nitro-glycerine to the extent required by the patent sued upon, to wit, enough to make an explosive powder without rendering the powder leaky, and without any explosive aid from the absorbents themselves. Dry pulverised nitrate of soda will thus hold 30 per cent. of nitro-glycerine, charcoal 45 per cent., sulphur 30 per cent. (all these are explosive compounds), and when combined, as in Vulcan powder, they will thus hold 33 per cent.

At a recent meeting of the Royal Society of Dublin, a paper was read on "The Physical Properties of Manganese Steel," by Professor W. F. Barrett. The author said he had obtained, through Messrs. Hadfield, wire drawn from manganese steel, a process that first presented great difficulties, but was ultimately accomplished with ease by heating the steel to whiteness, and quenching in cold water after a reduction through every two sizes had been drawn. Sudden cooling softens this steel; slow cooling hardens it. A No. 19 S.W.G. wire (diameter 0·98 millimetre) was thus obtained of two kinds—hard and soft; the density was 7·808. The electric conductivity was found by Professor Barrett to be very low. The No. 19 wire had a resistance of about an ohm per metre, the exact specific resistance in C.G.S. units being 77,000 for 1 cubic centimetre; ordinary iron is only 9800, and German silver 21,170 in the same units; so that some use might be made of manganese steel wire for resistance coils in electric lighting. Professor Barrett, by different methods, has determined the magnetic susceptibility—that is, the induced magnetisation—in a uniform field. Compared with iron as 100,000, manganese steel was found to be 300. In fact, it is very wonderful, judging by muscular sense, to find no sensible force required to move this steel, even in the most powerful magnetic field that could be obtained. Hence, as the author suggests, the use of manganese steel for the bedplates of dynamos and the plating of iron vessels is obvious. Ships built of such steel would have no sensible deviation of the compass. As excellent castings can be obtained from this steel, it ought to have many applications from its extreme hardness, enormous tenacity, and feebly magnetic character.

MISCELLANEA.

The export of coal and coke from Sunderland during 1886 was 3,945,434 tons, against 3,981,700 tons for 1885.

Only fourteen shipwrecks were reported last week, nine being British owned—three steamers—and only two were lost off the United Kingdom.

The Right Hon. G. Sclater Booth, M.P., has accepted the Presidentship of the Congress of the Sanitary Institute of Great Britain, to be held at Bolton in September next.

Two balloons ordered by the Chinese Government have just left Marseilles for Tientsin, accompanied by a French aeronaut, who is to teach the Chinese officers how to manage them. One balloon is 6000 cubic metres in volume, and the other 3000 cubic metres.

The Bath and West of England Society will this year hold its annual show at Dorchester, on May 30th and 31st, and June 1st, 2nd, and 3rd, and money prizes amounting to upwards of £2500, which is a considerable increase upon previous years, are offered for horses, cattle, sheep, pigs, poultry, cheese, butter, cream, &c.

We regret to have to record the death, on the 5th inst., of Mr. Alderman John Chapple, C.E., who was well known through the very difficult engineering operations he carried out in connection with the great steeple of the St. Nicholai, Hamburg, the work at St. Alban's Cathedral restoration, and on many important architectural works.

With the December number of last year the "Professional Papers on Indian Engineering" came to a close, their support having been less for some years than at first. As the "Roorkee Professional Papers," they were started in 1863 by Col. Medley. The December number is the 15th of vol. iv. of the third series, the size having been altered a few years ago from octavo to the less convenient foolscap size.

According to a Berlin technical journal, experiments have recently been made at the artillery range near Cummersdorf with a new kind of mortar and a new explosive warranted to hold its own with General Boulanger's melenite. This explosive was used against a fortification constructed as exactly as possible on the model of one of the French frontier forts called Fort' d'Arrêt, and in forty-eight hours it was "blown completely from the ground."

The inventor of the Austrian magazine rifle, which is now, in its complete form, about to be submitted to the British Government, is Herr Franz Fortelka, a former lieutenant in the Austrian army, who, during the first campaign in Bosnia, received a shot in his right eye which destroyed the optic nerve, and indirectly so affected the left eye that Fortelka, now only twenty-eight years of age, has been for the last nine years totally blind. In spite of this, however, he has made several valuable inventions.

A new salt boring is in progress at Greatham, a village considerably to the north of Port Clarence, where the earlier ones were made. It is of special interest as being likely to determine whether the bed extends so far in that direction, and if so whether its thickness is greater or less than further south. The boring belongs to Messrs. Tilly and Casebourne, and the land upon which it has been commenced belongs to the trustees of the Greatham Hospital. A depth of 558ft. has been reached. A bed of red sandstone is at present being perforated.

At a meeting of the Tyne Conservancy Commissioners held on the 10th inst. a return was presented showing the number of vessels laid up idle in the river. From this it appears that the number of steamers without employment was then slightly more than during the previous month, but the number of sailing ships was considerably less. It is now, of course, just the time of year when, owing to the ice obstructing the Baltic ports, there is the greatest difficulty in securing freights. With the advancing spring and a continuance of the revival in trade it is to be hoped and expected that the Tyne will soon again be used as a water way, and no longer as stocking place for idle vessels.

Referring this week at Birmingham to the system adopted by the Government in giving out contracts, Mr. G. Kynoch, M.P., said that the Government officials seemed to be more anxious to support a foreign firm that they did to encourage the trade of the country. He hoped, however, than the time was not far distant when Birmingham tradesmen would have a fair chance with the Government contractors, whether they were personal friends of the Government officials or secured their influence by money payments. They had been excluded from the Government favours for the past sixteen years, and he desired to see the law removed, and the contracts given to Englishmen.

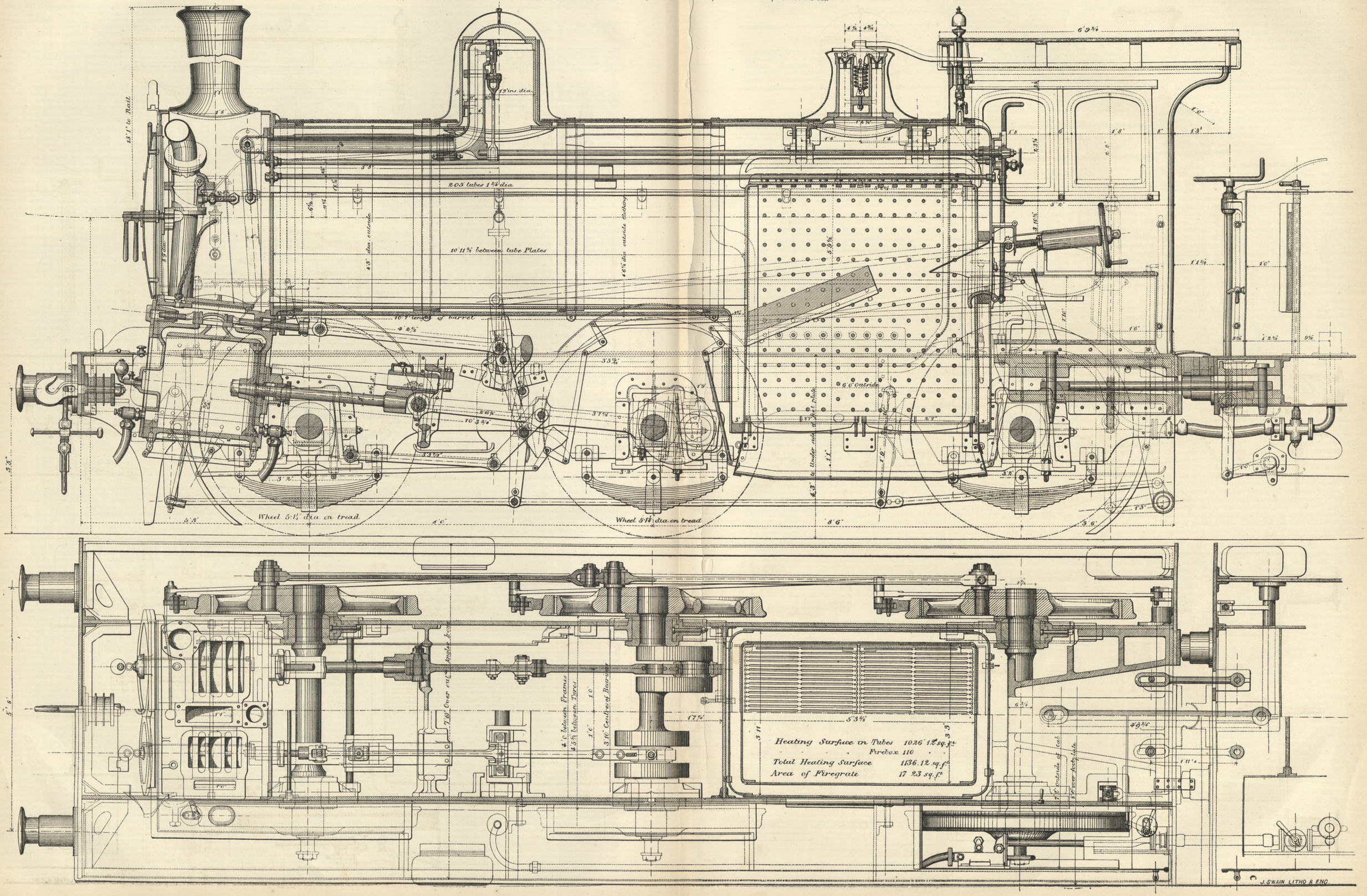
The preparations for the American Exhibition at Earl's Court are rapidly approaching completion. Contracts have been given out within a few days to Messrs. Doulton for sanitary appliances; the Brush Electric Light Company for "Search" lights for the Wild West grounds, and the Thompson and Houston arc-lights for the buildings. Messrs. Babcock and Wilcox boilers will supply a big Wheelock engine; Messrs. T. and W. Farmiloe will supply 75,000 square feet of glass for roof-lights; the Butterley Iron Company, the ironwork; and Lee and Chapman all the timber. M. Bartholdi, the sculptor, will lend an immense oil painting of the Harbour of New York, to which is added a panoramic view of that city, and Brooklyn, and Jersey City, and also a replica of his famous statue of Liberty, erected on Bedloes Island, in New York Harbour.

The committee appointed in connection with the proposed Birmingham and Gloucester Canal is having the various schemes actively under consideration. The proposal of Mr. Keeting is receiving favour, and it is suggested that the work should be carried out by a public trust formed by the Corporations of the districts interested rather than by a public company. The existing capital in the Sharpness New Docks and the Gloucester and Birmingham Navigation Company may roughly be stated at one million, and the necessary outlay on the Birmingham and Gloucester section, and that on the Gloucester and Berkley Canal and the docks at the entrance will probably amount to another million. At a recent meeting of the committee it was decided that a formal invitation be sent to the Corporations of Birmingham and Gloucester suggesting to them the desirability of appointing a committee to confer with the general committee for the improvement of the canal between Birmingham and the Bristol Channel.

The report of Colonel A. Ford, on the circumstances attending the explosion at Crarae Quarry, Loch Fyne, on September 25th last year, when a large party went to see the effect of some blasting operations in the quarry, many of them being seized with faintness, from which seven died, gives in minute detail the gases which must have escaped after the explosion of 13,000 lb. of gunpowder, and describes the symptoms which were developed in the injured persons. "Probably," Colonel Ford says, "the mischief was done by the carbonic oxide—of which 468 lb. were generated by the explosion, an amount which at the ordinary temperature and pressure would occupy a space of 6333 cubic feet. This would be sufficient to vitiate one hundred times as many cubic feet of air, but in the presence of carbonic anhydride—of which 3575 lb. were generated—it would render 1,266,600 cubic feet fatal to human life. A very small proportion of that gas in the presence of carbonic anhydride renders the air fatal. The symptoms, however, agree with those attributed to poisoning by carbonic anhydride, and the blood of one of the deceased was so liquid after death that it flowed through the coffin."

COMPOUND GOODS ENGINE, NORTH EASTERN RAILWAY.

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



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CONTENTS.

TO CORRESPONDENTS.

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

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J. W. S. (Brocketsbrae).—*Such papers would not possess any interest for the readers of* THE ENGINEER.

W. S. (Nottingham).—*There are much simpler and better safety appliances than yours. The cost of the rack and the noisy working of the whole would be serious objections.*

J. B.—*We cannot find space for your long letter, which contains nothing new. A paint may easily stand the red-hot iron test, which would explode at once if flame be tried. Explosive paints should not be used at all inside a ship or a house, and if you make them you will incur a serious responsibility, which will not be avoided by telling ship captains to use windsails.*

J. W.—*There is no book treating of bleaching and purifying liquids by electrolysis. The best books are—Watts,* 12s. 6d. (*Crosby Lockwood and Co.*) · *Gore,* 6s. 6d. (*Longmans—Science Series*). *There is also a book of receipts, which has an article on electrolysis, and says something about "bleaching" (American), published in England by Sampson Low and Co. There is also —"Electrolysé, Renseignements pratique," &c. Par Hippolyte Fontaine. Paris: Baudry et Cie.* (*See Review in* THE ENGINEER, 6*th March,* 1885.)

FIREWOOD-CUTTING MACHINES.

(To the Editor of the Engineer.)

SIR,—Could any of your readers inform me if there is a machine for cutting and chopping-up firewood in pieces ready for use, and if so, who are the makers?

FIREWOOD.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Session 1886-87. Tuesday, February 22nd, at 8 p.m.: Ordinary meeting. Paper to be read, with a view to discussion:—"Irrigation in Lower Egypt," by Wm. Willcocks, Assoc. M. Inst. C.E.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C. — Monday, February 21st, at 8 p.m.: Cantor Lectures. "Building Materials," by W. Y. Dent, F.C.S., F.I.C. Lecture II.—Description of the various limestones used as building stones—Methods of testing the quality of stone—The preservation of stone—Artificial stone—Terra-cotta—Firebricks. Tuesday, February 22nd, at 8 p.m.: Applied Art Section. "Wrought Ironwork," by J. Starkie Gardner, F.L.S., F.G.S.; Edward J. Poynter, R.A., will preside. Wednesday, February 23rd, at 8 p.m.: Ordinary meeting. "Recent Advances in Sewing Machinery," by John W. Urquhart; W. Anderson, M. Inst. C.E., will preside. Friday, February 25th, at 8 p.m.: Indian Section. "New Markets and Extension of Railways in India and Burmah," by Holt S. Hallett, F.R.G.S.; J. M. Maclean, M.P., will preside.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, February 24th, at the Institution of Civil Engineers, 25, Great George-street, S.W., at 8 p.m. Conclusion of discussion:—"Telephonic Investigations," by Professor Silvanus P. Thompson, B.A., D.Sc., Member.

SOCIETY OF ARCHITECTS.—Tuesday, February 22nd, in the Freemasons' Tavern, Great Queen-street, W.C., at 7 o'clock p.m.: Ordinary meeting. Paper to be read:—"Smoke Abatement," by J. J. Lish, vice-president (Newcastle-on-Tyne).

THE ENGINEER.

FEBRUARY 18, 1887.

THE PROPOSED CANAL BETWEEN INDIA AND CEYLON.

EVER since the success of the Suez Canal was demonstrated there has been evinced a strong desire to multiply such "short cuts" in every part of the world. We much fear that with regard to many of the proposals of this nature put forward, sufficient consideration has hardly been given to the very different circumstances which attend them to those which rendered the financial success of the Suez Canal almost a foregone conclusion. However that may be, it is not within our province to criticise such schemes on any such basis. If the prospects held out by their promoters to secure public support to their undertakings prove to be sufficient to induce this being granted, we can have no disposition to cavil at any possible multiplication of such works. Whether they prove to be remunerative or not to those investing their capital in them, it is at all events certain that each shortening effected in our ocean routes must be a distinct gain to the trade and commerce of the world, as well as to those whose business or pleasure entails their following them in person.

We some time ago referred to what is perhaps the latest proposal of this character which has been made, viz., the cutting of a channel through the island of Ramisseram. This island is situate between Ceylon and the mainland of India, and at present bars to ships of a draught over 12ft. the possibility of passing northward to the Bay of Bengal by that passage. As the consequence, all vessels proceeding to Madras or Calcutta have to steer to the eastward of Ceylon, this necessity entailing a voyage of between 300 and 400 miles longer than that which would be possible were the route by the Gulf of Manaar and Palk Straits open to them. It is for those interested in this scheme to show that the securing of this advantage will be so appreciated as to insure the adoption of the new proposed route to the extent required to make the outlay its opening out will involve remunerative. At the time when we before referred to this subject it was but little more than an idea, and those concerned with it had taken no steps to obtain a practical issue to their deliberations. The scheme has now, we learn, passed far beyond this stage. For a long time negotiations have been going on between the parties concerned and the Government of India, and we understand that the latter authority has made every important concession demanded of it. Powers to obtain land and cut the canal have been granted, exclusive rights have been conceded, and Government aid promised towards inducing the railway companies operating in the South of India to extend their system to what will constitute the new port to be established by the canal company on the Indian coast.

We can easily appreciate the motives which have led the Government to consent to such arrangements. Whether the scheme when carried out will be as attractive to captains of vessels as its promoters affirm it must prove to be, is a question with which the authorities are not called upon to trouble themselves; but for fully forty years past the Madras Government has annually incurred a very material expenditure for the purpose of keeping open and improving the existing narrow waterway through the rocky reef which may be said practically to unite the island of Ramisseram to the mainland of India. After all such expenditure, the results obtained by it have not been great. A few coasting steamers and other vessels of light draught are able to use it, but that is all. Even these do so with considerable difficulty, as the tide when making southwards heaps up the water at the northern entrance to the channel to such a degree that even full-powered steamers have, in addition to their engine power, to employ kedges and warps to surmount and pass it. To be relieved of their present annual expenditure, and to see the disability we have referred to removed, are inducements which sufficiently explain the readiness with which the Indian Government has met the applications made to it by the advocates of the new cut.

The site of the proposed undertaking has been viewed, and the design of the channel has been approved by so good an authority as Sir John Coode; so that we can hardly doubt that the proposals made are of an entirely practicable character. Contracts have also been entered into for the performance of the work. The tortuous navigation of Palk Straits to the northward of the proposed channel is to be so improved that we understand a clear deep waterway through that difficult passage of fully a mile in width would be secured. This it is proposed to mark in such a way that there will be no hindrance to be met with when once a vessel is well through the canal itself. The buoys to be laid down will be kept coated with luminous paint, and other lights will be established on fixed points, so that this portion of the navigation will be rendered as facile by night as by day. So far as we yet know, the establishment of docks on the island, which has been mentioned in connection with the general features of the design, has not been finally determined upon; but the site must lend itself freely to their construction should after prospects of trade render this desirable. We have heard it stated that the capital necessary to carry out the entire scheme will not exceed a million sterling, but as no prospectus has to date been issued we are unable to state whether this limit is accurate. Rumour has it that probably no such prospectus will have to be publicly circulated, as from the same rather vague source of information we learn that the whole capital required has already been, or will shortly be, privately subscribed. Whether or no in the end this new proposal will prove able to secure all the patronage that is now confidently claimed for it, there can be no reason why we should not congratulate the shipping trade of the East upon the approaching addition to its facilities which it must receive if—as there seems every reason to believe—the cutting of this new channel is shortly undertaken.

THE FLOW OF METALS.

IT is now twenty years since M. Tresca read a paper before the Institution of Mechanical Engineers at their Paris meeting, "On the Flow of Metals." The paper gave an epitome of the results obtained from a series of experiments made by its author with lead discs under compression in a variety of ways. He furthermore subjected heated wrought iron discs to similar tests, and observed that in all the materials employed in his experiments the tendency was invariably to flow in the direction of least resistance. Since the reading of that paper the subject has received attention from others, one of whom, Mr. W. E. Ward, of New York State, read an interesting paper before the American Society of Mechanical Engineers at their Atlantic City meeting in 1885, treating of the subject; and as it and the discussion thereon contains some points of interest to all engineers, we give these points to our readers. Mr. Ward tells us that the conclusions arrived at by M. Tresca gave some little importance to a feature developed in a series of experiments made by himself twenty-two years previously, the first stages of which involved such a stout contest with the flow of metals as completely to defeat the success of a novel machine which was designed and constructed for the purpose of heading long countersunk screw blanks and rivets in solid dies. The general arrangement of the machine favoured the use of excentric motions. Mr. Ward states that when he came to try the machine he found that the process of heading the blanks upset their shanks in the dies so much that they could not be withdrawn, and the further and more serious difficulty still, of the actual bursting of the dies themselves, followed, although they were 1¾in. in diameter by 1¼in. long, and the wire for the blanks no larger than No. 3 wire gauge; yet with the most careful tempering they failed to withstand the lateral strain involved in heading countersunk blanks. The cause of the trouble was not clearly revealed until a number of blanks were made designedly in a die which had been burst in this manner, all of which showed a thin fin or spine of metal which had been forced out from the sides of the blanks during the heading operation into and along the whole length of the fracture in the die. The question then confronted, continues Mr. Ward, "was whether such a fracture could occur under the amount of pressure required for heading a screw blank, and a lateral flow of metal follow into the fracture, unless the metal operated on was subject to a law that controls alike substances of every material consistency, whether solid or fluid. From the evidence furnished by the results of the experiments, there seemed but one reasonable conclusion, which was that as a rule the movement of solids, analogous to liquids under compression, will at some definite extreme react on a lateral barrier to their movement with the same persistence—less the difference in friction—as they exert in the longitudinal direction." Mr. Ward then proceeds to draw the conclusion that the bursting of his dies was due to the fact that after the shank of the blank had completely filled its die, and pressure was still continued, and the metal of the blank being unable to flow longitudinally, it exerted so great a lateral pressure as to burst the die. Before further quoting Mr. Ward we must comment on this theory. M. Tresca has shown that solid bodies under pressure follow the line of least resistance. A logical deduction can be inferred from the recognition of this fact—namely, that at no point covered by the material under pressure can the pressure exceed the force opposed to resist it at a given point, no more than can the pressure of water in the barrel of an hydraulic press exceed materially the load on a relief valve where so fitted. We then would ask why the swelling tendency of the shank of a screw blank should burst a die if such die be capable of opposing a force greater than that requisite to expand out the free unbound end of the blank intended to form the head and expected to expand into and fill up the countersunk cup in the top of the die provided for the formation of the head. Suppose, for example, that the die had an enlargement at some point in its bore, why, we ask, should the blank expand into and fill up this enlargement? That it will do so we have a right to assume, because here is a point of least resistance; that it will so fill up such enlargement is proved by Mr. Ward with the fractured die, for he found a spine or fin on the blank formed in it. If the metal flow here, we ask why will it not equally flow into the cup at top? Mr. Ward tells us also—in his most interesting paper—he overcame the difficulties of the seizure of his blanks and the bursting of his dies by limiting the pressure on his blanks first to an amount only sufficient to form a bulb or half completed head, and that he then left the other end of the blank free to move; the head was then completed under further pressure, the bulb itself alone receiving all subsequent pressure. Here is cer-

tainly a field for speculation. Why should the die burst when the shank of the blank is firmly supported endways during the latter stage of the formation of the blank head—a period when there cannot or at least ought not to be any further compression through the shank of the blank? Some enlargement of the head end takes place, because the bulb is thus formed. Why, then, does not this bulb relieve the end long pressure on the die? We find, or Mr. Ward found, that by dividing the operation of forming the head of the blank into two stages he prevented seizing or bursting of dies. Either there is a tendency in the blank to move endways after the bulb first begins to form, or there is not. If there is, why is not the shank pushed by shearing right through the bulb when the block at the end of the die is removed? If, on the other hand, there is no force present at all adequate to do this, why does the die burst? The resistance to shearing supplied by the bulb would seem less than the resistance offered by the die. This is a problem worth studying in connection with the whole question of the flow of metals. Mr. Ward's theory on this is that some surplus metal over and above that needed to form the head when present is forced into the shank, and causes the bursting, unless the further end of the blank is allowed some freedom, and this is provided by releasing it by removing the bottom of the die after the first bulbing has taken place for the head; but what there is to prevent the flow of the surplus metal of the head at the cup end of the die is not shown by Mr. Ward; neither does he tell us the temperature at which the blanks are headed. The bursting of the dies is illustrated in ordinary pressure rivetting, where it is well known that certain pressures must not be exceeded; otherwise the margin of the plate is first bulged and next split.

The discussion on Mr. Ward's paper brought out some curious as well as instructive points. Thus Mr. A. H. Emery referred to experiments made at Watertown Arsenal in the bursting of cylinders called gun-blocks. "These blocks were 11in. in diameter and 22in. long, with a bore of 3·3in. diameter. They were filled with bees-wax 10in. deep. The steel plunger which pressed upon the wax had to be hardened, inasmuch as it flowed out laterally, filled the cylinder tightly, so that it was very difficult to remove it in the first experiment before the hardening. The pressures are carried on these cylinders up to 90,000 lb. per square inch. A copper ring was put on the end of the plunger, which had its diameter reduced to about 2in. for about $\frac{3}{8}$th of an inch in its length. It was intended to act as a packing against the wax. It was found the cylinder expanded in diameter under the pressure, and the copper flowed up into the annular space thus formed; when the copper ring was withdrawn it had a flange round its edge." In Mr. Emery's own words, "The lip—flange—is now mainly on the upper side, which, at the end, is not more than two or three-thousandths of an inch thick, while at its bottom part it might be six or eight-hundredths of an inch thick, and ten or twelve-hundredths of an inch long. The copper really must have flowed in there at the outset with an opening of a very few thousandths, because the upper edge of the lip is only two or three thousandths of an inch thick, showing that the copper would probably flow through an opening of a thousandth or half a thousandth or a quarter of a thousandth of an inch thick, if subjected to a sufficient pressure. I have made some experiments in forcing lead through holes or grooves. I have had an opening of that kind of one two-thousandth of an inch thick, and forced the lead right up into it three or four-hundredths of an inch." Mr. Durfee, joining the discussion, referred to the manufacture of metallic cartridges, and described the manufacture of one form of them, in which at one stage of their manufacture they are cylindrical, but subsequently the portion next the bullet is reduced in diameter, giving the finished article somewhat the shape of a champagne bottle. The difficulty of upsetting metal so very thin—the thickness before upsetting being only 0·012in., and after the process 0·014—was apparently so great that the American patent officials refused a patent, on the ground that to upset metal so thin was an impossibility, and the applicant had to bring the examiner a number of samples to convince him it was not. Another speaker, Mr. Dodge, spoke of his experience with a testing machine. It was never strained to more than 10,000 lb. In it was a number of brass washers having a width of half an inch all round, which took the thrust of the pressure bearing against a cast iron block. He found that a hard brass washer under the thrust would flow out sideways and make a neat cup nearly half an inch high. This only occurred when the washer was allowed to rotate.

The limits of space at our disposal preclude our quoting this interesting paper and discussion at all exhaustively. We can only give the points raised in the briefest manner, and commend the report itself to the attention of our readers. Mr. Hamilton mentioned a gentleman who had put down machinery to make steel nails. He found that some of these nails were brittle, others were tough. He found that to get all the nails tough they must be cut at a certain critical temperature. If colder or hotter they are practically useless. Four explanations were advanced. (*a*) The method of forming the head, by crushing down a projecting end while the shank is gripped in a pair of dies, one part of the projecting metal being free to move, another is not so, and thus a shearing and tearing action is set up, causing rupture of the parts. Mr. Kent, another speaker, said he saw nails being made, and the blanks were heated in bundles very unequally; some blanks in a bundle were bright red, others dark red, the remainder black. Also, as the man attending the machine took about an hour to use a bundle, a process of gradual cooling was going on. This is (*b*), or unequal temperature; (*c*) is a chemical reason, analysis showing different quantities of carbon and phosphorous; (*d*) is the shape of the head, which is formed sharp-shouldered, no round or fillet being present. The essence of the rest of the discussion raised the following points, which deserve the attention of all metallurgists:—A head or enlargement can be made on the end of a bar or rod of metal either by continuous pressure or by intermittent pressure. The former by a die, the latter by a hammer. In both cases the surface of the rod receiving the pressure is practically bound and held by friction from moving at right angles to the line of pressure. In the case of continuous pressure a tearing, or at the least a rolling action, must take place amongst the molecules of the pin under pressure, and only free to move in proportion to their distance from the pressure contacts. In the case of intermittent pressure, before the desire, or at least the disposition, of the molecules to move produced by the blow has ceased the binding friction is removed, and every part of the material is free to move. The question then is, Will such disposition outlive the cause exciting it? That it will do so is testified to by various speakers. Mr. Kent, for example, said he had observed the flow of metals for half an hour after the pressure was relieved. A straight bar of metal was put on a testing machine and pressed transversely till it got a certain permanent set, so-called, when the load was removed. During the next half-hour, or perhaps longer, the bar kept straightening itself. Another speaker cited cases, such as are familiar to ironfounders in this country, as to the alteration of shape caused in castings by planing one or another surface, and by hammering or pincing with a hammer; and also the necessity that exists that to get a mathematically, or nearly so, true plane surface or a casting it must be rough planed first, and left for some days before receiving the final cut, the material taking its permanent set in the interim.

THE COLLECTION AND PUBLICATION OF LABOUR STATISTICS BY THE GOVERNMENT.

Recently we published a summary of a circular sent out from the Commercial Department of the Board of Trade to employers of labour in the engineering trades, with a series of questions to be answered as to the hours of work and wages paid to their men in the various departments of their shops. As we anticipated, the form in which the official demand has been put to employers in the engineering and iron shipbuilding trades of Lancashire—and, indeed, of the United Kingdom generally—to make returns of the wages paid to classified artisans in the several departments of their works, has excited much comment of a very unfavourable kind, so much so that it is not improbable the efforts of the Board of Trade to obtain such statistics as have been asked for will prove abortive. The resolution of the House of Commons, which was the initiative for the inquiry that has been set on foot, seemed to be a very harmless matter; but the form in which the Commercial Department of the Board of Trade has placed the question before the employers goes so much beyond and in excess of the requirements of the case as to have excited great distrust and opposition. The inquiry has, by the ineptitude of the Government officials, been made to assume a very harsh, inquisitorial character, which is being resented on all hands, as it exceeds even the inquisitorial powers of the Income Tax Commissioners, and is made to deal with questions which were in no way contemplated by the resolution passed in the House of Commons in March last, which was simply, "That in the opinion of this House immediate steps should be taken to ensure in this country a full and accurate collection and publication of labour statistics." From this expression of opinion, very broadly and indefinitely stated by the House of Commons, the Board of Trade has proceeded to draw up, under some specially peculiar conditions, a form of inquiry which the engineers of the country do not feel disposed to respond to as individuals. It is known that statistics in a very complete form, so far as the engineering and shipbuilding trades of the kingdom are concerned, are prepared annually by the Iron Trades Employers' Association, and are distributed for use amongst its members, the results being shown in the aggregate for each special district, and covering all the chief centres of the United Kingdom. Engineers, iron shipbuilders, and boilermakers know that these returns are trustworthy, and amongst themselves they are content to get the information in a collective form without any reference to the rates paid by individual employers, and beyond this form they are not disposed to go in response to the inquiries now being made by the Board of Trade. On the Lancashire Exchanges the question has been one of lively discussion, and the offensive form in which the inquiry has been issued by the Government officials has been treated with a very general feeling of resentment. Many of the largest firms have given a point blank refusal to fill in the forms which have been presented to them, and have confirmed this resolution after further correspondence with the Secretary of the Board of Trade. Nor is this feeling at all confined or local in its character. It is known that all over the country the largest employers, including the railway companies, have declined to give the information asked for, and have in very plain language given their reasons for the want of faith which has led them to refuse the information and to take the position they have done. It is therefore quite unlikely that as regards the trades under consideration the results of the Board of Trade inquiries will be of any value whatever as a contribution to the labour statistics of the country.

RAILWAY CHARGES ON RAILS.

The blue book on railway charges, issued a few days since, merits more attention than it has received. It is a return from many of the chief British and Irish railways of the charges made on home and foreign productions of various kinds, and some of the statements in it are especially worth the attention of gentlemen interested in the iron and engineering trades. One part of the return deals with the carriage of steel rails, and here it seems to be evident that the railways charge the same rates on the imported rails as on those of home production; and generally the same may be said of the charges for iron castings. But there are found very great variations in the charges of the companies. For instance, the North-Eastern Railway Company charges 6s. 8d. per ton for the carriage of rails from Hull to Darlington, 87 miles, and therefore under one penny per mile, whilst the Manchester, Sheffield, and Lincolnshire Railway charges 7s. 6d. per ton for the shorter distance from Hull to Penistone, 63 miles. From Newcastle to Leeds—98 miles—the North-Eastern Railway charges 7s. 6d. only, but there are, we believe, no steel rails rolled at Newcastle; whilst from Darlington to Carlisle—99 miles—the charge for lots in larger quantities is 8s. 4d., and there are steel rails rolled at Darlington, whilst Carlisle is so important a railway junction that it is probable that rails may be sent to that part. We have quoted the rate on the North-Eastern Railway, and another instance may be given, Middlesbrough to Leeds—64 miles—with a charge of 6s. 3d. per ton, whilst on the London and North-Western Railway the rate is 10s. 10d. only for the 131 miles between Manchester and Workington. Another part of the return deals with iron and steel manufactures, girders, &c., and here we find the same nominal agreement between the charges on home rates and rates on imported goods, but the agreement is not more than a nominal one. From Hull—which seems a most favoured port—to Durham, 111 miles, the charge is 8s. 4d., whilst on the Midland Railway the charge for a similar distance of 111 miles, but from Birmingham to Leeds, the rate is 11s. 8d. Again, the Manchester, Sheffield, and Lincolnshire Railway charges 7s. per ton from Hull to Sheffield, 59 miles, whilst the charge of the Midland Railway from Chesterfield to Manchester, 57 miles, is 8s. 4d. It is clearly proved, then, that the imports into Hull are carried at lower rates than are the manufactures in our own country carried between inland towns for similar distances; and though nominally the charge is the same for British goods from the ports, this is because no British goods are made at the ports cited. Hull does not roll either steel rails or girders, but Sheffield does, and it is a fair contrast to show that whilst from Hull there is a low charge on the goods imported, there is a higher charge on the home-made articles carried in similar quantities and for a similar distance over the same length of railway. It is one of the railway anomalies which press very hardly on the British manufacturer, but it is one which is very difficult to deal with, though it is one which especially needs the attention of those who have to draw up and to consider the Bill which in the present session should pass into law to make more equitable the railway charges.

LITERATURE.

Causeries Scientifiques, Découvertés et Inventions. By Henri de Parville. Paris: J. Rothschild, 13, Rue des Saints-Pères.

This remarkably interesting little book forms the twenty-fifth volume of a series, and perhaps we cannot give it higher praise than to say that it is well worthy to take rank with its four-and-twenty predecessors. It consists of an able and pleasant *résumé* of the scientific events of the year 1885, and its pages abound in new ideas and suggestions, which are as varied as they are numerous. M. de Parville does not waste words, and frequently we have found ourselves scarcely able to grasp the particulars of one invention before he beckons us, as it were, to the contemplation of some discovery of equal but probably quite diverse interest. Amongst so much that is good it is a matter of some difficulty to determine what to notice in particular; but it occurs to us that one of the most striking, as well as one of the most practical of the discoveries mentioned by M. de Parville, is that relating to the prevention of the terrible boiler explosions which must inevitably, under present conditions, recur from time to time, with disastrous results to life and limb. M. de Parville considers the so-called safety valves are practically useless, being at best more indicators of the approach of an accident than the means of preventing it; so an ingenious inventor, M. Barbe, has conceived an idea so simple and so practical that, as M. de Parville says, it is a wonder it has never been thought of before. What produces an explosion? Steam; and what steam? Water. "Here, then—to use M. de Parville's words—we have the explosion; and if at the critical moment we could rid ourselves of the water, the problem would be solved." Beneath the boiler the inventor places a valve, which, falling at the right moment, leaves free passage for the water. He makes an aperture, about 10 centimetres in diameter, at the bottom of the boiler. The disc closing this opening is kept in its place by one arm of a balance, the other arm of which bears a weight which equals the greatest pressure which can be reached with safety. The equilibrium is maintained until the pressure rises beyond the level of safety, then the counter-weight no longer balances the pressure of the steam against the disc; consequently the arm keeping the disc in place rises so as to allow the disc to fall freely, when the water rushes violently out, "and in two or three seconds all is over." It seems that there must be some mistake here as regards the time of exit of the water. Either the hole is larger than stated or the boiler is very small. M. de Parville assures us that repeated experiments have been made with the Barbe safety valve in presence of distinguished engineers, each time with the most satisfactory and conclusive results. What happens to the boiler plates after the water is gone we are not told, but after all this is a mere detail.

What M. de Parville has to say about the condition of the water of the Seine cannot be very agreeable reading for the people of Paris. According to a report of M. Daremberg, with which M. de Parville cordially agrees, the Seine is very little better than one vast sewer, but unfortunately, as M. de Parville remarks, "This is no new discovery." The unsatisfactory sanitary condition of the Seine has been a crying evil for the last fifteen years. Everyone knows it; commission after commission is appointed to deal with the matter, but still nothing is done. That the expense of remedying the evil would be considerable there can be no doubt, as the problem presents many complications; but, as M. de Parville remarks, "the health of Paris is worth millions."

Within the limits of our space it would be impossible even to glance cursorily at the different points of interest in M. de Parville's book. We can only very heartily recommend our readers to peruse this little volume for themselves, and he must indeed be difficult to please who could lay it down without finding in its 360 pages something to arrest and even to fascinate his attention.

South Kensington Museum.—Visitors during the week ending 12th February, 1887:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m.: Museum, 8547; mercantile marine, Indian section, and other collections, 3090. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m.: Museum, 626; mercantile marine, Indian section, and other collections, 194. Total, 12,457. Average of corresponding week in former years, 13,895. Total from the opening of the Museum, 25,410,746.

IRRIGATION IN EGYPT

No. IV.

The short account that has been given of irrigation in Egypt, would be incomplete without some mention being made of the system of forced service, which in the past has been one of the most important factors in the irrigation of the country, and which still remains one of the heaviest burdens upon its agriculture.

The Government, convinced that such an institution is incompatible with the advanced ideas of the century, have for a long time been contemplating a large reduction, if not a complete suppression of the levies, and a replacement of them by paid labour or mechanical appliances. The ministerial report of 1883 entered fully into the question, and stated that forced labour was then the only instrument at the disposition of the Government for the maintenance of the rivers, dykes, the basins and canals, and for the excavation and cleansing of the canals of all kinds, with the exception of the Ibrahimieh, the Ismailieh, and the Mahmoudieh. The physical conditions of the country require the expenditure of a vast amount of labour annually, but the evils of the system of forced service are such that the Government should lose no time in minimising the number of the levies and in resorting to mechanical contrivances, and free labour as much as possible. The burden of forced service has always been heavier for Lower than for Upper Egypt, as the works there have to be carried out precisely at the time when the presence of the men in their fields is the most necessary for harvest operations. The census, rather an old one, on which the present valuations are based, gives the number of men on whom service is imposed at 634,000.

Previous to 1883 there were as many as 160,000 men employed in equal proportions in Lower and Upper Egypt at one time, but after that date no more than 80,000 were called out, or one-eighth of the contingent. As this number was only changed four times during the 180 days of work, it followed that half the men subject to the levy escaped its burden, while the other half bore the double weight. The Minister of Public Works proposed to reduce the number of men by 50 per cent., and to employ forced labour only for indispensable works on the dykes, and for cleansing the Nili and Seidi canals. In compensation for such reduction, and to provide for the carrying out of the works by other means, he proposed further that each man so liberated should be taxed with the price of twelve days' labour, amounting to about 12·5f. per head.

The Government did not consider that it would be possible to carry out this project entirely. The Minister of Public Works, however, made trial of it in one province, that of Gharbieh, authorising a compromise of the tax by the voluntary payment of 7f. 50c. The result was not satisfactory, but the Government, moved by a sentiment of humanity, resolved not to relax their efforts, to put an end to so pernicious a system. It was calculated that an annual sum of £455,508 would be required in order to suppress entirely the forced service and to carry on the works through other means. The difficulty of providing such resources will be understood when the financial difficulties of the country during the past years are taken into consideration. We are happy, however, to be able to state that the efforts of the Government have been partially crowned with sucess. Out of a sum of 17,700,000f., inscribed in the last budget for the reduction of taxes, 6,500,000f. were devoted to a partial redemption of the levies. This sum sets free the half of the men employed in forced labour over the whole country, which has been done this year for the first time; it affects the class the most worthy of interest and pity, that of the poor fellah. The aim of all the works referred to is the better to utilise the waters of the Nile and to raise its level so as to distribute its waters over a greater superficial area; they do not in any way, however, affect the natural action of the river itself, which has great need of regulation.

The following table, drawn up from a report of Colonel Moncrieff, resumes the observations of more than a century and will show the enormous variations which take place in the rise of the waters. In the period of 126 years the Nile, at Cairo, has been marked:—

				m.
5 times at	.. ..	25 pies or	.. ..	20·12
24 ,,	.. ..	24 ,,	.. ..	19·58
28 ,,	.. ..	23 ,,	.. ..	19 04
21 ,,	.. ..	22 ,,	.. ..	18·50
19 ,,	.. ..	21 ,,	.. ..	18·23
13 ,,	.. ..	20 ,,	.. ..	17 96
11 ,,	.. ..	19 ,,	.. ..	17·69
4 ,,	.. ..	18 ,,	.. ..	17·42
1 ,,	.. ..	17 ,,	.. ..	17·15

A rise which surpasses 25 pies is dangerous; it may cause a rupture of the dykes or an inundation. From 20 to 23 pies the rises are moderate, and the best years are those when they are between 23 and 25. When the level does not attain 20 pies, certain regions, where the soil is high, cannot be watered. In 1877, when the Nile did not reach 18 pies, a famine ensued throughout the country. The advantage theretore of regulating the resources of the river is apparent. M. de la Malte has studied the question for some time, and has paid several visits to Egypt to satisfy himself as to the possibility of carrying out his schemes. In order to profit by the overplus of water at the time of the flood it would be necessary to construct a series of immense reservoirs in the meridional regions of the Valley of the Nile at different levels, capable of storing enormous quantities of water at the time of the flood, to be repaid to the river at low water. M. de la Malte's programme was a vast one; but he resolved to confine himself to the works which would be most immediately profitable to the country, and form a single reservoir in a suitable place.

Some years ago M. de la Malte formed a company under the name of "Société d'études du Nil," which appointed M. Jacquet —engineer-in-chief of roads and bridges—to make an especial study of works to be undertaken in Upper Egypt. To this end he explored that part of the country in conjunction with M. de la Malte; and on his return in 1882 published a learned report on the subject. We shall confine ourselves to pointing out the principal features of the project.

M. Jaquet proposes to create the first reservoir at Gebel Selseleh. On quitting Assauan in descending the Nile the river runs for a distance of forty kilos. in a valley closed in on both sides by mountains. The two chains then branch off almost suddenly, leaving the vast plain of Koum Ombas between them, which extends as far as Gebel Selseleh, a distance of thirty kilos. At this point the two chains again run close together, and the Nile traverses a defile of 400 metres in width, forcing its way through the rock as if it had been cut through to give it passage. To the east of this defile there is an opening of 1800 metres wide in the Arabic chain, which was once evidently the bed of the Nile. At no very distant period the rocks formed a ridge which held back the waters, and thus formed by their deposits the plains of Koum Ombas and Amangar at heights not now reached by the highest floods. M. Jacquet considers that the plain above the passage of Gebel Selseleh is marvellously well situated for the creation of an immense reservoir. It would form a vast circle shut in on all sides 30 kilos. long by 50 kilos. broad—in round numbers, a superficial area of 120,000 hectares. In his rapid survey, M. Jacquet was only able to take certain levels, but he estimated that of the plain as lower than the water mark at Gebel Selseleh, so that as soon as the waters attained 20 metres the whole of the plain would be flooded and every metre raised in this basin of 120,000 hectares would correspond to a store of 1 milliard 200 million cubic metres of water, taking into consideration the capacity of the river's bed as far as the top of the first cataract.

In the first instance the present bed of the Nile would have to be dammed up in order to raise the level in the reservoir; the old bed situated to the east, as before mentioned, would also have to be barred. It would then be necessary, naturally, to provide a fresh opening for the river; this would be done by opening up two new arms, one serving as a discharge, being 700 metres wide, would be dug to the west of the old bed of the river, while the second, only 300 metres wide, would open into the lower plains and run at the side of the Nile, being at the same time completely separated from the present bed. Independently of these two branches there would be constructed firstly, a navigation canal with a series of locks; secondly, an irrigation canal capable of discharging 500 cubic metres per second. Supposing the maximum retention to be 25 metres above the water mark, the lower surface of the waters in the lakes being fixed at 20 metres, seven milliards cubic metres of water could be accumulated, and restored to the Nile during the low water period.

The first result would be to remove all fear of inundations when the rise of the waters was excessive. As soon as any indication of a flood was perceived, the reservoir could be emptied, and such quantities of the rising waters drawn off as would be necessary to avoid any overflow into Lower Egypt; in fact, the capacity of the reservoir would permit 4000 cubic metres per second to be drawn off during more than twenty days. On the other hand, when the rise was likely to be insufficient, progressive stores could be made during the ascending period, beginning from the month of July, so as to have the reservoir completely full at the time of the flood. At this point a gradual opening of the reservoir would permit large quantities to be poured into the Nile for a considerable number of days, so as to lessen in a certain measure the evil of an insufficiency. The irrigation canal would besides, according to the project, bring under cultivation a superficial area of 400,000 hectares now lying waste.

The estimated expense of carrying out this project is 100 millions of francs; but this is a rough calculation, and the amount M. Jacquet thinks might be greatly reduced. The chief object of the mission was to satisfy the company as to the feasibility of M. de la Malte's plans. That they can be realised he is perfectly convinced. Numerous objections have been made to the plan of reservoirs. Losses would occur of the waters of the lake through infiltration and evaporation, it has been stated, and the basin would become choked with slime. These objections have all been satisfactorily disposed of by M. Gallois Bey, to whose report on the question we refer all those who are interested in the matter.

The advantages that would accrue to the country from the adoption of these schemes are manifest; they need no recommendation; but the finances of Egypt are still heavily involved, and we cannot tell when resources will be found to carry them out; but sooner or later we think they will be found a necessary complement to the works now proceeding in Lower Egypt. We have endeavoured to give an account of all the irrigation works now completed in Lower Egypt, and have pointed out all the projects for improvements over the whole country which are now under consideration, especially that of repairing the great barrage of Saidieh, which will become the pivot of all the irrigations of Lower Egypt. The Government of the Khedive is convinced of the importance of the proposed works, and the Minister of Public Works is concentrating all his efforts toward their accomplishment. There is every hope, then, that the time is not far distant when the country will benefit largely by their realisation.

Boghos Nubar.

THE STEAM ENGINE MAKERS' SOCIETY.

Amongst the annual reports issued by the leading trades' union organisations connected with the engineering branches of industry, the first to make its appearance is that of the Steam Engine Makers' Society, and Mr. James Swift, the general secretary, invariably introduces into his address comments upon various trade and commercial questions, which, although they may provoke dissent as to his conclusions, are always interesting as indicating the lines upon which the trades' union leaders are urging on the policy which they recommend the workmen of this country to pursue. Before, however, quoting Mr. Swift's opinions upon trade and economic questions, we will summarise briefly the results of the year's operations in connection with the society he very ably represents. The Steam Engine Makers' Society is one of the oldest trades' union organisations in the kingdom, and it now issues its sixty-second annual report. In submitting this, Mr. Swift has to express regret that the financial results of 1886 have not been so favourable as could have been desired, but the complaints as to bad trade and want of employment have been so general that the most superficial observer could see that a heavy strain was being put upon their resources. To put their position briefly, it was as follows: —At the end of 1885 the balance of funds stood at £10,435. During 1886 their income from all sources amounted to £12,515. The total disbursements had amounted to £13,292, being a loss of £777 upon the year's transactions, and reducing their cash balance to £9657, which was equal to £1 18s. 0¼d. per member. The number of members at the close of last year was 5079, distributed over 90 branches, which showed an increase of 17 members and two branches over the previous year. Summarising the tabulated particulars of the income, it appears that the Society has had to impose upon its members an extra levy of threepence per week, which has enabled it to raise an income from this source and its ordinary members' contributions of £11,405 as compared with £10,103 in 1885, and the expenditure side of the account shows that the increased contributions and diminished capital have gone chiefly in the support of unemployed members, the total paid in out-of-work donation benefit having amounted to £5822, which is at the rate of £1 2s. 11d. per member; and this sum, which exceeds even the amount paid during the extreme depression of 1885, is the largest amount paid during the whole history of the Society, with the exception of the year 1879. Superannuation benefit is another item which has shown a considerable increase, and funeral allowances also show a striking increase, the average cost having been greater than at any time since 1870; but for strike pay the expenditure has been slightly less than last year. The working expenses have amounted to £1710, an increase of £196 on the expenditure for 1885; but this is amply accounted for by the extra cost which has been incurred during the past year in revising the Society's rules and the number of committee meetings, delegations, &c., which have been necessary in relation to wages' questions.

Passing on to trade matters, Mr. Swift very truly says that it will need no extraordinary effort to demonstrate the fact which has been so patent to all, that trade has been bad, profits have been small, and thousands of idle hands have had no work to do. This state of affairs had not been confined to 1886, nor yet to the engineering branch of business, but had existed in all industries generally. In our own country the question had become so serious that the Legislature felt some effort should be made to ascertain the reason, and if possible to propound a remedy. With this view a Royal Commission was appointed in 1885, and as the result of the labours of this Commission had recently been made known to the country, it enabled them to utilise some of the evidence which had been collected during the inquiry. Mr. Swift then proceeds to deal some hard knocks at the Commission:—"It was," he says, "anticipated by some that the result would prove the cause of depressed trade to be the higher wages and shorter hours of the British artisan. If the charge be true, it is certainly not asserted in the Commissioners' Report, and although this body was composed principally of capitalists and employers of labour—the exceptions being Mr. C. J. Drummond, secretary to the London Society of Compositors, and Mr. Thomas Birtwistle, secretary to the East Lancashire Weavers—their testimony to our class is of a reassuring nature." Mr. Swift does not attempt to dissect the whole of the evidence given, but he asserts that "The Commission does not appear to have formulated any recommendations how trade can be improved hereafter, in any other than a general sense, by cheapening production and keeping pace with other nations in improvements and inventions. One member of the Commission—a professor of political economy whose questions to witnesses were of a nature to cause anything but a favourable impression as to his sympathy with the working classes—thought fit to draw up a Minority Report—of one —and its briefness, ambiguousness, and apparent dissent from the one principle—reduced hours—so important to the toiling population, forces the conclusion that he is so saturated with the theories created by the dismal science that a few years' toiling in a workshop would bring him more practical knowledge of labour and capital than twenty years' teachings in a college." Getting even a little more sarcastic, Mr. Swift adds:—"Political economy is very-much like technical education without practical experience, and the evils of the latter are frequently demonstrated in our workshops, and that to the detriment of the craftsman. A perusal of the Commissioners' Report on depressed trade will show that the two labour representatives possessed all the practical experience that was needed to carefully look after the interests of their class, whilst the political economist was so bound up in his theories that it appears as though he were transposed from the seventeenth century for the purpose of lecturing the working classes how they were to be stall-fed, like cattle, and that at such a rate as would just keep body and soul together, that they might perform the task allotted to them by capitalists. Such theoretical nonsense has few adherents at this late period of the nineteenth century, and the sooner our college professors rivet their attention to monopolies, duties, and currencies, and leave capital and the working classes to settle their own labour difficulties, the better it will be for the community and all concerned."

Mr. Swift next proceeds to review past periods of bad trade and their causes, and coming on to the present period of depression he says:—"It is only reasonable to expect that every class have their reasons for certain effects that have been caused, and we, like other people, have an opinion, and this we believe will be endorsed by a good portion of the working class. Many people dispute the assertion that there is any such thing as 'over-production, but qualify it by saying that it is 'under-consumption,' which, to our minds, is a distinction without a difference. It is immaterial what term is used, if it be true that large masses of people are out of employment and no one offers to find it for them, as there is no market for the goods they manufacture. This result, we contend, has been arrived at within the past ten years by the mania that has taken possession of all manufacturers 'to cheapen production,' that we may compete with, and practically starve out, other nations. To effect this, machines are adopted, wherever possible, to dispense with labour, and if not possible to dispense with humanity requiring a weekly wage, to let it be unskilled labour instead of a craftsman, as the large masses are more easy to deal with in the wages question than the skilled artisan who has a trade society to support him. If possible, boy labour is substituted, and in our trade we have met with one case during the year where the youths for the time being were as three to two journeymen. Female labour is, if possible, utilised, and if we were to quote cases outside our own industry, the statements would be a discredit to our country, and all 'to cheapen production,' which means that the total earnings of the masses must be reduced. This may seem good policy to beat the foreigner, but it is overlooked that whilst the total earnings of the people are reduced, that it leaves so much less to be spent on home productive goods; these are impoverished, and to such an extent that trade declines with them, their employés are thrown out of work, and the circulation of capital further curtailed, to the detriment of the country as a whole. The attempts made to cheapen production have been so successful that over-production has become an accomplished fact, and the recent depression has, to our minds, been a prominent factor in the past ten years' depressed trade." In support of his theory Mr. Swift quotes the tabulated returns showing the value of the exports of steam engines and machinery from 1840 to 1886, the tonnage of ships launched, and the prices of pig iron from 1870 to 1886, and production of pig iron, coal, and steel rails, with the number of furnaces in blast from 1870 to 1885. He then adds:—"In 1873 and 1875 the miner was accused of all kinds of extravagances, it being asserted that his weekly wages were so great that he could not spend them in the limited time at his disposal. In 1885 the output of coal was 32⅛ million tons more than in 1873, yet the miner is now paid a starvation rate of wages, and no signs of a material increase. Here is the cost of production very forcibly demonstrated, and the over-production follows in its train. The weight of iron made in 1873 was 6,556,171 tons, and to extract this from the ore, 683 furnaces were in operation. In 1885 the output of iron was 7,250,657 tons, and the number of furnaces was 419. The net result of the two periods is, that in 1885, 684,486 tons more were produced than in 1873, and that with 264 furnaces less than thirteen years ago. The same facts present themselves as to exports in engines and machinery. In 1877—we take this year as the exports are given in value, and the price of iron is the nearest approach in the two years—the total exports were £6,722,868, and in 1886 £10,133,869, whilst a reference to our table of unemployed will show that we had in 1886 an average out-of-work list of 297, but only 111¾ in 1877, although the

total exports were more than one-third less than they were in the depressed year just closed. The result of adapting labour-saving machines in our trade could be quoted in isolated cases that we come in contact with, but would not be accepted as evidence unless details were supplied. In the cotton trade it has recently been recorded that in 1850 the average number of looms attended by each person employed was 2⅓, but it was now 3¼, or an increase of 40 per cent. In 1850 the average speed of the loom was 160 picks per minute, but it now reaches 192, or an increase of 20 per cent. In addition to this the cotton operatives assert that the increased energy of the weavers, closer supervision of management, coupled with a degree of discipline unknown a few years ago, another 15 per cent. is ground out of them, so that each weaver fully performs 75 per cent. more labour than what they did in a given number of hours in 1850." Mr. Swift evidently feels, however, that all this argument may in some way come home in rather disagreeable fashion to the trade which he specially represents; but he faces the question with his previous remedy of reduced hours of labour. "As workers in the manufacture of engines and machinery," he admits that they may be accused of having helped to bring about these changes and of "biting the hand that feeds;" but, he adds, "we are, as our unemployed lists show, in nearly an equal position with those otherwise affected, so it becomes a question for the general body of workers what is to be done to improve our position. Various theories and suggestions have been put forth as to how this can be effected, each of which may be very good in its way. We believe, however, that one plan is universally admitted to be the first to be tried, and that is, to reduce the hours of labour to eight per day at the first opportunity. The question is one that is slumbering, as it were, in men's minds, but the first chance that presents itself, all the fire and enthusiasm will at once be seen in the firm stand that will be taken. Up to this time little has been said on the point at either trades congresses or public meetings, as the general feeling seems to be that when the opportunity comes the effort shall be made, and that without any excessive demonstration." Mr. Swift does not allude to the fact that as a result of this cheapening of production a sovereign will now buy more food, fuel, clothes, &c., for the steam engine maker than it ever bought before. Mr. Swift concludes his address with the expression of deep sympathy with the many earnest and honest members who have suffered privation during the year just closed, either from enforced idleness, short time, or reduced wages. He believes, however, that trade has now taken a turn for the better, and earnestly hopes that the slight improvement now seen may soon extend and labour be put at a premium, instead of a discount, as for some years past.

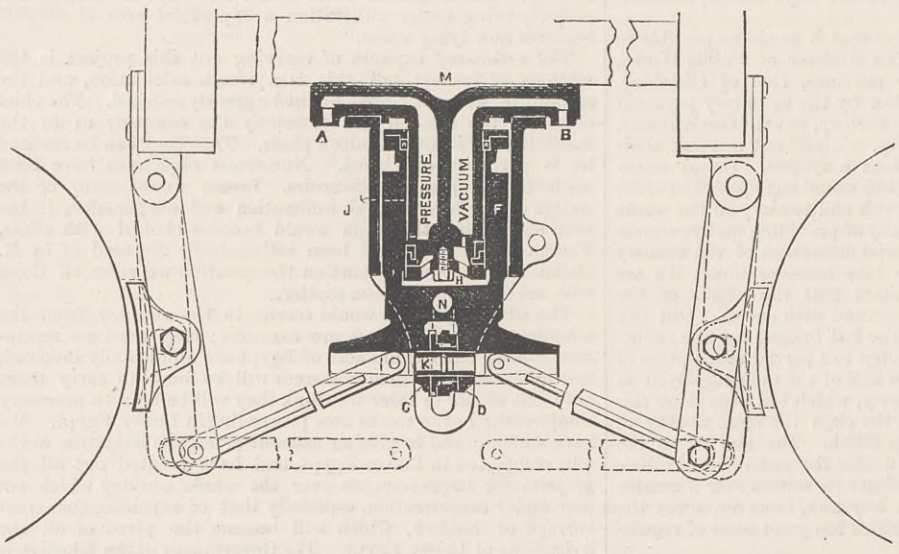
THE INTERCHANGEABLE AUTOMATIC CONTINUOUS BRAKE.

In our last issue we briefly referred to the trial of the Interchangeable Automatic Continuous Brake, which was carried out on Wednesday, the 9th inst., on the Hadleigh branch of the Great Eastern Railway, near Ipswich. Before giving the result of the trials it may be well to describe the form and principle of action of the brake, the invention of Messrs. Cowling Welch and Parker-Smith, a working model of which was shown in the Inventions Exhibition in 1885. The brake is now in the hands of an association, the secretary of which is Mr. John Hardcastle, of Leeds. The principle of the brake is that of a weight acting by gravity alone and operating through inclined thrusting rods as toggle-levers on ordinary hangers and brake-blocks, an arrangement which has the effect of multiplying the power of the moving weight. The brake is, as the name indicates, automatic as well as continuous. What may be called the normal state of the brake is on, the weight being down. When off, the weight is raised and kept out of action by compressed air, vacuum, steam, or other fluid transmitted by a continuous pipe throughout the train. The accompanying drawing illustrates the form in which the principle was applied on the occasion of the trials in question. F, the weight, which, as will be seen, is a moving cylinder working on a piston M, rigidly fixed to the under side of the frame of the vehicle. To put the brake on, the weight is let down so as to bring the thrusting-rods almost to—or within a definite distance of—the horizontal position, whereby the blocks are forced against the wheels with the required pressure. The brake, as used at the trial, was adopted by means of an arrangement of pressure and vacuum chambers around and below the piston at J and H, to work with either compressed air, as in the Westinghouse brake, or with partial vaccuum, as in the automatic vacuum system. For working with the former a train pipe with two branches, each fitted with the ordinary Westinghouse hose pipe and union, is attached to the tapped hole in the piston M at A, and led to each end of the vehicle, while for working with the vacuum system a similar pipe, fitted with the ordinary vacuum hose pipes and unions, is attached to the corresponding hole at B. By this provision any vehicle fitted with the brake can be attached at the middle or at any part of a train using the Westinghouse or the vacuum system, and will not only form a connection between the brakes on the other vehicles in the train, but its own brake will work in harmony therewith. For the purpose of maintaining constant in degree the effect of the toggle levers, which would be impaired, or at all events would vary through the wear of the brake blocks, there is provided at K an automatic ratchet-and-wheel arrangement, operated by the rising and falling of the weight, which—by turning a right and left-handed nut in the screwed ends of the thrusting rods—takes up the wear of the blocks as it occurs. In this way the angle of the rods where the brake is remains constant, and the efficiency of the weight is maintained without the attention of the officials until the blocks are worn out, and require to be replaced in the ordinary course of working. Each vehicle is provided with a hand lever acting on the weight for releasing and applying the brake when detached from the engine, as in shunting, &c. But the attachments are so arranged that, while the weight is capable of being fixed up, it is impossible to fasten off the brakes against the engine driver. Immediately on establishing the pneumatic connection throughout the train, either by vacuum or by pressure, the driver acquires control of all the brakes, and the hand levers at once automatically fall out of action.

It is claimed, as a special feature of this brake, that it is "not conditionally and temporarily automatic, but is absolutely automatic in the true sense of the term," due to the fact of the operating force being the force of gravity, in contra-distinction to force derived from pneumatic pressure or vacuum. Moreover, and as arising out of the foregoing, it is claimed for it that in using this brake the driver knows the maximum amount of brake power at his command, and on which—apart, of course, from any variation due to the state of the rails—he can at all times confidently rely. It is further claimed for it that it entirely fulfils the requirements of the Board of Trade, in being (1) efficient in stopping trains, instantaneous in action, and capable of being applied by either the engine driver or the guards; (2) instantaneously self-acting in case of severance of the through connections; (3) capable of being put on and taken off—with facility—on the engine and any vehicle of a train; that (4) the brakes are capable of being used in daily working; and that (5) the materials employed are of a durable character, so as to be easily maintained and kept in order. Another merit which is claimed for it is that as the toggle arrangement, by multiplying the power of the weight, enables a comparatively light weight to be used, the expenditure of mechanical power in operating the brake is relatively small, while the cylinder spaces to be filled or emptied—with any given standard of air pressure or vacuum—being proportionately small, rapidity of action is likewise secured.

The portion of railway selected for the trial, and on which the stop-tests were made, was level and straight, so as to enable comparison to be made with other recorded trials of a like kind. The trial train consisted of six ordinary four-wheeled high-sided wagons, weighing empty from 4 tons 12 cwt. to 4 tons 17 cwt. each, and loaded so as to give a total weight, including the vehicles, of 54 tons 7 cwt. The train was drawn by a Great Eastern engine, weighing in average working order 38½ tons, and fitted with the Westinghouse automatic brake as used on the Great Eastern Railway. For the purpose of obtaining a vacuum, the last wagon carried a small vertical boiler and ejector.

As a preliminary to the stop-trials, the pressure pipes on the wagons were coupled to the Westinghouse apparatus on the engine, when the working of the brakes by hand, and the automatic release of the hand gear at the will of the driver, were shown. The first series of stop-trials was with air-pressure, and consisted in slipping the engine from the wagons at various speeds at an ascertained point, when the Westinghouse brake couplings were parted and the brakes on the train of wagons automatically applied—their speed at the moment of parting the couplings, and the distance they subsequently travelled in coming to rest, being noted. The speed was ascertained by an electric speed recorder, the circuit being made and broken alternately by one of the flanges of the leading wheel of the engine coming in contact with levers fixed at a convenient distance—146·8ft.—apart. The distance travelled was ascertained by chalk marks placed on the rails 10ft. apart, the fractional lengths being of course allowed for. The time was also noted in several cases, but only approximately.



Then followed a couple of trials of the distance travelled by the engine and wagons—coupled together—after the application of the brakes; but as there was no common relation between the weight and brake power of the engine and wagons, the results obtained—which were less favourable than with the wagons alone—are worthless for any purpose of comparison, and need not therefore be recorded.

The pressure pipes were then disconnected, and the vacuum connections coupled to the apparatus in the last wagon, the engine being then used simply for giving velocity to the train, from which it was slipped at the moment the vacuum was destroyed by opening the end of the through pipe.

The following table gives the result of the trials with the wagons alone:—

Speed. Miles per hour.	Distance stopped in. Feet.	Time. Seconds.
	With Air Pressure.	
26	176	not noted.
28	188	,,
30	250	,,
33	322	11
33½	322	11
	With Vacuum.	
40	459	13
40	441	not noted.

The time available for using the line of railway being exhausted, the trials had to be brought to a close without the opportunity being afforded for trying one important feature of the brake, namely, the facility the arrangement offers for easing off and on the brake force by increasing or decreasing, as the case may be, the pressure or vacuum in the through connections. With the air pressure, or the vacuum at its full, the brake is off; with the pressure, or vacuum at its least, the brake is fully on; while, of course, any intermediate amount of brake force between these limits it is claimed, can be brought into action at the will of the driver by merely turning, more or less, the handle of the pressure or vacuum brake-cock on the engine, a power of adjustment of the highest importance in working heavy trains—and especially heavy goods trains—on a line with a succession of steep gradients.

The main characteristic feature claimed for the brake is its being adapted to work equally well with either air pressure or vacuum. Any vehicle fitted with it can not only be used as a self-braking machine in conjunction with its fellows, but equally well with either the Westinghouse or the vacuum system in use on lines over which it may be required to travel. Whether it will be found, on further trial, to realise the expectation of its inventors remains to be seen. It must be noted that the experimental train consisted of only six wagons, whereas trains of as many as fifty wagons are commonly run. The difference between working a brake on a six-wagon and on a fifty-wagon train is so great, that before any opinion can be expressed upon the working of a new brake, tests must be made on the longer train under ordinary working conditions, the above experiments not affording a criterion in this respect.

THE STANLEY EXHIBITION OF CYCLES.

This annual exhibition of bicycles and tricycles which is now controlled by a joint committee of the Stanley Bicycle Club, and of the leading manufacturers was held last week at the Royal Aquarium. The exhibition under notice was undoubtedly the best and most representative exhibition of cycles ever held, for although the number of machines exhibited—some 574 in all—is not the largest on record, the machines exhibited were interesting in many respects and showed that a higher standard of workmanship has been attained, more especially amongst the smaller manufacturers. The exhibition did not disclose many novelties, in fact with one or two exceptions those particular fads of the inventive genii which have hitherto been so much *en evidence* were conspicuous by their absence. The most noticeable feature of the exhibition was the extreme lightness with which the machines are being built. An average ordinary roadster tricycle now weighs from 50 lb. to 60 lb., whereas two years ago from 80 lb. to 90 lb. was considered light. Messrs. Hillman, Herbert, and Co., of Coventry, showed the lightest tricycle in the world. This wonderful machine is intended for the racing path, but has already had a severe trial on the road with a twelve-stone rider. The machine weighs only 28½ lb. complete. The same firm exhibited a 56in. ordinary bicycle for racing purposes weighing but 17½ lb., while several other firms showed machines which run those quoted very close as regards weight.

From the large number of rear-driving safety bicycles exhibited it seems that they will supersede the ordinary bicycle which has been popular for many years. In this type of machine the skill of the inventor appears to have been devoted to devices for isolating the rider from the vibration of the machine, as most manufacturers showed machines with some arrangement for cutting off or suppressing the vibration, the simplest and most effective being that used on the Olympia bicycle, manufactured by the Midland Cycle Company, of Wolverhampton. This consists in making the frame carrying the driving wheel and pedal crank axle and seat in two parts, connected together by a horizontal joint controlled by a spring so that the frame will give slightly in a vertical direction.

In tricycles the prevailing type was the front steerer, controlled by a direct transverse handle bar, while the most noticeable improvements in construction was the use of large steering wheels and the use of four bearings on the driving axles. Messrs. Humber and Co., of Beeston, whose machines have earned such enviable notoriety, now use four bearings on the driving axles of all their tricycles, though we are of opinion that the size of the steering wheels of their machines may with advantage be increased, notwithstanding the device they use to cut off the vibration set up by the pilot wheel. This firm exhibited a racer and a roadster "Cripper" Humber tricycle, on the former of which twenty miles has been ridden within one hour, and on the roadster machine the journey from Land's End to John o' Groats was accomplished in five days and ten hours, both of which feats have never been equalled or excelled. Messrs. Pausey and Co. showed a convertible tandem tricycle which by a very neat and rigid telescoping device corrects the rider's position when the machine is converted into a single one. The same firm also exhibited a machine which may be converted into a rear driving safety bicycle or into a tricycle without interfering with the good points of either machine.

Messrs. Rudge and Co., of Coventry, who claim to be the oldest and largest manufacturers of cycles in the world, had an exceptionally fine exhibit. Their leading tricycle, the "Crescent," has a large steering wheel which is mounted on a new principle which ensures rigidity of the frame with direct and absolute control over the wheel. This firm were the original patentees of the rear-driving safety bicycle now so much used, their patent being dated 1879.

Mr. J. H. Dearlove exhibited a new type of tricycle protected by letters patent, designated the "Phantom," which appears to have the particular merit of extreme simplicity. This machine has a single driving wheel placed in the rear of a pair of steering wheels mounted on a cross axle pivotted to the frame carrying the driving wheel in the centre of its length. The steering wheels are controlled by a transverse handle bar, and the head or joint connecting the two parts of the frame is set at such an angle that when the steering wheels are turned for the purpose of running the machine on a curve, the driving wheel leans over towards the centre of the path of motion of the machine, which renders the machine very stable when running at a high speed. This maker uses ordinary axle ball bearings for the steering head, which makes a very neat and effective ball bearing head.

Of the many tricycles exhibited having devices for the isolation of the rider from vibration, the "Whippet," made by Messrs. Linley and Biggs, must certainly claim pre-eminence, though whether its efficiency is outweighed by its complication is a matter of opinion. In this machine—which has a single driving wheel placed in the rear of two steering wheels—the seat, pedal crank axle, and handle bar are mounted on a second frame pivotted at or near to the axle of the driving wheel, the forward end of the frame being suspended by a strong spiral spring, the strength of which can be adjusted to the weight of the rider and to the amount of movement desired. The handle bar is connected with the steering wheels by a very clever device which allows the bar to rise and fall with the auxiliary frame while controlling the wheels by a radial movement about its central pivot. The firm also showed a rear-driving bicycle fitted with this arrangement.

A new firm, Messrs. Bruce, Green, and Co., showed a new type of tricycle which may be taken as a modification of the well-known "Humber." The front wheels instead of being the drivers are merely steering wheels, and the rear wheel carried by the trailing backbone is the driver, being made of a size approximately equal to that of the front wheels. A very simple device is used for raising and lowering the pedal crank axle, so that there is no necessity for providing any adjustment for the saddle.

Messrs. Hillman, Herbert, and Co., of Coventry, whose exhibits we have before referred to, showed the first really practical

tandem bicycle for two riders. The machine has two equal sized wheels, the front one being the driver. Each wheel is connected to the frame by a vertical head or socket, and with each other by a link connection, so that both wheels are turned in the act of steering.

Messrs. Singer and Co., of Coventry, whose name has become a household word in connection with "Carrier" tricycles, exhibited no less than twenty-nine different machines, no two of which were alike; among them being a new tandem tricycle, in which the front steering wheel is controlled entirely by the rear rider, by a raked steering spindle passing down through the central tube of the frame and connected with the fork carrying the steering wheel by a coupling-rod. This firm also showed a compound tandem for carrying four riders.

As an example of the sacrifice of beauty to rigidity and economy of construction, the Surrey Machinists' Company exhibited a number of machines in which the wheels are carried by single tubes instead of the usual forks, the axles consequently being overhung. We cannot say that this arrangement is pleasing to the eye.

The Coventry Machinists' Company, among a large selection of machines, showed a new type of dicycle, manufactured under Welch's patent. This machine has two equal sized wheels placed parallel and opposite to each other on the end of a straight axle, so that the rider has to balance himself in a forward and aft direction. The machine is driven by a single central chain, and appears to be a great improvement on all similar machines hitherto introduced.

Amongst the exhibitors were the Clavinger Cycle Company, which has recently been floated to construct bicycles and tricycles under the voluminous patent granted to W. Golder, and referred to by us in a recent issue. We anticipate these machines will not meet with popular favour, as their only apparent recommendation is their complication.

Amongst the ordinary bicycles, Mr. F. Weck, of Birmingham, showed the only real improvement in these machines in the exhibition. It consists of a device for altering the rake of the front fork for giving increased safety to the machine as emergency may require. This is attained by hinging the prongs of the rear fork to a supplementary fork carrying the trailing wheel at about the centre of its length, so that its point of connection may be varied with respect to the centre of the steering wheel, which causes the backbone to rise or fall and so vary the rake of the front fork. The hinge is controlled from the handle bar by a cord or chain running down the backbone. Mr. F. Warner Jones exhibited several rear-driving safety bicycles fitted with an improved swing frame, which answers the dual purpose of cutting off vibration and allowing the rider to vary his position to compensate for gradients.

Amongst the firms who manufacture the component parts of cycles, the Abingdon Works Company, of Birmingham, had a fine display of parts, their driving chains, which are machine-made, being beautiful specimens of accurate work. They are also introducing a new type of ball-bearing head which possesses many novel and useful points. Mr. W. Bown, of Birmingham, the maker of the well-known concentrically adjustable ball bearings, introduces a chemical method of fixing tires which apparently renders them immovable, though we are of opinion that for practical purposes it is not so good as Otto's new method of fixing tires by means of a corrugated spring wire, which, although of recent invention, is being extensively used by some of the leading manufacturers. According to this method, the tires are made out of lengths of rubber cord through which is passed a corrugated wire. The free ends of the corrugated wire, after the ends of the rubber cord are forced back, are engaged with one another by simply giving them one twist, when the corrugations lock with one another; the ends of the rubber then close up over the joint. To get the tire into the hollow of the rim, it is stretched by a special apparatus, which elongates the corrugated wire sufficiently to allow it to be slipped into place. It remains to be seen whether the corrugated wire will cut through the rubber, which has been the inherent fault of all previous wired tires. Should it not do so we anticipate that the difficulty of fixing rubber tires will have been solved.

Messrs. Perry and Co., of Birmingham, the well-known pen makers, showed a new driving-chain for velocipedes, the chief point of which is that every link is detachable. The chain consists of a series of solid rectangular links with connecting links interposed, the connecting link consisting of a flat plate with T-shaped ends, which are turned up to slip through and embrace with the ends of the rectangular links.

Stamp forgings of remarkable cleanness and freedom from defects were shown by several firms, and illustrated the extent to which this method of production has gained ground and superseded the use of malleable castings, which though at one time most extensively used in the construction of cycles, are now but rarely used even in the cheapest machines. We are not aware that Nordenfelt's new metal has yet been used in the construction of cycles, but it seems to us that it is specially adapted for such machines as these, where lightness combined with strength is of primary importance.

Taken as a whole, the exhibition was worthy of this rising industry, and is an example of the results of small beginnings, and of the development of what was at one time thought to be little more than a passing fancy, at the most a popular sport. It is only a question of time before we shall see a radical change effected in the conveyance of both passengers and goods through the agency of cycles.

THE INSTITUTION OF MECHANICAL ENGINEERS.

(*Continued from page* 111.)

IN continuing the discussion on triple cylinder compound engines, Professor Ryan said he felt a little out of place in this discussion, not having served his time in the stokehole or its vicinity, but as Mr. Kirk had told them in his letter that this was a commercial question rather than a mechanical one, he felt that possibly he might be listened to for the five minutes that were allotted to him. The 15 per cent. arrived at by Professor Kennedy was a concession—a very large concession—to the author of the paper. Professor Kennedy's view was that something like 25 per cent. was unaccounted for in diagrams usually, and he therefore roughly conceded 15, and if he did not take 15 in 100, but in 85, well it did not make very much difference. Mr. Morrison, as the representative of the author of the paper, should have been thankful for that amount of concession. Then again, with regard to the method that Professor Kennedy calculated the volumes of the steam by, it appeared to him that it was precisely the method that Mr. Mudd was advocating that he used—that was, that he continued the compression curve upwards and measured the volume of the steam which was admitted into the cylinder, not taking account of that which remained, as it were, in stock. Now, with regard to the paper itself, he saw that the general conditions of efficiency stated were three equalities—firstly, in the range of temperature; secondly, in the initial stress on each crank; and thirdly, in the indicated horse-power of each cylinder. Now, with regard to the equality of temperature, he thought there was some danger of letting that condition be exalted into an article of faith; and in this particular connection he wished to be understood in the sense in which the little girl defined it, "a belief in something which you know to be impossible." Now, he did not see that there was any particular merit in "equality," at least when dissociated from "liberty and fraternity;" and he did not see that when it was connected with temperature, if they could get equality to the very last decimal, that it would be worth striving for. Now, what was the reason which animated the author to aim at equality of temperature so far as one could gather from the paper? It was in order to divide the range of temperature between the three cylinders, so that no one of the cylinders should have an inordinate range of temperature. He did not think it was proven by any means that inequality in the range of temperature caused any large amount of evil. If the condensation was proportional to the first power of the range of temperature, he thought there could be no reason why it should not be unevenly divided amongst the cylinders; but if, as there seemed some reason to believe, it varied as some other function of the range of temperature, then, perhaps, there would be a slight advantage in equality. But now arose the question whether the equality of temperatures affected anything else; and he thought that there was a very close connection, in theory at all events, between the equality of temperatures and the equality of horse-powers. In the discussion which took place at Leeds he found that Professor Smith was credited with having made a statement on this point which read thus: "The three equalities enumerated at the commencement of the paper as general conditions of efficiency, while all desirable, appeared mutually incompatible; but if equality of mean total pressure were substituted instead of equality of initial total pressure, then this equality, together with equality in range of temperature, would include the third equality of indicated horse-power." Mr. Morrison had that evening, he thought, endorsed that view to a certain extent; at least to this extent, that horse-power equality depended on temperature equality, and on the pressures; but he rather inclined apparently to the initial total pressure than to the mean; and then he made some criticisms on Professor Smith's remarks, which he—Professor Ryan—had not time to answer. But what he wanted to point out was that he was going to sin even more than Professor Smith did, and to cut out that mean total pressure condition altogether; and to say that theoretically at all events the equality of temperatures should depend solely and wholly on equality in the horse-powers. Now he said that theoretically. He did not mean to say that it was so absolutely in practice, but then they must compare the practical results with the actual theoretical relations, or else they would be lost entirely in their efforts to obtain a solution of the problem. Now, if the triple expansion engine were a perfect engine, which, of course, nothing terrestrial was, and he supposed nothing marine either, then that relation would obtain. If the triple expansion engine were a reversible engine that would be the case. He meant reversible in academic slang, not in the phraseology of the stokehole, because he supposed all their vessels had reversible engines, except, of course, the line of battle ships—they did not seem to have any means of going backwards. (Laughter.) Now he would say further, in expansion of that statement, that the equality of horse-powers carried with it as a consequence the equality of temperatures if the engine were perfect, but of course the engine was not perfect, and very far from perfect. The only thing he would say was that in so far as the triple expansion engine functioned reversibly, and as far as the same defects existed in all the cylinders, so far would he expect the equality of temperatures to be connected with the equality of horse-powers. He had cast his eye along the diagrams on the wall, to which he appealed in support of the fact that the relative value of the initial stresses did not in any way affect the connection between range of temperature and horse-power. Then he would go on to refer to those calculations of Professor Kennedy, which had caused so much discussion. With regard to those calculations he would like to say that it appeared to him they might cut both ways. They might be interpreted to mean not that the evaporative power of the fuel was too great, but that that which Professor Kennedy did not believe in, namely, that there was very little condensation in the high-pressure cylinder, was true. If that were admitted, then his 15 per cent. fell to the ground, and they had a nearly normal case. It was the opinion of some people, and it was an opinion he should like to support to-night, that the condensation in the high-pressure cylinder was of very much less account then the condensation in the other cylinders. As the time was so limited, he must touch upon these points very rapidly. He gave Professor Kennedy the benefit of one point, which was that they might take all Mr. Wyllie's diagrams, and they would see that the temperature range was greater in the low-pressure than in the high-pressure, and yet at the same time the horse-power of the low-pressure was less than that of the high-pressure. Now, they knew that the low-pressure was steam-jacketted in Mr. Wyllie's practice, but the high-pressure was not; so that the high-pressure, with a smaller range of temperature and without any steam jacket, gave a much greater efficiency than the low-pressure in every diagram on the wall, with one exception, and in that case there was something like 37 per cent. range of temperature greater in the low-pressure and only something like 22 per cent. gained in the horse-power; so that it was quite clear that the efficiency of the high-pressure cylinder was much greater in Mr. Wyllie's engines, at all events, than that of the low-pressure cylinder. He would point out that the condensation depended upon (1) range of temperature; (2) area of cylinder exposed to steam; (3) the weight of metal concerned in the thermal changes. No. 3 depended on (1) conductivity k; (2) specific heat c; (3) time of alternation of temperature T. In fact No. (3) varies as $\sqrt{\frac{k\,T}{c}}$. Professor Kennedy considered that the high-pressure cylinder was the unruly member, and as such that it ought to be jacketted. The following were some of the reasons for disagreeing with Professor Kennedy's view that the high-pressure cylinder should be steam-jacketted rather than the low-pressure cylinder. He assumed throughout equal ranges of temperature in the cylinders and efficient lagging:—(1) Suppose the range of temperature was the same in the high-pressure cylinder, yet any one of its cylinder covers is exposed to the cooling influence of expansion during three-quarters of a revolution only if the cut-off be at half-stroke. (2) The area of the piston and of the end of cylinder is a larger fraction of the area of the sides of the cylinder in the low-pressure than in the high, and these end areas are exposed to the steam throughout the whole stroke. (3) Greater condensation will take place in the low than in the high, because the proportion of the area of surface relatively to the weight of steam in the cylinder is greater in the low-pressure cylinder. This is evident, because the weight of steam passing through the three cylinders varies but little. (4) A larger weight of the cylinder will be active in the thermal changes in the low-pressure than in the high, because the area exposed is greater. (5) Condensation lubricates the piston in the high-pressure cylinder, and this dispenses with oil and its consequent evils at high temperatures, and in the feed-water. (6) Condensation matters less in the high-pressure, because all the condensed steam is re-evaporated into the next cylinder, while in the low it is passed into the condenser. (7) The steam jacket is partly idle during admission in the high-pressure and very little use with the ranges of temperature used in triple expansion engines, considering the high mean temperature in the first cylinder. On the other hand the steam jacket will be very effective all the time when on the intermediate or low-pressure cylinders, because of the considerable gradient of temperature between boiler steam and steam in the second and third cylinders. (8) The steam gets wetter and wetter as it passes through the cylinders. (9) The evidence of Mr. Wyllie's diagrams that the unjacketted high-pressure cylinder is much more efficient than the jacketted low-pressure cylinder, taking account of the relative ranges of temperature.

Mr. Mair said he thought the thanks of the Institution ought to be given to those who represented the author of the paper, because he had given them—if he might use a foreign phrase—his inside practice, for which he thought they ought to be exceedingly obliged and grateful. They had also to thank Mr. Cochrane for having said at the last meeting that the statement of the pounds of coal used by engines was an utterly valueless statement. An engine did not use coal at all, it simply used steam, or rather it used heat, and they ought to know how much heat the engines used, and then they would be able to tell how much and at what efficiency the engines stood. There was no doubt at all about this fact, that those three-cylinder compounds were more efficient than the two compounds, for this reason. He did not think there was so much in the range of temperature as the various speakers seemed to imply. If they looked at the temperatures they would find that with the Anglian the range of the temperature with the ordinary two-cylinder compound was 70 and 75, and in the triple it was 71, 71, and 79, a very small portion indeed. Again, if they looked at the Lusitania, there the range of the temperatures for the two-cylinder compound was 71·9, 72·78, and for the triple it was 71, 68, 76, so that there was not very much in the range of temperature there. The plain, simple reason why the engine was more economical than the other was the fact that it was not convenient in a marine engine to have more than 60 lb. of the high pressure in the cylinder for various practical reasons. As regards the number of expansions that could be made in an ordinary compound engine, if they took a boiler pressure of 60 lb. of steam, with 9·2 expansions, they got thermal units, 334.

Lbs.	Expansion.	Thermal units.
80	13·2	327
100	14·1	325
120	13·7	330

That showed that if they had passed somewhere about 10 to 12 expansions, say 11 expansions, there was not much economy in going on with two cylinders at no higher rate of expansion, and then he thought the triple would come in; and he thought they had not yet given the requisite number of expansions to obtain all the economy that could be obtained from using a triple expansion. As to the heat, that was given up by the steam jackets of the engine first of all, but did not think that with these engines at C there was very much advantage, where the range of temperature was small, in putting on jackets. Undoubtedly economy would exist by using jackets, but the question was whether it was worth the trouble and the bother of using them. The stokehole was not a very nice place for making bulky experiments in, and even on shore they had engines with their jackets choked up with water, and it was a question if it was worth the trouble and expense of putting them on. That was a commercial question. As regards the heat, that was given up in the jackets of the engines. He saw that there was a statement made in one of the papers before the Institute, that the steam that was condensed in the jacket merely gave up its internal heat. The way in which M. Regnault made his experiments was this. He had a boiler in which he evaporated water at a constant pressure, and he put in his calorimeters and he condensed the steam with cold water. He measured the amount of rise of temperature in his calorimeters in connection with the quantity of water passed through, and found that he had got the total heat of the steam, that is to say, not only did he get the internal heat of evaporisation but he also got the heat due to extra work. That is what M. Regnault found, and that is exactly what goes on in the jackets of an engine or in any other form of condenser It did not matter whether the steam was going through the cylinders of an engine or whether it was being condensed in a jacket, it gave up its total heat exactly in the same way.

Mr. Halpin said he thought they had greatly to thank the author for the paper. It was on compounding applied to marine engines, and he hoped it would be followed by a similar paper by someone on the stationary engine, which would make the cycle perfect. With regard to the question of steam jackets, he certainly must say that he believed in jackets, and particularly in those marine engines where they all found it so advisable and so advantageous to use the liners. When they used a liner, what objection there could be to turn the space into a jacket he failed to see. They had an enormous advantage in the ordinary marine engine like those mercantile engines, that in all cases they had a fall of 6ft or 8ft. between the bottom of the cylinders and the boiler, so that the jacket in that condition would easily drain itself. He did not at all agree with the statement that was made by the speaker in the discussion, that the jackets wanted very careful looking after at sea. If they simply put a separate pipe on to them and a separate pipe back from them they would look after themselves. He looked upon the jacket in this particular place in the same way as he looked upon the bed plates. They had to look after the bed plates in the sense that they wanted tightening, and they looked after this jacket in the same way. He tried to trace in the same way what made the efficiency in various cylinders, and he did not know that he had succeeded in doing it. They had given them the cylinders of the Para, in which they got the diameters, the stroke, and the total mean pressures—observe, not the effectivee mean pressures, but the total mean pressure. Of course they got the heat available inside the cylinders, and they knew the total pressure inside the jacket was constant. From that they could get a coefficient which might possibly give them a rough approximation as to the value of the jacket, as between 4·2 and 11·13. He thought that great thanks were due to Professor Kennedy for taking up this matter of the water. He did not know how he had calculated, but when he had given such a liberal coefficient as 15, such a very low coefficient as 15, and then brought out an average result of 12·88 of evaporation, which was the mean of the whole of his experiments, it is clear their thanks were due for showing that. If the Committee appointed by the council were going to make experiments—and he hoped they would—he ventured to suggest that they use meters. He did not say any form of meter was absolutely accurate, but they all knew meters were accurate between 3 or 4 per cent., which was a very long way short of 25 or 15 per cent., which Professor Kennedy gave him, and if they used a meter if anything broke down they need not stop. They would certainly get a very much closer approximation than they could get in dealing with a body like that. They had only got to deal with 1000 gallons of water at the outside, which was a very small matter to deal with in a meter. If they wanted to make the thing more perfect they might put another kind of meter on, an inferential meter on the discharge water, from which he thought they might get very valuable results if not very accurate. The results commercially would be this, they would see whether it would be cheaper to drive a larger volume of water through a certain money value of brass tubes or the reverse, and what was the best thing to do in their condensers. In this paper there was another thing that had not been alluded to that he thought should be noted. All the coal was not weighed, only one-seventh of it was weighed, and the other six-sevenths they measured in some way in skips. That would give rise to far greater errors than if it were possible to weigh the whole of the coal, which, he thought, would have been a very much better thing. In connection with these experiments, Mr. Mudd, he saw by the papers half-a-year ago, made some exceedingly valuable experiments, putting a whole engine on a bedplate and working it; but there he soon got to the end of his tether. He could only get friction diagrams, but he thought that with a very slight additional expense he could have got an additional load on the engine. Professor Thurston, in America, took up 500-horse power, and then he was not within miles of the limits of his power, so that he thought that a thing of the size he used it would be an exceedingly cheap thing to rig up, and infinitely more accurate experiments could be got than at sea. The feed-water

was measurable on land and perfectly under control. When he came to the question of ports, he found it a question of compromise, but those diagrams showed it very effectively, not alone what the actual port area was, but also what the valve opening was at the same time. One word he would say with regard to the figures the author gave of a vacuum. He gave for the whole of those a vacuum of 27 or 27·5, whatever it might be, but that under the circumstances was a statement which was not of the value it might be, because the barometer was not given. The barometer should certainly be given, and then one would know what was being done. He would further suggest that instead of giving a vacuum, and instead of giving the barometer if the vacuum was 27 and the barometer was 30, if they gave a coefficient of 9, that was all that was wanted—one knew what had been obtained, and that was translatable all over the world, instead of having millimetres by one certain vacuum to keep the whole thing shown. With regard to the three cranks, of course, as far as turning moments went they were very nice things, and kept a very easy action on the engine. When one looked on the engine and saw that three cranks had to be accompanied by suitable bearings, the question was not altogether so simple. They could get those bearings true with a bar—he was willing to allow that they could get them in, and that they got the bearings true, but whether they could easily keep them true he thought would be very doubtful and very difficult.

(*To be continued.*)

LETTERS TO THE EDITOR.

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

COMPOUND LOCOMOTIVES.

Sir,—I have read in the last number of your excellent publication, of which I am a constant reader, the reproduction of a note by M. Von Borrie, in which it is said that the failure of a compound locomotive, tried on the Kaiser Ferdinand North line of Austria was due to an injudicious use of the Mallet system.

I desire to free myself from all responsibility concerning this engine, which was not constructed after my plans, which I have not seen, and of which I have never even seen the drawings. If it belongs to my system it is in possessing two unequal cylinders, but if what M. Von Borrie points out has really happened, it is because it did not possess the pressure reducer which I employ in all my compound locomotives, and which prevents the pressure in the large cylinder ever exceeding that of the boiler at the time when the fresh steam passes direct into the two cylinders. I have engines, such as those on the line at Bayonne and Biaritz, which have been in use since the 1st of June, 1877, and others which have been in work for seven or eight years without any defect of the kind ever being stated concerning them.

The drawing of the appliance of which I am speaking was published in your journal in 1879, when in that year I made a communication to the Institution of Mechanical Engineers on the compounding of locomotive engines. I suppose in stating that the locomotive of Mr. Worsdell, which you have described, was the first goods locomotive constructed, you meant in England, as the article of 1879, to which I have just referred, stated that I had applied the same system to locomotives, *à marchandiser*, since 1877. Besides the drawings, which accompanied the article, showed this.

A. Mallet.

128 bis, Boulevard de Clichy, Paris,
February 7th.

Sir,—Will you kindly allow me space in your valuable journal for a few remarks on compound locomotives? In your impression of January 14th, after having given it as your opinion that goods locomotive engines offer the best opportunity for testing the value of compounding, you state that the engine you illustrate that week—January 14th—is the first compound goods engine constructed. Well, perhaps it is so in England; but you must not forget that there are other places in the world, and other gentlemen besides Mr. Worsdell who can build locomotives; yes, and also compound goods locomotives. I am very much inclined to doubt the assertion that Mr. Worsdell's compound goods engine was the first of its kind. Perhaps I may be wrong, but I fancy that we had a compound goods locomotive running here before Mr. Worsdell built his. At all events, it is over a year since Mr. O. Busse, locomotive superintendent, Danish State Railway, Arhuis central shops, built a compound goods engine, and it has been running since, and has given pretty satisfactory results; in fact, something very similar to Mr. Worsdell's engine, *i.e.*, from 1½ to 2½ tons per week. This engine was one of a class of goods engines from Stephenson's, Newcastle-on-Tyne, 15 × 22 cylinders, 4ft. 6in. wheels, six-coupled, and, after having run eighteen years, it was found necessary to give it a new boiler and cylinders. Mr. Busse concluded to make a new engine of her, and made her into a compound with 16in. high-pressure and 23in. low-pressure cylinders, using the same wheels and stroke; slide valves worked by Stephenson's gear. The engine when finished was, as far as workmanship and design goes, equal to anything produced either in England or Germany, and the trial trips proved that the engine was perfectly qualified to do the work expected of her. The first day's trial was with a train made up of heavy loaded coal trucks weighing 250 tons exclusive of engine and tender. The trial was over a rough road rising 1 in 100 the first five miles, with many nasty curves. Weather moderately fine. She took that train up the hill like a house on fire. I was with others on the foot-plate, and I was a little surprised to see the amount of steam got so easy with the coal she was supplied with. Coal! well, it looked more like what they used to ballast the wagon ways with in Northumberland thirty years ago. Anyhow, she steamed splendidly, and started the train as easy as any other non-compound locomotive. Mr. Busse determined to put thirty tons more on next day, and she walked away with them in first-class style, over the same ground as the previous day; after which the engine was put into regular duty, and has been running regularly since, and with the exception of a broken connecting rod on the high-pressure engine, and a broken piston head in the low-pressure cylinder—both of which showed flaws in the iron—nothing has been done to her. This engine can be seen at work any day on the West Division in Jutland. I nearly forgot to state that on both breakdowns she worked her train to the depôt, the one time with the high-pressure cylinder alone, and the other with the low-pressure cylinder worked with the steam direct from the boiler. Begging you will forgive the length of this letter, I will conclude with wishing Mr. Worsdell every success in his very laudable endeavours to prove the utility of the compound locomotive, but I do not believe he constructed the first goods compound locomotive. Nevertheless, I for one feel satisfied that the compound is the locomotive of the future, whatever drawbacks there may be at present.

A Roundhouse Foreman in Denmark.

Arhuis, February 10th.

[Our statement referred only to England.—Ed. E.]

IS THERE A LAW OF STORMS?

Sir,—I wrote to you on the 13th January, calling attention to the late Mr. George Jinman's law of storms, and I therein stated that between January 29th and February 9th there are three dangerous storm centres due over the British Isles—the one due on or about the 1st prox., being the return due period of the snow storm of the 22nd March, 1885; and further I stated that the details of these storms, which time would not permit of my giving, would be forthcoming through the medium of the *New York Herald* telegrams probably about the 27th, and our Meteorological Office when the storms arrived. Well Sir, true to my date, on the 27th we were favoured with the telegram from New York stating that a storm was on the way, and the weather we have experienced over the period I named shows that the storms struck the British Isles precisely as I predicted, based upon Mr. Jinman's law.

The verification of my forecast not only proves beyond the shadow of a doubt the existence of perfect storm periods but effectually disproves the oft-told tale of the Meteorological Office that it is impossible to forecast storms more than 48 hours in advance. Was my prediction not sent out more than 48 hours in advance? I sent it out at least 17 days in advance, and I assert that so perfect is the law that I could just as easily have sent it out 17 months in advance, and to prove my assertion I would refer you to the verification of my forecast sent to the press on the 6th of December last, announcing a storm over the North of Scotland and North Sea for the 19th to 21st December, which came true to date, and which storm I have documents to prove Mr. Jinman predicted exactly 5½ years in advance.

More conclusive evidence could not be given. Comment on the conduct of the Meteorological Department and Meteorological Society in ignoring the existence of a periodic law is unnecessary—the matter lies with the public. To say that it is impossible to tell more than 48 hours in advance when a storm is coming is simply childish, the law is as perfect as that which governs the law of the solar system. Every storm has a fixed period of development, and can be calculated with mathematical precision, weeks, months, and years in advance, as has been proved to demonstration, notwithstanding which, Sir—and you will hardly credit it—the late Mr. Jinman offered to attend at the Admiralty, Board of Trade, and Meteorological Offices to give such information and explanation of his law as would enable the several officials to foretell the weather for themseives, but his offers were rejected.

72, Bethune-road, Stamford Hill, Arthur Wilson,
London, February 8th.

[If our correspondent would say precisely what he means by a storm, we should be in a better position to know whether his prophecies have or have not been fulfilled.—Ed. E.]

THE ASSOCIATION OF FOREMEN ENGINEERS.

Sir,—I have been a reader of your paper for many years, but have not noticed much space devoted to the proceedings of the Foremen Engineers.

I have sometimes thought—and I believe I am not singular in that—if you took a little more interest in our proceedings it would probably—to use a quotation in your last issue—do us some good and you no harm. This, however, being entirely in your own discretion, I would not have troubled you on the subject but for a paragraph in your last issue taking notice of a circular sent to our ordinary members. I was at first surprised at this sudden development of interest in our proceedings, as we have sent many circulars to members previously which have not been honoured by such publicity, but soon found it was merely used as a convenience for yourself or your contributor publishing an opinion on a question which was freely and fully discussed and decided by the Foremen Engineers years ago.

Most of our members had, and still have, a very kindly feeling towards Mr. Newton, and are not likely to forget his exertions on behalf of our association during its early years; but *The Foreman Engineer* was a private venture of his own, which he hoped would be serviceable to foremen all over the country, and not merely the organ of the London Association.

The Foreman Engineer failed to secure the support of the provincial associations, and Mr. Newton ceased to publish it; but it is wrong to suggest that the London association either asked or expected him to continue it at a loss.

The stoppage of *The Foreman Engineer* did not, however, leave us quite destitute of the means of communication, as the appended circular is in itself a proof. We find no difficulty in communicating with our members, and, as it is well known that our meetings are held in the Cannon-street Hotel on the first Saturday of each month, those who do not attend can scarcely plead want of knowledge. I believe we are no worse off in regard to attendance at our meetings than our provincial brethren, or even some more important associations, but the present officers are desirous of improving matters.

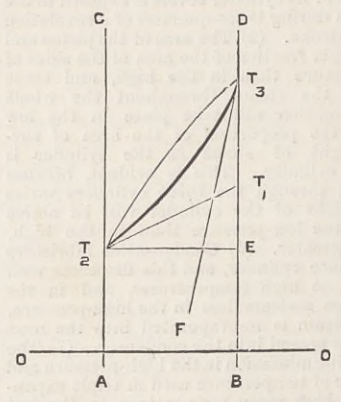
We would be glad to obtain, if possible, your own assistance; but, if that is too much to expect, I do not think it unreasonable to ask that a private circular to our own members should not inflict on us such a one-sided statement as that contained in the paragraph above mentioned.

William Powrie,
President of the London Association of Foremen Engineers.
7, Charterhouse-street, 10th February.

[The columns of The Engineer are and have always been open to the communications of the Foremen Engineers' Association. If they do not avail themselves of the fact that is not our fault.—Ed. E.]

CYLINDER CONDENSATION.

Sir,—I have read with much interest your remarks on this subject in your leader on the 4th inst., also in your issue of the 7th January, and in a late number of last year. Cylinder condensation is, as you say, a mysterious process, and any engineer with an extended knowledge of steam engine practice will, I believe, be of the same opinion. I have come across several instances of excessive condensation in the steam cylinder which could hardly be accounted for satisfactorily, and on the other hand I have known cases where this evil seemed to be conspicuous by its absence. In spite, however, of all that has been said on this matter, I believe that the known action of the cylinder walls is almost, if not altogether, competent to produce effects as great as any that have been observed in practice, as can be shown in the manner adopted by Professor Cotterill in his work on the steam engine. The rate at which heat will travel through a metal wall is wholly dependent on three things. These are the conductivity of the material, the difference of temperature on the two sides, and the thickness of the wall. It would thus appear that if the difference of temperature on the two sides could be indefinitely increased or the thickness indefinitely diminished, while the temperature difference remains the same, the rate of conductivity of heat through the metal may be increased to any amount. In the case of the steam engine cylinder, we have control only of the average temperature difference, and cannot check the quick changes that take place on the inner surface of the metal, and it is just these changes that produce the wonderful condensing effects so often noticed in actual practice. This will be seen by the following considerations:—Assume that hot dry steam enters a comparatively cold cylinder, some of it will be condensed immediately by contact with the cylinder walls, and at the same time the temperature of the latter will be raised; before the heat represented by this increased temperature has had time to travel outwards there is a fall of temperature due to the expansion of the steam, and some of the heat of the cylinder walls will flow back again into the stream. There is thus a constant flow outwards of heat due to the average difference of temperature of the two sides of the cylinder walls, and a reciprocating flow of heat into and out of the metal on the same side, and which never passed through it. The differences of temperature caused by the latter action may be very great between layer and layer of metal, and hence will cause an exceedingly rapid flow of heat—which is of course absorbed by the metal—far greater than would be caused by the average difference of temperature on the two sides of the wall. Taking an inner layer $\frac{1}{100}$in. thick, and a difference of temperature of 200 deg., the heat absorbed would be 10 thermal units per square foot of admission surface. This is as much as is commonly found in practice, although in some cases the condensation may be a great deal more, as, for instance, in some experiments conducted by the American Board of Naval Engineers, when the condensation was at the rate of 21·4 thermal units per square foot of area exposed. Besides the action of the cylinder walls themselves, there is the water left after exhaust, which may act very potently in causing condensation. A layer of water $\frac{1}{100}$in. thick would be just as effective in this respect as the same thickness of iron. The above reasoning may be illustrated by a sketch. Let A B C D be a section of the cylinder wall, t_2 the average external temperature, t_1 the average internal temperature. The flow of heat and fall of temperature will be represented by the line t_1 t_2. If now the internal temperature suddenly rises to t_3 there will be an accumulation of heat going on in the metal, and the temperature at any point will be represented by some such curved line as t_3 t_2, the tangent to which at t_3, viz., t_3 F, representing the flow of heat at that particular point. This line is seen to be very steep, and hence the excessive rate of flow of heat into the metal.



I should be glad to see this question tested, as you suggested some time back, by means of a thermopile, which would show whether there is that rapid and large increase of temperature here supposed.

George Harrison.

Didsbury, near Manchester, February 2nd.

VYRNWY WATERWORKS.

Sir,—Under the circumstances referred to in the concluding paragraph of my letter to you, published in your issue of January 21st, 1887, I must decline to continue the correspondence further than to point out, in conclusion, that the *facts* stated in my two letters to you are not and cannot be controverted.

30, Great George-street, Westminster, T. Hawksley.
February 17th.

Sir,—No person who has a proper respect for age and eminence, or who is capable of appreciating great engineering achievements, can fail to feel deep regret that Mr. Hawksley has been drawn into the miserable controversy about the Vyrnwy Waterworks. There are plenty of small and disappointed men in the profession who will be delighted to have an opportunity of throwing a stone at him from behind a hedge, but I have yet to learn that any engineer who knows the facts on both sides, and whose opinion is worth having, has said a word in disapproval of his conduct.

The "Civil Engineer" who writes to you on behalf of Mr. Deacon evades the real issue. The public and the profession do not want special pleading about titles and conflicting agreements. The question is, Who did the work? From the time of Mr. Hawksley's agreement with the Corporation until the day of his refusal to have anything more to do with them, how was Mr. Deacon employed? We know what he claims, but what did he do? He said that he signed the drawings. But had he any share in their preparation? Were they, or any of them, the products of his brains and experience? If the drawings and specifications were, as Mr. Hawksley alleges, prepared in his office in London, under his own directions without any assistance from Mr. Deacon, and were sent down to Mr. Deacon to be carried out, Mr. Deacon then adding his own signature, how can Mr. Deacon truthfully and honestly be called "joint engineer"?

Noble monuments of Mr. Hawksley's skill are to be found all over the country.

"Civil Engineer" conveniently ignores Mr. Hawksley's allusion to Mr. H. Williams. This is a subject about which there was much writing in the Liverpool newspapers six or seven years ago. Letters were published from Mr. De Rance, of H.M. Geological Survey, Mr. J. Sturgeon, and others, to prove that Mr. Williams was the first to propose the Vyrnwy for the supply of Liverpool, and that his preliminary plans were submitted to the late chairman of the Liverpool Water Committee and to Mr. Deacon long before Mr. Deacon made his first report. Mr. Sturgeon wrote very indignant letters about the treatment of Mr. Williams, and he ought certainly not to be forgotten in any history of the Vyrnwy scheme.

J. H. L.

February 16th.

FRICTION OF ENGINES.

Sir,—That the friction of engines is a constant quantity, independent of the speed, was foreseen years ago. Mr. Mansell, in his paper on "Speed of Vessels,"—see Engineer, 1876—followed this reasoning. In the "Merkara" example his investigation shows the loss in pressure to be a constant (f) of 7·76 lb. per square inch, when referred to high-pressure piston for that case. The particulars being as under:—

Trials.	I.	II.	III.	IV.	
Speed—knots.. ..	6·20 ..	9·20 ..	11·09 ..	12·91	
Unit pressure—lb.	22·79 ..	38·12 ..	53·55 ..	73·30	* Unit press. $-(f)$
Effective ,,	15·03 ..	30·36 ..	45·79 ..	65·54	= Effective press.
Gross Ind. H.P. ..	299 ..	738 ..	1225 ..	1940	
Effective H.P. ..	158 ..	483 ..	863 ..	1422	
Revols. per min. ..	31·15 ..	44·75 ..	54·35 ..	63·23	

In Professor Thurston's experiments, the revolutions being nearly invariable, the loss in H.P. is more easily seen to approach a constant having an average value of about 3¾ lb. per square inch of piston area.

I thought it might interest some of your readers to draw attention to Mr. Mansell's graphic solution of the frictional loss.

Liverpool, February 11th. W. S.

THE TRENT CANAL.

Sir,—One sees gladly in your last number that steps are being taken to prevent an important outlet from the Midlands passing into commercial hands.

Those interested in the cheap transport which the Trent can afford may read with advantage the evidence given before the Waterway Committee of 1883. Although that inquiry came to an untimely end, enough was elicited to show the danger of letting important water routes fall into the hands of companies.

It was stated that the rates charged for transport on the Aire and Calder Navigation were about ½ths of railway rates. As there is reason to believe that on such a waterway goods can be carried for from ½d. to ¾d. per ton-mile, the loss to the public is say ½d. per ton-mile.

W. M. C.

Edinburgh, N.B., February 9th.

AMERICAN ENGINEERING NEWS.

The following information concerning engineering works, and on industries relative to engineering trades, is from a New York correspondent:—

Large railroad project.—Mr. Jay Gould is at the back of the newly incorporated Kansas Western Railroad Company. His son, George J. Gould's name, heads the directorate. The line will form a perfect gridiron system in Kansas, its franchise includes lines in every county but one, and it is stated that other lines will be run wherever cities, towns, or villages desire. The capital stock is 50,000,000 dols.—£10,000,000. The Omaha, Lincoln, Hartland, and Eel Paso Railroad Company has been incorporated to build a

line 950 miles long, from Omaha, Neb., to Eel Paso, Tex. The surveys are to be run this spring, and work will be started this year in Kansas. The capital stock is several million dollars. The Chicago, Paducah, and New Orleans Railroad Company is another large scheme. It is stated that it will build an independent line from Chicago to New Orleans. A large bridge will be built over the river at Paducah. The capital stock is 10,000,000 dols.—£2,000,000. The Atchison, Topeka, and Santa Fé Railroad is contemplating enormous extensions to its system, which already aggregates over 5000 miles. Contracts were let this week for a considerable portion of the new line from Kansas City to Chicago—chartered as the Chicago, Santa Fé, and California Railroad. This company has purchased the St. Louis, Kansas City, and Colorado Railroad, now under construction, and will push it to completion. Eastward from St. Louis, Mo., the company will acquire and widen the Toledo, St. Louis, and Kansas City Railroad, which is a narrow gauge line. By its new lines the company will have control over a system reaching from the Atlantic to the Pacific and into Mexico. It will be a dangerous rival to Gould's immense Missouri Pacific system. Active preparations are in hand for a considerable extent of new lines and extensions.

Electric street railroads.—There is a very strong movement now in favour of electricity as motive power for street railroads—tramways; and all systems—storage, centre rail, underground conductors, overhead wires, &c.—seem to be equally favoured. In Alabama this is especially the case. Montgomery has adopted the Van Depoele system entirely, and other cities are experimenting and building electric lines. At Scranton, Pa., the system is giving entire satisfaction. Little has been done thus far with the accumulator system, but experiments are now in progress in this city with the Julien motor on the Eighth Avenue Surface Railroad. This system has been in use in Brussels and Paris, and the motor has been imported from the latter city. A trip of five miles was made in about forty-eight minutes; the average speed maintained was six miles per hour. The storage batteries are placed under the seats, and weigh about five tons. They will run for about six hours, and the operating expenses are said to be from 10 to 20 per cent. less than on cable railroads.

Heating railroad cars.—Already the wild outcry against the dangerous coal stoves in cars is dying out, the fearful accidents of the last few weeks, in which persons were burnt to death in wrecked trains, having been obliterated from the public mind by other matters. Railroad officials and societies, however, are still discussing this question, but very little practical result seems to be attained. It is suggested that Congress pass an Act prohibiting the use of fires, and compelling the adoption of some safe and efficient system. Bills have been introduced into the State Legislatures of Nebraska and Indiana with this same object in view.

The coal strike.—One of the most extensive strikes ever known is now in progress. It was started by the coal workers and handlers, who are paid starvation prices by one of the wealthiest monopolies of the world. Thinking to crush the movement, the monopolists refused to make any concessions; then the coal handlers and shovellers, canal boatmen, carters, and others, joined the strike; no coal was sent over the railroads, prices went up rapidly, and the poorer classes were entirely deprived of a supply; the dealers could only supply small quantities, several large manufactories closed down, throwing numbers of men out of employment, and the scarcity was felt by all classes. The steamships got their supplies with difficulty. The monopoly still holding out, though losing far more than first concessions would have cost, the freight handlers, wharfmen, longshore men, and others employed on the river front, went on strike on the 27th inst. to the number of 20,000. The situation is very threatening, and the entire police force of New York City is on reserve duty; Jersey City and Brooklyn are equally affected. There have been several collisions between the strikers and "scabs," and some blood shed; several merchants have applied for police protection. The coal wharves and tipples are guarded by police, specials, and detectives, and the strikers intimidate the few men the companies can get to work. In some cases the brakemen on coal trains have joined the strike.

Steamer shafts.—The Union Ironworks, San Francisco, Cal., have ordered the shaft for the new cruiser Charleston from Krupp. Cramp Bros., of Philadelphia, have ordered the shafts for the other three ships for the Navy from the English firm of Whitworth.

Pure water supply.—While new waterworks, large and small, are being established in all parts of the country, cities which have a water supply are turning their attention to its purification. The "Hyatt Filter" is being very extensively adopted, as it is found to work with little trouble, satisfactory results, rapid operation, and economy of working. A report has been made by Captain Symons, U.S. Engineer Corps, showing the feasibility of filtering the water supply of Washington, D.C., and it is in contemplation to put in a filtering plant for the purification of the entire Croton water supply of this city. The filter bed is kept clean by the use of 6in. cone valves containing copper in the form of shot. These valves admit the water for cleaning, and hold back the filtering material. At Somerville, N.J., there are six of these filters, with a capacity of 150,000 gallons per day each. The 30ft. filter has a capacity of 3,000,000 gallons per day.

The Hawaiian treaty.—The Government has extended for seven years the reciprocity treaty between this country and Hawaii. Free trade is to exist between the two nations, and the King of Hawaii is not to extend the duty-free privilege to other countries. Pearl River Harbour, near Honolulu, is to be ceded to the United States for a coaling and naval station.

The Lake trade.—The prospects for the coming season are most encouraging. Several grain steamers are being built, and all the lake shipyards and dry docks have plenty of work.

Uniform specifications for bridges.—At the regular meeting of the American Society of Civil Engineers, on February 2nd, 1886, the matter of standard forms of specifications was further discussed. It was urged by Professor Waddell that while a standard might be adopted for ordinary work, work of considerable importance, such as cantilevers, long spans, and braced piers, should have individual specifications prepared. He called attention to the useless and unscientific practice of carrying to fine decimals calculations of strains, the data for which are assumed and but little more reliable than guess work; the substitution of a few empirical rules would be an immense saving of time and labour, and would give equally satisfactory results. Mr. Macdonald, of the Union Bridge Company, himself an expert bridge engineer, stated that while manufacturers could agree on standard forms for specifications, engineers and designers would not abandon the opinions held by each; the growth of and changes in bridge construction which are now taking place render it inadvisable to adopt such standards. Mr. Theodore Cooper, the bridge engineer and designer, author of the widely used "Specifications for Railroad Bridges and Viaducts, and for Highway Bridges," declared that he was strongly opposed to such standards, as in designing a bridge for which he would be responsible he would most certainly adopt his own ideas, and while some persons seemed to think that bridge building was so easy that with uniform specifications anybody could make a design, yet he was quite sure that the science was by no means fully understood as yet, and was not yet ready for standard specifications. He pertinently asked why such specifications had not been adopted for masonry, whereas every engineer writes his own and embodies his own ideas for such work.

Improved car wheels.—Mr. Allen, of the Allen Paper Car Wheel Co., the inventor of the "Allen" wheel, has patented an improvement consisting of placing flat steel rings between the paper body and the tire and hub, thus enabling the tire to be forced on or off, and the hub removed without injury to the paper body; the rings are rivetted to the thin iron discs which cover the exterior of the paper body. Mr. Allen has patented a steel tired wheel with a steel or cast iron body. The body is of double disc form, the discs being dished out; the hub and body are formed in one, and the hollow space between the two discs is strengthened by radial ribs like spokes.

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

(From our own Correspondent.)

THE finished iron market is this week somewhat unsettled. The makers of common bars and some other sections are showing a greater unanimity of determination than heretofore to get better prices—action which is being met by consumers in a spirit of some opposition. It is now coming to something like a tug of war between manufacturers and buyers as to who shall prove the stronger. There is certainly no flush of orders for any class of finished iron outside sheets which could be used by makers as the best means of supporting their firmer front.

The great discrepancy which still exists between the prices of pigs and unmarked finished iron is the strongest argument in favour of a rise in the latter. The pig iron makers have secured their position, inasmuch as the contracts which they are now executing have been taken at advanced prices. This applies particularly to makers of Midland pigs imported into this district in large quantities. Finished iron makers, on the contrary, have been unable as yet, except in sheets, to get any general advance, and they have to give more by from 5s. to 7s. 6d. per ton on pigs.

The current quotations for unmarked iron may be correctly gleaned from the quotations of the Pelsall Coal and Iron Company, whose list this week stands at P.C. bars, £5 5s.; P.C. hoops, £5 10s.; crown bars, £6; crown hoops, £6 5s.; crown sheets, £6 10s.; charcoal sheets, £13; hinge strip, £6; gas strip, £5 5s.; nail strip, 24in. wide to 13 gauge, £5 5s. Other firms there are, however, who freely own that they are unable to get prices equal to these.

In their efforts to get more money, the makers of small rounds and squares have held an "informal gathering to consider the situation," and, after discussing the matter, they resolved "to advance the charge for extras on small rounds and squares, in order to meet the increased cost of manufacture." For a long time past the custom of charging extras upon rounds and squares of smaller than ½in. size has fallen into disuetude among the small iron makers, in consequence of severe internal competition. Now, however, an attempt is to be made to get back to the old custom, which has always been recognised by the best iron makers. The advance, if it can be obtained, should mean 5s. to 10s., and on to 20s. per ton, according to the size.

One of the most important meetings in connection with the iron trade which has been held for a long time past upon the question of prices took place this—Thursday—afternoon at the Queen's Hotel, Birmingham. Invitations had been addressed to every one of the 110 firms connected with the South Staffordshire finished iron trade, and the meeting was officially called by the secretary to the Ironmasters' Association in response to a request which had been made to the chairman—Mr. Benjamin Hingley, M.P.—"to give the members of the trade an opportunity of discussing the question of the low prices of finished iron as compared with the quoted rates for pig iron." The meeting assembled in the hope that some steps might be taken to advance prices. Mr. Hingley presided, and the attendance numbered over 70. After discussion it was unanimously resolved to advance all descriptions of unmarked finished iron, including bars, hoops, strips, &c., 10s. per ton upon the minimum prices prevailing previous to the rise in pigs. Marked iron prices are not affected by this resolution, such bars remaining at £7. It was announced that the minimum extras on small sizes of unmarked iron had been raised to the following:—Rounds and squares of ⅜in., 5s. extra; $\frac{5}{16}$in., Nos. 1 and 2, 10s.; Nos. 3 and 4, 15s.; No. 5, 25s.; No. 6, 35s.; No. 7, 55s.; No. 8, 75s.; and No. 9, £5. The extras on marked bars remain as before.

There is no relapse in the favourable condition which has of late marked the sheet trade. Specifications are coming in from the galvanisers and other consumers with the needed alacrity, and the mills are kept busy. There has not been the same difficulty in the matter of prices in this branch as in the other departments of the finished iron business. The reduction in make and the good demand has combined to enable makers to command better prices by 10s. per ton compared with when pigs were down at the minimum. This advance is fully maintained. Singles for galvanising purposes are quoted £6 to £6 5s.; doubles, £6 10s. to £6 12s. 6d.; and lattens, £7 10s. to £7 12s. 6d. Some makers refuse to sell this week at former prices, believing that the market will further advance in their favour. The New Side Ironworks, Walsall, of Mr. Jno. Southern, will be re-started next week, and this week the Shrubbery Ironworks, Wolverhampton, which have been standing since Christmas for alterations, have also been set going again.

Pig iron sellers refused yesterday in Wolverhampton, and to-day in Birmingham to give way in price as to any description upon offer. They combated the contention that the tendency of the Cleveland market should affect the course of prices on these Exchanges. Lincolnshire, Derbyshire, Nottingham, Northampton, and similar makers are so well sold that they do not care to accept new business at lower than quarter-day rates. Consumers, on their part, are not willing to pay full recent prices, and the quantity of iron changing hands is only small.

Northampton pigs stand at about 40s. to 41s. delivered; Wiltshires, 40s. 6d. to 40s. 9d.; and Derbyshires, 41s. to 42s. 6d. Native pigs are 52s. 6d. for all-mines; 37s. 6d. to 42s. 6d. for part-mines; and 30s. to 32s. 6d. for common. Hematites from the West Coast and from Lancashire keep strong at an average of 60s. per ton, delivered here.

The comparative statement which has been issued by the South Staffordshire ironmasters, as a preliminary to an attempt at the abolition of the payment of extras in the mills and forges, was considered at a meeting of ironworkers at Brierley Hill, on Monday. An opinion was expressed that the statement was unreliable, and a resolution was passed recommending the operative section of the Wages Board to instruct the secretary to give the stipulated notice for a reconsideration of the wages question, with a view to obtaining an advance. The operative secretary to the Arbitration Board expressed the opinion that the masters' claim would not be pressed. The practice recently introduced at some of the works of trollying instead of dragging the iron was likewise considered. A communication was read from Messrs. Hingley and Sons, by whom the custom had been introduced, saying that they could not revert to the old system, but that if the ironworkers persisted in adopting an antagonistic attitude, they would have to close their works, which had been recently kept on solely for the benefit of the men.

The constructive ironwork manufacturers have lately booked several good contracts, and activity rules in many of the engineering establishments. Heavy castings meet with a rather better inquiry, and the commoner classes of light ironfoundry work are in average sale, but at no better prices. The galvanised iron roofing manufacturers are booking orders at a steady pace, foreign lines being the most noteworthy.

Cast iron pipe founders are in receipt of better inquiries, among them being one from the Liverpool Corporation for between 3000 and 4000 tons. It is not yet known whether the contract will be secured for this district.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—There is no new feature of any importance to report in the condition of the iron trade of this district. The market remains about stationary, both as regards prices and demand, with, however, a tendency still in the favour of buyers. Here and there fairly large transactions are reported, but these are very exceptional, and with the present unsettled aspect of affairs, buyers prefer generally to limit their purchases to hand-to-mouth requirements. Although undoubtedly prices are gradually receding from the recent advance, there is no great pressure to sell on the part of makers, and a very considerable proportion of the advance is still maintained.

There was a full attendance on the Manchester iron market on Tuesday, but the inquiry for either pig or finished iron was only very limited, and there was but little actual business doing. For Lancashire pig iron, quotations remained at 39s. 6d. for forge, and 40s. 6d. for foundry, less 2½, delivered equal to Manchester; and although local makers are selling very little, they hold firmly to these figures. District brands also still average about the same price, but there is Lincolnshire iron now being offered at as low as 38s. to 39s., less 2½, delivered into the Manchester district. For outside brands offering here prices remain practically unchanged from last week. Good named brands of Middlesbrough foundry are quoted at 45s. 4d. to 45s. 10d. net cash, delivered equal to Manchester, and Scotch makers, in the face of the miners' strike, hold to late rates, but these are 2s. 6d. to 3s. per ton under the top prices that have recently been asked, and so far the stoppage of the pits does not seem to have contributed towards any renewed actual upward movement. For the moment, however, any quotations are scarcely more than nominal, as there is little buying going on to really test prices.

Hematites are rather easier. For some brands makers are still quoting 59s. to 60s., less 2½, delivered equal to Manchester, but there are good No. 3 foundry qualities to be got at 58s. per ton, less 2½, delivered into this district.

In the manufactured iron trade business continues slow, and makers in some instances are very short of specifications to keep their works going. Prices average £5 to £5 2s. 6d. for bars, £5 7s. 6d. for hoops, and £6 10s. to £7 for sheets per ton delivered into the Manchester district.

Reports as to the condition of the engineering branches of industry are somewhat conflicting. The general tone of the reports issued this month by the leading trades union societies is decidedly more hopeful, and is backed up by a substantial reduction in the number of members in receipt of out-of-work support. On the other hand, I cannot find that, so far as the large works throughout this district are concerned, there is any material improvement in the actual condition of trade. Tool makers are slightly better off, and, as I pointed out in previous "Notes," there is rather more activity amongst locomotive builders and machinists, but slackness of trade is still the general report. The returns of the Amalgamated Society of Engineers show a reduction of about 1 per cent. on the number of members throughout all the branches in receipt of out-of-work support, whilst in the Manchester district, which has hitherto been, if anything, in a worse position as regards employment than other important centres, there is a reduction of about 1½ per cent. as compared with the returns for the previous month of the number of members in receipt of out-of-work donation, and one special feature is an increased demand for pattern makers, which is certainly an indication that somewhere there is more work going out. The returns of the Steam Engine Makers' Society also show a similar improvement in the same direction, and from all the important industrial centres better reports are sent in with regard to the condition and prospects of trade.

I hear on very good authority that, in view of the rising opposition to which I referred last week to the proposed Steam Boilers Registry and Inspection Bill, the draught of which recently made its appearance, the Board of Trade has decided to withdraw the Bill. The opposition, I may add, has not come so much from boiler-makers and engineers, as from steam users all over the country.

In the coal trade there is a moderate business doing, with prices maintained at about late rates. Pits are barely working full time all through, but supplies are plentiful in all descriptions of fuel. At the pit mouth best coal averages 9s. per ton; seconds, 7s. 6d.; common house coals, 6s.; steam and forge coals, 5s. to 5s. 6d.; burgy, 4s. 6d. to 5s.; best slack, 3s. 6d. to 4s.; and common, 2s. 6d. to 3s. per ton.

In the shipping trade there is a brisk business doing owing to the continued miners' strike in Scotland compelling vessels which usually load at Scotch ports to come to Liverpool and Garston for supplies, and the result is that better prices are being got. For steam coal delivered at the high-level, Liverpool, or the Garston Docks, the average figure is 7s. 6d., but in some special instances as much as 8s. per ton is being obtained.

As was to be expected the colliery owners in the South-West Lancashire district have decided not to entertain the applications for an advance of 10 per cent. in wages sent in last week, nor are they prepared to make any alteration in the existing arrangements as to the conditions of the time of working. I have heard a report that there is a very determined feeling amongst the men as to the matter, and there may be some temporary stoppage of the pits, but the men will scarcely be so ill-advised as to enter upon a protracted strike in an attempt to enforce their demand.

Barrow.—The quieter tone which was observable in the hematite pig iron trade at the end of January and in the beginning of the present month has had some effect in depressing the market, but while the demand was quieter, it was known that makers, being fully sold forward, were very firm in their quotations, and could only accept business at practically full prices. Makers a fortnight ago, however, were quoting 52s. per ton, although that price was not realised. Now the quotation is 50s. per ton net f.o.b. for mixed Bessemer parcels and 49s. 3d. for No. 3 forge and foundry iron, and at these rates business has been done. The demand is still good, and it is fully believed that a continuance of brisk trade will be experienced. Makers are briskly engaged in bringing about an increased make of iron, and at Carnforth, Ulverstone, Barrow, Millom, Cleator Moor, Whitehaven, Workington, and Maryport additional furnaces will soon be put in blast. There are large shipments both of iron and steel to America, the colonies, and the Continent, and the forward deliveries already arranged for justifies the belief there will be a brisk trade in shipping throughout the season. The steel trade is briskly employed, and large orders are held. The demand for steel rails is steady, and inquiries representing very heavy deliveries are to hand from American, colonial, and other sources. Rails, blooms, and billets represent a very good trade, and makers have done more business lately in ship steel. Preparations for a large trade in the latter are in progress. Rails of ordinary heavy sections are quoted at £4 2s. 6d. per ton net f.o.b. I hear it stated on good authority that the Moss Bay Iron and Steel Company, Workington, is about to establish a branch in Canada. The manager of the company, Mr. Kirk, has been for some time in America, and it is understood that large ore royalties, in a very favourable position for steel manufacture, have been secured, also that arrangements are now in progress for the establishment of works on the Canadian Pacific seaboard. There are now 150,902 tons of hematite pig iron in the West Cumberland Storing Company's stores, being an increase of 3144 tons on the 24th ult. The shipbuilding trade is still quiet, although it is believed some large contracts now being negotiated for will be placed in this district. The engineering trade is quiet both in the general and marine departments. Iron ore finds a good market, and full prices are ruling—11s. to 12s. per ton net at mines. Finished iron is in quiet request. Coal and coke steady and firm, but the business doing is not at better prices. Shipping is better employed than for some time past, and the prospects of an active season are showing themselves. A movement is on foot to secure a new dock at Workington. A large foreign trade is done there, and the traffic is now largely worked through Maryport.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE Midland Railway Company is in the market for 3000 to 5000 tons of steel rails, and the Great Eastern Railway have asked tenders for 250 sets of railway points. Further locomotive work is also on the way from India, the Indian Midland Railway having invited tenders for forty-two engines and tenders. It is not expected that the Midland will be able to place their rails at the low quotations secured by the Manchester, Sheffield, and Lincolnshire

a short time ago—stated at about £4 5s. a ton—or that the Indian Midland Railway will be successful in having their work booked at £37 10s. per ton. The tendency of values is steadily upward, in spite of the severity of competition for both rails and engine work.

Yorkshire collieries have opened the year well with the Hull coal trade. During January last there were sent to Hull 98,984 tons against 84,872 tons during the corresponding month of 1886. The exports were 36,570 tons, this being a large increase on the tonnage of January, 1886—viz., 25,208. Germany took 9533 tons—more than one-fourth of the whole tonnage sent to foreign countries, while Denmark had 7393 tons, and Sweden and Norway 7145 tons. Russia secures the bulk of her supplies in the latter month of the year, before the ice closes up the ports. At home house coal is now quoted in the best qualities from 13s. to 14s. 6d. per ton; seconds, from 11s. 6d. to 12s. 6d.; other qualities, 10s. to 11s. 8d.; nuts, 5s. 10d. to 7s. 11d.

A large local company, whose principal specialities are ordnance, steel castings, marine forgings, &c., has just declared a fourth dividend for the year 1886 at the rate of 2½ per cent., and a bonus of 4 per cent., making, with the dividends already paid, 14 per cent. for the twelve months, free of income-tax. This does not look as if the heavy trades, so far as these goods are concerned, had been unprofitable in 1886.

The electric light and the telephone make rapid progress in Sheffield. Messrs. Tasker, Sons, and Co., of Angel-street, who are the pioneers of both enterprises in Sheffield, have recently commenced the supply of the electric light to merchants, hotels, and others. Their first "instalment" of forty-five lights is now all taken up. These lights are of 1200-candle power each. A large drapery establishment has ordered fifteen for its premises. Other systems of electric lighting are in operation, but the bulk of the work is in Messrs. Tasker's hands, and so confident are they of the future of electricity as an illuminant, they have put down power sufficient for four or five times the lights now ordered. The result in the end must tell upon gas companies' receipts for lighting. Probably the gas company will seek compensation in encouraging the use of gas for power and heating purposes. The Sheffield Telephone Exchange, which now numbers 400 subscribers, have commenced to give constant service, Sundays included.

On Monday morning a miner named Michael M'Carthy was killed in a dynamite explosion near the Edmund's Main Colliery, Worsbro' Dale. A gangway had been used to convey coal to the canal. The valley between the pit and the canal was crossed by means of brick piles. These piles were being removed by M'Carthy, who had done similar work a few weeks previously. A hole was drilled in the base of one of the piles and a dynamite cartridge inserted, but it did not act. M'Carthy inserted a second cartridge in another hole, lighted the fuse with a lamp he had in his hand, and the charge, instantly exploding, almost blew him to pieces.

I hear that Mr. Alexander Wilson, managing director of Messrs. Charles Cammell and Co., is about to be presented with a testimonial by the workmen at the Derwent Iron and Steel Works, Worthington. Mr. Wilson has been very liberal in opening the new infirmary free of debt. The ceremony was performed by Mrs. Alexander Wilson, and on that occasion Mr. Wilson handed a cheque for £380, the amount of the debt remaining on the institution. It is intended that the presentation should take the form of an illuminated address, and any surplus will be devoted to fitting up one of the wards in the infirmary, to be called "The George Wilson Ward," in memory of Mr. Alexander Wilson's brother, whose sudden seizure and subsequent death excited so much sorrow in 1885.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The trade in Cleveland pig iron continues exceedingly dull, neither buyers nor sellers showing any disposition to operate. Makers will not need fresh orders for some time to come, and consumers are content to wait, seeing that prices still tend downwards. At the market held at Middlesbrough on Tuesday last very few actual transactions took place. For some parcels of No. 3 g.m.b., which did change hands, 35s. 9d. per ton was accepted, or 6d. less than would have been taken last week. Forge iron has not fallen in value as much as No. 3, as most of what there is in the market is held by makers, and therefore it is less subject to speculative operations. The price current on Tuesday was 34s. 9d., or 3d. per ton lower than on the 8th inst.

Messrs. Stevenson, Jaques, and Co.'s current quotations are:—"Acklam hematite," mixed numbers, 50s.; "Acklam Yorkshire"—Cleveland—No. 3, 39s.; "Acklam basic," 40s.; refined iron, 54s. to 64s.

Warrants are now of less value than makers' iron, as several holders, both at Middlesbrough and at Glasgow, are anxious to sell out. At Middlesbrough 35s. 6d. has been accepted, and at Glasgow, 35s. 4½d. per ton.

The stock of pig iron in Messrs. Connal and Co.'s Middlesbrough store increased 686 tons last week.

A decided improvement has become apparent in pig iron shipments from the Tees since the beginning of the present month. Up to Monday evening last 24,537 tons had left the port, or 7000 tons more than in the corresponding portion of January.

In the finished iron trade no improvement is discernible; manufacturers continue to quote £4 15s. per ton on trucks at works for ship plates and common bar iron, and £4 10s. for ship angles. The competition is very keen, orders are scarce, and even these low prices are not easily realised.

Ironfounders are better off for work than they have been for a long time.

The strike of the Northumberland coalminers continues in full force. Several events have occurred during the last week which may have a decided effect upon the ultimate issue. On the 7th inst. the officials of the union issued to the other trade societies of the country a circular appealing for help. In it they say that 16,000 men and boys are out of work, of which 12,000 are members of the union. They assert that the Northumbrian coal hewers' wages do not on the average exceed 20s. per week, and that the other workmen earn considerably less. They admit that the daily rate paid has been higher than in other districts, but say that the large amount of time lost brings down the average to the above low figure. They, as usual, ignore the fact that it is to enable the employers to do a larger trade and avoid the lost time that the reduction is demanded. It is the old story. The employers desire to give full employment at such lower rates as will enable them to compete. The workmen desire to retain the present amount of idle time, and that their wages should be kept up to a level which will cover and provide something to spend during it. The amount necessary to maintain the men during the strike is said to be £8000 per week.

The union officials had issued their circular, justifying the men's action in striking and appealing for pecuniary aid only three days, when, to the astonishment of everyone, they suddenly resigned their positions. Their reasons are not made public, but it is generally supposed to be in consequence of a lack of that almost unanimous support which they deem to be essential at so serious a crisis as the present one. Such an event at such a time has naturally encouraged the employers greatly, and placed the men in an awkward predicament. However, a vote of confidence, or the reverse, has been demanded from the men at all the collieries affected, and most of the ballot papers have already been returned. As far as can be seen there is little doubt but that there will be a large majority in favour of asking the officials to re-consider their decision, and resume the management of affairs.

Already there is considerable distress in the pit villages, especially in the families of the non-unionists, and labourers, who have had nothing whatever to do with the strike. Efforts are being made by various philanthropic individuals to relieve these poor people, but they are so numerous that it is to be feared there will be great increase of mortality among them unless the dispute be quickly terminated.

The steel workers at Eston are now again fully at work. A compromise was effected by the employers agreeing to advance their wages 2½ per cent. in lieu of the 10 per cent. claimed.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The pig iron trade has been much depressed in the course of the past week. Inquiries were few, comparatively speaking, and the colliers' strike instead of improving the prices, as such an occurrence has sometimes done, has so far had the precisely opposite effect. The ironmasters are thoroughly at one with the associated coalmasters in resisting the advance of wages at present, and the putting out of blast furnaces at Gartsherrie and elsewhere is accepted as indicating, not merely that coals are scarce for furnace purposes, but that the ironmasters are not pressed for delivery, and that their prospects at present are not so good as to warrant them in raising the cost of production by increasing the pay of the colliers.

The past week's shipment of Scotch pigs amounted to 6330 tons, as compared with 7852 in the corresponding week of 1886. The output is materially curtailed, although this will probably be but temporarily during the labour dispute. Our best customer for Scotch pigs is the United States, which has taken double the quantity since the beginning of the year that was sent there in the same period of 1886.

Business was done in the warrant market on Monday in Scotch iron at 43s. 4d. to 43s. 6d. cash. On Tuesday 43s. 4½d. was quoted, but buyers at the close were at 43s. 6½d. On Monday, Cleveland and Cumberland warrants lost 6d. each on Glasgow Exchange, but the loss was partially recovered on Tuesday, when a slightly improved feeling prevailed. On Wednesday business took place at 43s. 7d. to 43s. 8d., and back to 43s. 4d. cash. To-day—Thursday—the market was firmer, with business up to 43s. 11d., closing with buyers at 43s. 10½d. cash.

The current values of makers' pigs are 6d. to 1s. below those of the preceding week. Gartsherrie, f.o.b. at Glasgow, No. 1, is quoted at 51s. 6d. per ton; No. 3, 44s. 6d.; Coltness, 57s. 6d. and 46s. 6d.; Langloan, 53s. 6d. and 46s. 6d.; Summerlee, 55s. 6d. and 45s. 6d.; Calder, 52s. and 44s.; Carnbroe, 48s. and 43s. 6d.; Clyde, 48s. 6d. and 44s.; Monkland, 45s. 6d. and 42s.; Govan, at Broomielaw, 45s. 6d. and 42s.; Shotts, at Leith, 51s. and 46s.; Carron, at Grangemouth, 52s. 6d. and 44s. 6d.; Glengarnock, at Ardrossan, 50s. 6d. and 43s. 6d.; Eglinton, 45s. and 41s. 6d.; Dalmellington, 47s. 6d. and 43s.

The steel works, the malleable iron furnaces, and quite a number of other works have been either wholly or partially idle this week from want of fuel, in consequence of the colliers' strike.

During the past week there was shipped from Glasgow locomotives to the value of £12,900, comprising five for Calcutta and a like number for Bombay; machinery, worth £6434, for India; an iron barge, £2250, for Calcutta; £1075 sewing machines for Rouen, and £411 for Antwerp; £8325 steel goods, most of which went to America; £23,000 general iron manufactures, £12,860 of which was pipes and railway iron for Bombay, and £4840 bridgework and pipes for Calcutta.

The coal shipping trade has been greatly curtailed by the strike, the past week's shipments having been at Glasgow, 6986 tons; Greenock, 152; Ayr, 5935; Irvine, 2151; Troon, 5472; Burntisland, 10,576; Leith, 2082; Grangemouth, 1742; and Bo'ness, 1072; total, 36,168, as compared with 62,622 tons in the corresponding week of 1886. The scarcity of coals has been so great that prices have advanced in some cases nearly 50 per cent. Some of the steamship lines have arranged to have supplies of coals brought round to the Clyde from Cardiff to supply their vessels' bunkers, while other vessels are coaling at Liverpool and elsewhere on their outward or inward voyages.

Orders for about 10,000 tons of new shipping have been placed with Clyde builders in the course of the last ten days.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The coal trade maintains its vitality well, especially at Cardiff and Swansea, the former sending away last week over 160,000 tons, and the latter 27,000 tons. This week, too, is opening well, and some fine cargoes have already left. One of these was 4000 tons, two of them 2600, one, 2500, and eight over 1000 tons. From Cardiff alone the first day of the week the total consignments of coal for foreign destination amounted to over 32,000 tons. A good deal of this went to India.

I am sorry to record the death of one of the oldest and best known of the house-coal owners, Mr. William Beddoe, of Llancaiach, after a short illness. From a working collier Mr. Beddoe had raised himself to a position of wealth and influence. His grandfather was the discoverer of the Mynyddyslwyn seam, one of the special coals of Monmouthshire, which promises to be very soon, like the No. 3 Rhondda, as extinct as the Dodo. The finest unworked coal of the No. 3 is now owned, in the neighbourhood of Pontypridd, by Messrs. Crawshay, of Cyfarthfa.

January's coal trade in London has a favourable appearance. By the various railways the Aberdare Iron Company sent 8300, Fforchaman 4200, Cwmdare 2000, Cwmneol 3800, Aberaman 4300, Waynes 1400, Bwllfa 7100 tons. Wales also sent to London last month 8100 tons of its valuable coke for locomotive purposes on the Great Western, and 800 tons of foundry coke. I am glad also to see that patent fuel is again looking up, as London was a buyer of the Welsh article to the extent of 6300 tons during January. While the steam coal trade is thus, as I have shown, becoming much more active throughout the district, the house coal trade is also brisk, and this is telling favourably on the shipments at Newport, Mon.

A new pit is being sunk into the Brithdir veins by the Rhymney Iron and Coal Company, not far from Pengam, and already a hundred hands are being employed. The Bargoed district is in a much healthier condition than it has been.

The one great and grave question now under discussion in South Wales is the danger threatened to the very existence of the sliding scale, which, of all institutions, has been productive of the greatest possible good to the colliers and to the community at large. The sliding scales, established in 1875, is the outcome of the great strike of 1874-5, by which Lord Aberdare estimated the colliers of the district sustained a loss of three millions sterling. Since it has been in force, strikes, except of a small and isolated character, have been unknown in the colliery districts, and a better feeling has been brought about between master and man. Of the many institutions augmented after a vast expenditure of time, money, and thought, by Sir W. T. Lewis, this has been regarded as the masterpiece, and it would be a national calamity to see it broken down after so many years practical proof of its excellence. The danger awaiting it is in the scheme of representation. For the purpose of a fairer mode it has been suggested that the district should be divided into four divisions, and it is in the opposition awakened, and adverse action taken, that danger to the scale is foreseen. I hope that the mass of thoughtful and rational-minded colliers will stoutly oppose any such suicidal course as to abandon the scale.

Pig iron has shown a slight falling off, but foreigners maintain their ground, and that so firmly, that ironmasters are holding back from much business.

The rail trade is not very brisk at any of the works, and a good deal of the work done is in the bar.

Tin-plate continues on its old lines—one section full of work and the other stagnant.

Mr. Whitehouse, of the Abercarne Works, has issued a manly manifesto to his disaffected people, telling them that to concede their demands is an impossibility; that his offer is the best that can be made, and he renews it; but, if not accepted, he has no other alternative than to sell horses and material, and get out of the works as he best can.

Tonnage coming in has been rather deficient this week, so the exports of tin-plate do not show so well, and stocks not being so rapidly lowered, some of the weaker makers have in a few instances accepted 3d. per box less. Still, as a rule, quotations hold, and for best Bessemers 13s. 6d., and for Siemens 14s. 6d. have been booked; 3d. less represents the ordinary run. For wasters, 12s. 6d. are given.

Barry Dock is progressing well, and Mr. Walker promises to score another success in this quarter. A good deal of interest was centred in the trial at Cardiff between him and his Swansea opponents last week, and Mr. Walker's evidence was regarded by those not interested in the case as a manly and straightforward one.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The dark clouds on the political horizon are beginning to cast their baneful shadows here and there on the iron markets of this country, and their influence has already had the effect of checking the orders to some extent, though prices have remained as yet unaffected by them, except in so far as pig iron is concerned, which has, indeed, been raised by the Convention still another mark per ton. Buyers have been scared by the warlike rumours stirring, but all branches have not been equally affected. The works are pushing on vigorously with the orders in hand, and the prices generally are firmly maintained, and when the present haze has cleared away, the general commercial situation being healthy, a continuation of the improvement may assuredly be expected. In Silesia, where stocks have been rapidly cleared off, the prices are very firm. Now that the wrought iron convention is definitely established and at work, there is no difficulty whatever in realising the enhanced prices fixed upon for merchant bars, girders, sectiona iron of all sorts, and plates, at which prices a brisk business is being done. Forge pig of best quality has got up to M. 50 p.t., and twenty-five blast furnaces are at work, producing 7000 tons per week. Some of the rolling mills have, however, been fortunate enough to make contracts before the late rise, at M. 48, up to the end of the second quarter of this year.

In Belgium the iron trade is satisfactory. Forge pig has been sold at 42f. p.t., and the lowest price of foundry pig is 44f. It will be instructive to note the prices of Belgian coals, inasmuch as it is contemplated to set up a rivalry with it against the English. Semi-bituminous small coal at the mines, in France, per metric ton is quoted at 5·50 to 7·50; nuts, 7·25 to 7·50; good slack, as brought to bank, 11 to 13·50; cobbles and lumps, 19 to 21, and 21 to 23 respectively. In the Mons basin the trade is quiet at the following figures:—Machine coal, 7·50; good slack, as brought to bank, 8·50 to 9; cobbles and house coal, 15 to 16; dust for coking, 5·50 to 5·75. Contracts for coke have been made at 12f. p.t. In France the warlike reports seem to have exercised a similar influence on the iron markets as here, and prices are not quite so firm as they were. At last it would appear as if France had begun to realise the advantages of an export trade, for during the last year some considerable deliveries have been made to foreign parts. In Rheinland-Westphalia the continued improvement in ores has suffered a check, and prices have been depressed by the cheaper quotations of Spanish ores ruling at the present time; but still the demand is good. The blast furnaces have contracted for the sale of their produce for the first and a portion of it for the second quarter, and the deliveries are taking place briskly. The prices have now risen M. 10 p.t. from their lowest previous level. The smelters have been particularly fortunate, for, whilst this rise has taken place, neither ores, coke, or coals, have gone up in anything like proportion. Buyers of pig iron are awaiting the result of the elections to the Reichstag, and this is somewhat checking the orders for the moment, but if they fall out favourably the general opinion is that a buoyant trade with enhanced prices will come in the spring. The present price is M. 47 to 50 for best brands of puddling iron. The exact figures for 1886 are 3,339,803 of pig iron of all kinds produced against 3,751,775 t. for 1885. Spiegeleisen is not quite such good request at M. 51 to 54·50; superior sorts higher. Foundry, Bessemer, and basic pig are firm at M. 49 to 55 51 to 52, and 44 respectively; and Luxemburg is M. 34 p.t. The rolling mills are full on, rolling off the large orders on the books for merchant iron, girders, &c.; but here again, on account of the elections, many orders are being kept back, and until the former are decided it is probable that the latter will even become seldomer. One good thing is that nearly all the old stocks at the works have been cleared off, and as this was the case with the merchants some short time ago, there must be a good trade coming, when the atmosphere is clear of disturbing reports. Merchant common bars are noted at M. 102 to 108, and even 110; angles, 105 to 112; hoops, 105 to 112; Bessemer billets, at 119 to 125 p.t. Plates are firm, at prices varying from M. 140 to 155 to 160 p.t. for those in iron and Bessemer steel. The demand, however, is not great, either for home or export account. Thin sheets of all thicknesses are in as great request as ever, no stocks are anywhere to be found, and yet the price cannot get up to be proportionate to the cost of the raw material. The prices are M. 135 to 145 p.t. Wire rods are still being exported in large quantities, and the price is firm at, for ordinary sorts, 6 mm. gauge, M. 112 to 115 p.t., and higher according to quality. Drawn iron or steel wire costs M. 130 p.t. Of the steel and rail branch there is little new to report. At the last tendering for rails in Holland Krupp's tender was the lowest, the prices of the other Rhenish works being between M. 111·20 and 113 p.t. The Belgian offers this time were considerably higher than these, and English firms did not tender at all. A report is current, which, however, requires confirmation, that the chances for an International Rail Convention being formed are but small, as all the French and two of the largest works in England have declined to entertain it, and that consequently the negotiations have been broken off. Steel sleepers are noted at M. 115 to 120; wheels and axles complete, 300 to 310 and higher; axles, 230; and tires, 210 to 215 and higher. The machine shops have secured a little more work, but both in orders and in prices there is much to be desired. A small order for 100 covered railway wagons has been given out, which fell to the lot of the works in the Eastern Provinces.

The hardware industry of Remscheid—the Birmingham of Germany—is also participating in the general improvement in the iron trade, and the factories are well employed, though the prices are not very satisfactory. Very large quantities of skates, which are now made by machinery, are being manufactured; files, implements of all sorts, and the coarser kinds of tools, which for the most part are being exported to America, Russia, and Spain. The union of steel works has, however, just raised the price of steel, which is a hindrance to a more extended business; but it is not anticipated that the enhanced prices can long be maintained.

Coal and coke for industrial purposes are in very good demand, and the latter has been contracted for for long periods at a trifle better price. Gas coal cost M. 6·40 to 7·80; slack, 5·40 to 6·00; lump, 7·60 to 8·40; coking coal, 3·30 to 4·00; foundry coke, 8·00 to 10·00; blast furnace coke, 6·80 to 8·00 p.t.

As only one-tenth of all the zinc made comes upon the English market, and England's output is only one-fourth of the whole production, the Continental members of the zinc convention are making strenuous efforts to elevate this country into the staple place for this metal, so that the market quotations shall in the future date from Germany—probably Berlin—instead of from London. It is believed here that this will be accomplished. Such transferences are difficult, and it remains to be seen if this be so easy an operation as is supposed. An incipient agitation is going on here, with the object of getting an import duty levied upon raw copper, but it meets with no encouragement from the Government, so matters will remain as they are for the present.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, February 3rd.

OUR telegraphic advices up to this hour in Philadelphia, Pittsburg, and Chicago indicate a rather quiet market throughout the Interior. Large consumers are pretty well supplied with material, and are therefore declining to purchase for summer requirements at the present advance, which ranges from 10 to 20 per cent. above the prices which prevailed during autumn. Steel rails are quoted at 39·00 dols.; foreign nail slabs at 35·00 dols.; domestic slabs at 34·00 dols.; speigeleisen, 28·50 dols.; Bessemer pig, 22·00 dols.; cargo scrap, 24·00 dols. Foreign material of all kinds is dull, on account of high prices. Brokers here are quite confident that, should quotations allow it, they will do an immense business during the coming season. There is every indication of an extremely active season, both in importations and in domestic production.

The rail mills are taking very few new orders, and those which are accepted are for small lots for summer delivery. Brokers have failed to place much business abroad in steel rails or in steel material of any kind; yet they are quite confident that after the 1st of April they will succeed in placing several large lots of 5 to 10,000 tons to be delivered on the Gulf or Pacific Coasts. The pressure for summer and autumn deliveries is not so urgent as a short time ago. The producing capacity of American furnaces and mills is being very rapidly increased.

Tank and plate iron is being ordered in large lots at 2½c. per lb. Beams and channels will likely be advanced to 3½c. in a few weeks. Old tee rails are quoted at 25·00 dols. at tide water, though some parties are asking more. Scrap is selling at 24·00 dols. to 25·00 dols. American foundry iron runs from 20·00 dols. to 23·00 dols., according to quality. The producers in all avenues are holding back. The strong upward tendency is likely to crowd prices a little higher; but in all directions there is a conservative tendency, caused by the probability of heavy importations of English steel rails and iron. The American iron market, in a word, is very strong, very active, and full of encouragement, both to foreign makers of material and home producers.

NEW COMPANIES.

THE following companies have just been registered:—

Boscombe Pier Company, Limited.

This company was registered on the 3rd inst., with a capital of £15,000, in £5 shares, to construct a promenade, pier, jetty, and landing-place at Boscombe, Christchurch, Hants. The subscribers are:—

	Shares.
C. W. Wyatt, Bournemouth, land agent	1
H. Bazalgette, Bournemouth, solicitor	1
J. Savage, Bournemouth, tutor	1
J. G. Shepherd, Bournemouth, bank manager	1
W. Hoare, Bournemouth, builder	1
J. C. Harvey, Bournemouth	1
J. A. Hosker, Bournemouth, surgeon	1

The subscribers are to appoint the first directors; qualification, 20 shares.

Creed's Patent Permanent Plant Coffer Dam Syndicate, Limited.

This company proposes to carry on the business of engineers and contractors, especially for works connected with water, such as harbours, docks, embankments, reservoirs, subways, the raising of sunken or stranded vessels, and the reclamation of land, &c. The company was incorporated on the 4th inst., with a capital of £3000, in £1 shares. The subscribers are:—

	Shares.
J. M. Foler, J.P., C.E., Holmes Chapel, Cheshire	1
H. Budden, Cricklewood, N.W., contractor	1
G. P. Jay, 12, Basinghall-street, land agent	1
J. R. Carrick, C.E., 21, Arlesford-road, Clapham-road	1
R. Wainwright, 18, Alexandra-road, N.W., merchant	1
R. Richards, 4, Tokenhouse-buildings, engineer	1
J. F. King, 52, Loraine-road, Holloway, architect and surveyor	1

Upon terms of an agreement of the 12th ult., the company will purchase from Mr. Thomas Creed, of Milton House, Huddleston-road, Willesden-green, an exclusive license for the South-Eastern District, of the letters patent No. 2272, A.D. 1885, for an improved economical and rapid construction of coffer dams, and other works where water is to be excluded. The purchase consideration is £900 in fully-paid shares, and £100 in cash, with a royalty of one-fourth the profits of any works, after setting aside a sufficient amount as will pay 5 per cent. upon the subscribed capital, with the option to the purchaser of purchasing the royalty for £20,000, payable four-fifths in shares, and one-fifth in cash. Mr. S. Wells, of 45, Finsbury-pavement, is to receive from the company £200 in fully paid-up shares, and £100 in cash, in consideration of services and expenses in connection with the formation of the company.

Registered without special articles.

Dowson Economic Gas and Power Company, Limited.

This company was registered on the 3rd inst., with a capital of £30,000, in £10 shares, to acquire the following letters patent, viz., No. 2859, dated 30th June, 1881, and No. 3406, dated 10th July, 1883, granted to Joseph Emerson Dowson, C.E., of 3, Great Queen-street, S.W., for improvements in the manufacture and treatment of gas. The subscribers are:—

	Shares.
J. E. Dowson, C.E., 3, Great Queen-street	1
Major-General C. S. Webber, 15, South Eaton-place	1
W. B. Mercer, 3, Great Queen-street, S.W., secretary	1
A. Dowson, C.E., 3, Great Queen-street, S.W.	1
W. Hartmann, 18, Billiter-street, merchant	1
C. E. Ellis, 1, Temple-gardens, barrister	1
H. Brown, 7, Wallbrook, solicitor	1

The subscribers are to appoint the first directors; the number is not to be less than three, nor more than seven; qualification, 50 shares; remuneration, £250 per annum. Mr. J. E. Dowson is appointed managing director, at a salary of £600 per annum, and will also be entitled to an additional sum equal to 5 per cent. upon the net profits of each year, after taking into account his own salary and the directors' remuneration as part of the working expenses.

Electrified Rooms Company, Limited.

This company was registered on the 8th inst., with a capital of £525, in 21 shares of £25 each, with power to increase, to purchase, and work the following patents:—A patent dated 25th February, 1886, granted to Captain Arthur Hy. Byng, for novel forms of applying electricity for therapeutic purposes; and also a patent dated 31st May, 1886, granted to the same inventor for a regulation for high tension electric currents; also to acquire the electrical appliances of Captain Byng now upon the premises, 23, Landport-terrace, Southsea. The subscribers are:—

	Shares.
A. W. White, Cambridge Junction, Portsmouth, railway agent	1
Lieutenant-Colonel N. W. Walton, Southsea	1
Major P. L. Gordon, Southsea	1
R. J. Rastrick, Southsea, pharmaceutical chemist	1
D. C. Wallsnorton, Southsea	1
A. Ford, Portsmouth, surgeon	1
J. R. Martyr, North-end	1

Registered without special articles.

New Electric Light Syndicate, Limited.

This company was registered on the 9th inst., with a capital of £16,000, in £10 shares, to trade as electrical engineers, manufacturers, and contractors, and for such purposes to adopt an unregistered agreement of the 8th inst., between C. Maltby-Newton and Alfred William Hornblow. The subscribers are:—

	Shares.
*S. Tugman, Primrose Club, St. James's	1
*C. Maltby-Newton, C.E., Maidenhead	1
*C. D. Singer, 47, St. Mary Axe, printer	1
Mrs. M. Tugman, 98, Junction-road, N.	1
T. Borras, 8 and 9, Martin's-lane, E.C., surveyor	1
J. Rogers Creasy, Sidcup, printer	1
H. F. Hall, 111, Queen's-road, Dalston, clerk	1

The first three subscribers are appointed directors; qualification, 25 shares. The company in general meeting will determine remuneration.

Universal Simplex Type Writer, Limited.

This company was registered on the 4th inst., with a capital of £100,000, in £1 shares, to carry on the business of type-writer manufacturers and mechanical engineers. The subscribers are:—

	Shares.
A. E. Kirk, 93, Lansdowne-road, Hackney, tobacconist's agent	1
T. Cranfield, 1, Grasley-road, Walworth	1
A. J. Salter, 36, Gresbrook-road, Upper Holloway, warehouseman	1
A. Wren, 38, Richmond-road, Barnsbury, clerk	1
P. Roberts, 37, St. Augustine's-road, N.W., clerk	1
G. Holmes, 202, Hackney-road, engineer	1
J. Kenny, 8, Scales-road, Tottenham, journalist	1

Registered without special articles.

ELECTRIC LIGHTING.—Lord Thurlow's Electric Lighting Act (1882) Amendment Bill, which has been introduced in the House of Lords, is founded on the evidence submitted to the House of Lords Select Committee of last year, and amends the compulsory purchase clause by extending the rights of the undertakers from 21 to 42 years, and provides for the valuation of the goodwill of the undertaking as in other industrial undertakings. The postal telegraph provisions as to laying of wires are from the Government Bill of last year.

NEW BOILERS AND ENGINES.—The following paragraph from the American *Milling Engineer* may be commended to many:—In starting new steam machinery for the first time, the greatest care should be taken, in order to prevent injury. The change from low temperature to very high ones exerts tremendous force, which is all the more dangerous and insidious for the reason that its effects are not seen until the mischief is done. This great force is expansion, or the dilation of volume—bulk, or superfices, by heat, and those unfamiliar with it have no conception of the strains set up. We shall not go into a discussion of them in this article, for it would require many figures and references to authorities and physics for which the general reader has little interest. We content ourselves with brief practical directions for avoiding damage to plant, involving future repair and pecuniary loss. Boilers newly set should be heated up very slowly indeed, and the fires should not be lighted under the boilers for at least two weeks after setting, if it is possible to wait this length of time. This two weeks enables all parts of the mason work to set gradually and harden naturally; the walls will be much more likely to remain perfect than where fires are lighted while the mortar is yet green. When a fire is started under a new boiler for the first time, it should be a very small one, and no attempt should be made to do more than moderately warm all parts of the brickwork. A slow fire should be kept up for twenty-four hours, and on the second day it may be slightly increased. Three full days should elapse before the boiler is allowed to make any steam at all. When the pressure rises, it should not be allowed to go above 4 lb. or 5 lb. by the gauge, and the safety valve weight should be taken off to prevent any possibility of an increase. Steam should be allowed to go through all the pipes attached for steam, and blow through the engine before any attempt is made to get pressure on them. The object of all these precautions and this care is to prevent injury by sudden expansion, which, as we have already stated, may cause great damage. The cylinder itself should be thoroughly heated before the engine is started, and the back head should be left off and steam blown through the port by moving the valve by hand. This will drive out any borings or chips and core sand left in the ports. If these precautions are observed, and the engine run very slowly indeed, at first, for a few hours, increasing the speed by degrees, the probabilities are that much fewer repairs will be needed than where reckless haste is used to start up at once after the last joint has been made on the premises.

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.

15,507A. COMPOUND LIQUID HYDROCARBON GAS MOTORS, C. T. Wordsworth and J. Wolstenholme, London. 27th Nov., 1886.—[Received January 24th, 1887. No. 1065 then given is cancelled. Originally included in No. 15,507, 1886.]

16,451A. STOP BELLS, C. E. Challis, London. 15th Dec., 1886.—[Received February 5th, 1887. No. 1828 then given is cancelled. Originally included in No. 16,451, 1886.]

17,163. SHIP'S BOTTOM SCRAPER, T. Thorsen, Norway.—[Received February 5th, 1887. No. 1850 then given is cancelled. Antedated July 7th, 1886, under International Convention.]

17,164. JOINT for PIPES, J. Delpeutte, London.—[Received February 9th, 1887. Antedated August 17th, 1886, under International Convention.]

8th February, 1887.

1933. CUTTING TOOLS, R. W. Griffiths, London.
1934. CURLING TONGS, W. Leigh, Balsall Heath.
1935. SPINNING FRAMES, &c., J. Wallace, jun., Belfast.
1936. COAL TONGS, C. Meason, Birmingham.
1937. SPINNING JUTE, &c., A. McCulloch, A. Carrie, and D. Ogilvie, Dundee.
1938. STUDS, W. Brierley.—(*J. F. Bachmann, Switzerland.*)
1939. ROLLERS for PRINTING, E. Carter, Halifax.
1940. SHEARING SHEET METAL, D. Smith, jun., Wolverhampton.
1941. POTTER'S FILTER PRESS, J. Critchlow, T., W., H., and L. Forester, Longport.
1942. ACOUSTIC TELEPHONES, C. Auty and F. Mori, Halifax.
1943. ROOF GLAZING, H. E. Peach, Birkdale.
1944. FIRE BARS for FURNACES, E. Green, Radford.
1945. FURNACES, W. Begg, Manchester.
1946. SUPPLYING HEATED AIR to BURNERS of OIL LAMPS, A. Westwood, London.
1947. SLIDING TRIVET, J. E. Maddock, Birmingham.
1948. SMOKERS' POCKET COMPENDIUM, W. Logan, Monkwearmouth.
1949. BOLTS, A. B. Milne, Birmingham.
1950. ADJUSTING BALANCE of TWO-WHEELED VEHICLES, C. G. McDowell, Warrington.
1951. MATCH-BOX, S. Jacob, Birmingham.
1952. SWITCH for ELECTRIC LIGHTING, A. F. Dewar and F. Wilson, London.
1953. TELEPHONE SUPPORT, S. Rosenblatt, London.
1954. DOOR FASTENERS, G. G. Smith, London.
1955. ALARM COMMUNICATION, A. Mathey, London.
1956. FASTENING for BANGLES, &c., M. and S. Lotheim, Birmingham.
1957. PORTABLE INHALING APPARATUS, E. Krull, London.
1958. CARTRIDGES, W. Ford, Sutton Coldfield.
1959. TELEPHONIC RECEIVERS, J. L. Corbett, Glasgow.
1960. FILE-CUTTING MACHINERY, A. G. Brookes.—(*A. Weed, United States.*)
1961. BASE FORK, R. R. Main, Glasgow.
1962. COUPLING, &c., RAILWAY ROLLING STOCK, R. Graham, Carlisle.
1963. WHEELS for PERAMULATORS, G. Asher and J. Buttress, Birmingham.
1964. TUBULAR SECTIONS, J. Oliver, Chesterfield.
1965. GAS, J. Birchall, London.
1966. NEEDLES, B. H. Smith, Birmingham.
1967. OIL CANS, W. Royle, London.
1968. CARD-BOARD BOXES, H. Taylor, London.
1969. MASHING FRUIT, &c., J. Trickett, Sheffield.
1970. FUNNELS, A. Gersdorff, London.
1971. DOOR MAT, W. David, London.
1972. TIES, &c., F. Brown, London.
1973. BI-CARBONATE COLUMNS, W. B. Cogswell, Liverpool.
1974. CAUSTIC SODA, &c., L. Mond and D. B. Hewitt, Liverpool.
1975. PADDLE-WHEELS, &c., G. Beach, London.
1976. COAL BOXES, J. R. Lambert, London.
1977. HOLDFAST FISH-PLATES, &c., J. A. McLaren, London.
1978. CHAIN HARROWS, J. Huxtable, London.
1979. AUTOMATIC WEIGHING MACHINE, E. Ubrig, London.
1980. CASTOR, H. Forman, London.
1981. METAL DRUMS, J. A. Howell, London.
1982. TRANSFORMING HEAT into ELECTRICITY, G. E. Dorman, Stafford.
1983. BRAKE, Digdy de la Motte du Boulay, Dorsetshire.
1984. SELF-ACTING ADVERTISING MACHINE, G. J. Rhodes, London.
1985. TRUNKS, W. B. Williamson, Middlesex.
1986. STAMPING, &c., MACHINERY, C. W. Pinkney, Middlesex.
1987. HATCHING EGGS by ARTIFICIAL HEAT, C. E. Hearson, Middlesex.
1988. MOVING BALES of MERCHANDISE, T. W. Potter and A. M. Tod, Middlesex.
1989. DRIVING CHAINS, R. F. Hall and T. Mabbutt, London.
1990. HARBOURS, G. F. Redfern.—(*R. J. H. Saunders, Lisbon.*)
1991. BRAKES, O. May and E. K. Coates, London.
1992. TREATING BREWERS' GRAIN, G. Epstein, London.
1993. BLEACHING SOLUTION, E. Hermite, E. J. Paterson, and C. F. Cooper, London.
1994. BOTTLE, F. Marsh and A. Jarman, Cambridgeshire.
1995. VEHICLES, H. H. Lake.—(*D. M. Pfautz, United States.*),
1996. MILK, J. Carnrick, London.
1997. SEWING MACHINES, H. H. Lake.—(*J. E. Wheeler, United States.*)
1998. SULPHURIC ACID, A. M. Clark.—(*J. Brown, F. Herreshoff, W. H., and G. H. Nichols, United States.*)
1999. WAGON, T. Hill, London.
2000. HEATING APPARATUS, R. A. Rew, C. B. Foote, J. W. Hull, and B. B. Day, London.
2001. CUTTING, &c., PAPER, A. M. Clark.—(*E. Brissaut, France.*)
2002. MILE-STONES, E. H. Burgoyne, London.
2003. HATS, J. R. Kelsey, Middlesex.
2004. CLIPS, S. Pitt.—(*O. Kallenberg, Switzerland.*)
2005. BREWING, C. Clinch, London.
2006. CUTTING FINGER NAILS, A. Samuel, London.
2007. DRILLS, H. Reeves, London.

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2008. ROOF TILES, G. Evans, London.
2009. PRINTED MATTER, J. Blakey, Leeds.
2010. FURNITURE NAIL, &c., C. Crisp and W. Crisp, Essex.
2011. HYDRO-CARBON LAMPS, F. R. Baker, Birmingham.
2012. PRINTING ARTIFICIAL SKIES, &c., G. J. Sershall, Hockley.
2013. RAILWAY VEHICLE COUPLING, R., T., and J. J., Redhead, J. Carr, and G. A. Dixon, Newcastle-upon-Tyne.
2014. FELT HATS, &c., F. W. Cheetham, Manchester.
2015. CORRUGATED IRON, &c., ROOFS, W. Gwinnett, Wolverhampton.
2016. SHOE UPPERS, A. Gregory, Leicester.
2017. WHISK, &c., W. F. Mason, Manchester.
2018. LOOMS, R. L. Hattersley and J. Hill, Yorkshire.
2019. VELOCIPEDES, M. Woodhead and P. Angois, Nottingham.
2020. FOLDING SPECTACLES, C. Heath, Southport.
2021. SAFETY HORSE BREAKING APPARATUS, J. McHardy and G. C. Hill, Dollar.
2022. RECORDING SPEECH, T. Heskin, Lancashire.
2023. RAISING, &c., RAILWAY CARRIAGE WINDOWS, J. Wallace and A. Hoster, London.
2024. METALLIC CAMEO PORTRAITS, M. Cobe, Manchester.
2025. PRODUCING MEAL from OATS, &c., J. P. Hepburn, Liverpool.
2026. GOVERNORS for STEAM, &c., ENGINES, H. Tate and J. Kellip, jun.
2027. BOOT TREES, J. Blakey, London.
2028. ELECTRIC BATTERIES, P. Jolin, Bristol.
2029. ELECTRIC BELLS, P. Jolin, Bristol.
2030. PULLEY BLOCKS and SHEAVES, W. Alexander, Glasgow.
2031. CARTS, R. G. Garvie, Glasgow.
2032. STEAM TRAPS, P. Fyfe, Glasgow.
2033. FACILITATING the TRANSIT of RAILWAY WAGONS, C. Simmons and B. Williams, London.
2034. PIANOFORTE ACTION, C. A. Latarche, London.
2035. PREVENTING ACCIDENTS in HOISTS, W. H. Noble, Halifax.
2036. AUTOMATIC BRAKE for LITHOGRAPHIC, &c., PRINTING MACHINES, J. Rusby, London.
2037. KITCHEN-RANGES, H. S. Moorwood, Sheffield.
2038. COUPLING and UNCOUPLING RAILWAY, &c., VEHICLES, A. Petty, Sheffield.
2039. PREPARING WOOL, &c., for SPINNING, J. W. Smith, Bradford.
2040. REMOVING CORNS, E. J. Händler, London.
2041. TAKE-UP DEVICES for SEWING MACHINES, S. W. Wardwell, London.
2042. PHOTOGRAPHIC CAMERAS, J. R. Gotz, London.
2043. COUPLING, &c., ROLLING STOCK, G. F. Stickings, London.
2044. ADVERTISING, &c., C. Wraa, London.
2045. TRANSMISSION of POWER, T. D. Hollick and W. E. Rickard, London.
2046. BUCKLES for BRACES, C. F. Gardner.—(*S. May, United States.*)
2047. ADVERTISING SIGN, W. H. Wakfer, London.
2048. LIGHTING RAILWAY CARRIAGES with GAS, J. E. Rigby, Glasgow.
2049. CONTROLLING and REVERSING GEAR, C. Henderson, Glasgow.
2050. GALVANIC BATTERIES, G. Wehr, London.
2051. HOLDING SCREW HEADS, NUTS, &c., K. Banks, London.
2052. KNITTED FABRICS, G. H. Nussey, London.
2053. REELS for DRYING FISHING LINES, W. D. S. Dickins, London.
2054. REVERSING SLIDE VALVES, C. F. Thompson, London.
2055. SHOES for HORSES, &c., C. J. Jutson and F. A. Poupard, London.
2056. MINERS' SAFETY LAMP, J. Douglas, London.
2057. NON-INTOXICATING BEVERAGE, W. Ansell, London.
2058. SPLIT COTTARS or GIBS, &c., A. T. Harvey, London.
2059. INDICATING the BOILING of LIQUIDS in a KETTLE, F. E. V. Beans, London.
2060. COPPER, W. Gentles, London.
2061. APPARATUS for PAYING WAGES, &c., J. Freeman, London.
2062. NECK-TIE FASTENERS, P. Gye, London.
2063. ROTATING ENGINES, H. Faija, London.
2064. SEWING MACHINES, H. H. Lake.—(*A. A. Fisher and A. J. Hart, United States.*)
2065. KNEADING MACHINES, J. Peyer, London.
2066. INDICATING the LEVEL of LIQUIDS, H. H. Lake.—(*A. Ferraris, Italy.*)
2067. FASTENINGS for BOOTS, &c., J. Needham, London.
2068. FOLDING BEDS, &c., J. Y. Johnson.—(*W. C. Ilsley, United States.*)

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2069. CORN METERING, A. W. Anderson, Woolwich.
2070. FLUE THIMBLE and STOPPER, W. P. Walters, B. McKee, and R. Collins, London.
2071. ADJUSTABLE PIPE TONGS, G. H. Hollidge, London.
2072. STRAINERS for TEA and COFFEE POTS, A. H. Bowman, London.
2073. METAL POLISH, C. Hall, Bristol.
2074. CLIP or HOLDER for HOLDING ADDRESS &c., CARDS, R. J. Jones, London.
2075. FILTERING PAPERS, W. Young, London.
2076. EMBOSSETTE, J. C. Mitchell, Exeter.
2077. BROOMS and BRUSHES, H. Pipe, London.
2078. SELF-CLOSING VALVE TAPS, J. Wright, London.
2079. CONTROLLING TELEPHONIC COMMUNICATIONS, J. Gill, Keighley.
2080. DISTRIBUTING INK, J. J. Linzell, London.
2081. FINISHING ITALIAN or SATEEN FABRICS, M. Sharp, Bradford.
2082. BUSTLES or DRESS-IMPROVERS, W. Percy, Northumberland.
2083. STEAM BOILER with GAS GENERATOR FURNACE, J. Salter, Manchester.
2084. LOCKSTITCH FAIR STITCH MACHINE, J. Cutlan, London.
2085. HYDRAULIC VALVES, A. and W. Purvis, Glasgow.
2086. MEASURING CURRENTS of ELECTRICITY, T. Parker, Manchester.
2087. SEALS, S. H. Gillam, Bridgwater.
2088. SAFETY APPARATUS, J. G. Beckton, Middlesbrough-on-Tees.
2089. WATERPROOFING TEXTILE FABRICS, T. F. Wiley, Bradford.
2090. STOPPERING JARS, &c., D. Rylands, Barnsley.
2091. LOOMS, E. Woodhouse and J. J. Grimshaw, Bradford.
2092. UTILISING COAL DROSS, &c., L. A. Brode, Pollokshields.
2093. LETTERING METALLIC PENCIL CASES, A. G. Harley, Birmingham.
2094. SEED DRILLS, C. E. Taunton and J. W. Battershill, Birmingham.
2095 METAL HEEL PLATES, C. Roberts, Liverpool.
2096. TABLES, C. I. Wiley, London.
2097. DISINFECTING MATERIAL, H. K. Spark and J. Warburton, Sheffield.
2098. BRAZIL HOES, J. Perks, Wolverhampton.
2099. GENERATING HEAT in STEAM BOILERS, &c., J. A. Drake, Halifax.
2100. CUTTING SCALE BOARD, G. Downs, London.
2101. OVERHEAD RAILWAYS, W. P. English, London.
2102. PIANOFORTES, R. Davidson, Glasgow.
2103. CLEANING FILES and RASPS, R. Denison, London.
2104. LANTERNS, T. Bass, London.
2105. MILLS for GRINDING GRAIN, F. K. Woodroffe, London.
2106. HOLDFAST for WINDOW BLINDS, J. H. Seldon, London.
2107. HOISTING BUCKET, E. F. Bamber.—(*S. J. Kilby, Bengal.*)
2108. CIRCULAR KNITTING MACHINE, J. Bettney and B. Hurst, London.
2109. REMOVING FUSEL OIL from CRUDE SPIRITS, H. Grote, London.
2110. IMPARTING BUOYANCY to LIFEBOATS, &c., F. W. Brewster, London.
2111. BALL COCKS or TAPS, J. T. Harris, London.
2112. WATER-CLOSETS, J. T. Harris, London.
2113. RAISING, &c., WINDOW SASHES, A. Walker and D. Bell, Glasgow.
2114. MOULDING the EDGES of PLATES of GLASS, O. C. Hawkes, London.
2115. PULLEYS for WINDOW BLINDS, &c., G. H. Stokes and H. S. Whitehouse, London.
2116. DROP-DOWN SMALL-ARMS, W. Monton, E. Brettell, and W. Bentley, London.
2117. THERMOPILES, G. E. Dorman, Stafford.
2118. GARDEN CHAIRS, S. N. Castle, London.
2119. FURNACES, F. M. Spence and D. D. Spence, Manchester.
2120. PLAYING a GAME, J. L. Coutenceau, London.
2121. LOADING and DISCHARGING COAL CARGOES, G. Taylor, London.
2122. ELECTRIC MOTORS, R. E. B. Crompton and J. H. F. Soll, London.
2123. PRODUCING DESIGNS upon TEXTILE FABRICS, &c., H. H. Lake.—(*L. Whitefield, United States.*)
2124. SUSPENDING PENCIL-CASES to WATCH CHAINS, H. L. Symonds, London.

2125. CHRISTMAS, &c., CARDS, M. L. Jonas, London.
2126. HAIR PIN, F. Savory, London.
2127. FILTER PRESSES, J. Brock and T. Minton, London.
2128. PRINTING INSTRUMENTS, F. H. W. Higgins, London.
2129. COUPLING for RAILWAY WAGONS, J. Walker and H. Harwood, London.
2130. ELECTRICAL INDUCTORS, F. Jehl, London.
2131. PUMPING LIQUIDS, P. M. Justice.—(*J. Macdonald, United States.*)
2132. DRESS IMPROVERS, T. Hurley.—(*C. E. Longden, United States.*)
2133. CYLINDERS, &c., G. Bentley, J. B. Jackson, and J. Macnary, London.
2134. GALVANIC BATTERIES, A. Schanschieff, London.

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2135. BLIND FURNITURE, W. M. Simons and J. Tagg, Nottingham.
2136. OIL LAMPS, W. H. Pasley, Birmingham.
2137. SPECTACLE CLEANER, G. A. Millar, Yorkshire.
2138. STARCH, H. L. Sulman and E. E. Berry, London.
2139. NEEDLES, G. Hollington, Birmingham.
2140. BRACKET, A. Barr, Glasgow.
2141. SAFETY PIN, O. G. Goodman, Birmingham.
2142. SPINNING MACHINERY, J. Smith, Bradford.
2143. BELTING, F. T. K. Firmin, Liverpool.
2144. SPINNING and DOUBLING COTTON, H. Ashworth, Manchester.
2145. HANGER for MIRRORS, &c., W. D. Wilkinson and F. Fowler, Warwickshire.
2146. WARPING MACHINE, W. G. Bywater and T. B. Beanland, Leeds.
2147. FIRE-BLOWERS, W. Pugh and W. E. Hart, jun., Wolverhampton.
2148. COVERING WALLS, W. P. Bruce, London.
2149. PRODUCING FLUORIDE of MAGNESIUM, A. Feldman, London.
2150. IMPROVED INJECTORS, J. Y. Johnson.—(*R. Seguela, France.*)
2151. REDUCING ZINC, P. Keil, Liverpool,
2152. ADJUSTING the STONES of MILLS, J. Higginbottom and O. Stuart, Liverpool.
2153. FURNACES, C. Johnson, Durham.
2154. RACE GAMES, W. S. Oliver, Canonbury.
2155. AUTOMATIC GEAR for ENGINES, J. Tickle, West Bromwich.
2156. APPLYING ALARUMS to BAGS, &c., W. H. Percival, London.
2157. ARRANGEMENT for HOISTS, M. Thompson, H. Thompson, and J. Waidron, Bradford.
2158. FIRE-BARS, D. N. Arnold and W. Young, London.
2159. STRAINING POTATOES, A. Lawrie, London.
2160. FLUSHING CLOSETS, A. D. Middleton and W. J. Brown, London.
2161. MAKING DENTILS, T. Higgins, London.
2162. COMBS, S. T. L. Kouyoumdjoglou, London.
2163. INDICATOR, J. Holdsworth, Bradford.
2164. LAMPS, S. Arnold, Bradford.
2165. TROUSERS STRETCHERS, J. H. Johns, London.
2166. SNOW PLOUGH, A. Lockett, London.
2167. PRINTING MACHINES, E. J. Lambert, London.
2168. COATING PLATES with TIN, T. Freeman and D. R. Jenkins, London.
2169. SPADE, &c., F. A. Thompson, London.
2170. COFFEE POTS, H. J. Carpenter, Middlesex.
2171. ORGANS, W. J. Ledward, London.
2172. STOPPING WINDING ENGINES, T. B. Temple, London.
2173. BALLS, A. Slazenger-Moss, London.
2174. BUTTONS, E. Griffith, London.
2175. SIGNALLING, B. Dukes, London.
2176. PADLOCKS, T. C. Down, Staffordshire.
2177. INJECTORS, H. Holden and R. G. Brooke, London
2178. WATCHES, P. Pommier, London.
2179. RAILWAY SIGNALLING, J. Saxby, J. S. Farmer, and H. Kirby, London.
2180. GATES for CROSSINGS of RAILWAYS, F. B. Behr, London.
2181. HANSOM CABS, J. H. Hannay, London.
2182. GAS BLOW PIPES, T. Carpenter and W. H. Ford, London.
2183. BOTTOM of OVENS, S. Bradford, London.
2184. CARRYING SADDLES of VELOCIPEDES, A. H. Overman, London.
2185. BICYCLES DRIVEN by REAR WHEEL, F. Hughes.—(*G. Rothgiesser, Germany.*)
2186. COMBUSTION of FUEL, M. P. W. Boulton, Oxfordshire.
2187. FIRE-BARS, A. Tolhurst, C. A. Glazbrook, and A. Philbey, London.
2188. LOADING BARGES, W. Thomas, London.
2189. BOOTS, &c., C. E. Bird, London.
2190. PREVENTING ACCIDENTAL DESCENT of CAGES, F. N. Wardell and J. Mitchell, London.
2191. ELECTRO-MAGNETIC MOTORS, H. H. Lake.—(*J. Audouy, France.*)
2192. WASHER for JOINTS of TUBES, &c., H. D. Cooper, London.
2193. RAILWAY BRAKES, A. J. Boult.—(*J. L. Brown, United States.*)
2194. GAS ENGINES, H. J. Haddan.—(*W. Gavillet and L. Martaresche, France.*)
2195. DECORATING FURNITURE ELECTRICALLY, F. H. Judson, London.
2196. MUSICAL INSTRUMENTS, J. A. Cave, London.
2197. HEEL PLATES for BOOTS and SHOES, G. Randall, London.
2198. SLING or SUSPENDER for KNAPSACKS, &c., H. J. Rose, London.
2199. FIRE-ARMS, A. Martin, London.

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2200. DIAPHRAGMS of ELECTRICAL TELEPHONES, J. S. Ross, London.
2201. BLACKING, &c., R. E. Donovan and J. McKenny, Dublin.
2202. PLATE and HOLDER for a CUP or GLASS, R. W. Binns, Worcester.
2203. WIRE ROPES and CABLES, J. B. Stone, London.
2204. INTERNAL STOPPER, A. Mooney, Knottingley, and W. Wharldall, Pontefract.
2205. CHURNS, J. Wooldridge, Stourbridge.
2206. CUTTING the PILE of VELVETS, &c., D. Scott, Manchester.
2207. CUTTING VELVETS, CORDS, &c., D. Scott, Manchester.
2208. CUTTING VELVETS, CORDS, &c., G. Roger, Manchester.
2209. DRESS SUSPENDER, H. Worsley, Manchester.
2210. CONVERTING OILS into SPRAY, S. F. Rhodes, London.
2211. BRACE BUCKLES, C. W. Eyland, Birmingham.
2212. BUCKLES, &c., for BRACES, &c., C. N. Eyland, Birmingham.
2213. WORKING of FLY COMBS or DOFFERS, G. and J. Carver, Cleckheaton.
2214. REFRIGERATION, F. N. Mackay and A. G. Christiansen, Liverpool.
2215. CARDING ENGINES, T. B. Kay, Manchester.
2216. DRILLING COAL, C. Poole, Blyth.
2217. WINDOW SASH FASTENER, W. Eaves, Birmingham.
2218. SCHOOL DESKS, C. Bennet, Glasgow.
2219. PRESSURE REGULATORS for GAS, &c., A. K. Irvine, Glasgow.
2220. SILICON STEEL, E. V. Seebohm, London.
2221. BREWING SACCHARUM, J. W. Bailey, Greenock.
2222. ELECTRIC SEWING MACHINES, T. H. Williams, London.
2223. COMBINED DOOR SPRING, &c., W. Fryer, Birmingham.
2224. NECKS of BOTTLES, J. H. Dale, London.
2225. CUTTING, &c., INDIA-RUBBER for SOLES of TENNIS SHOES, E. Carter, Halifax
2226. AUTOMATIC GAS GOVERNORS, A. Gozzard, Sheffield.
2227. COLLAPSIBLE SHIP, J. W. Shepherd, Glasgow.
2228. FORCED BLAST STEAM BOILER FURNACES, J. Gilmour, Glasgow.
2229. CHEMICAL FIRE EXTINGUISHERS, D. Spence, Glasgow.
2230. HARDENING STEEL, W. W. Curley and J. Hall, Sheffield.
2231. MIXING GRANULAR MATERIALS, J. Crossfield and E. Beck, Liverpool
2232. WHEELS for RAILWAY CARRIAGES, S. and F. E. Andrews, London.
2233. FELT HATS, L. Herzberg, London.
2234. AUTOMATICALLY EXTINGUISHING FIRE, W. H. Percival, London.
2235. NOVEL COMPOSITION, P. Grosfils, London.
2236. LUBRICATORS for GAS ENGINES, H. Bamford, London.
2237. FITTINGS for TUBES, H. D. Cooper, London.
2238. SUPPORT for RODS, PIPES, &c., W. Small piece London.
2239. COMBINATION of CERTAIN TOOLS, R. S. Carter, Bristol.
2240. PRESSED CARDBOARD BOXES, H. Henschell, London.
2241. MOWING and REAPING MACHINES, R. Davison, London.
2242. REEDS for LOOMS for WEAVING, W. Halliday, London.
2243. COMPOUND FRICTION WEIGHTING MOTION, T. Singleton, Halifax.
2244. DOOR BOLTS, &c., F. Taylor, London.
2245. FURNACES for HEATING, &c., MINERAL SUBSTANCES, F. M. and D. D. Spence, Manchester.
2246. PREVENTING OIL FLOWING out of LAMPS when UPSET, F. V. Smythe, Gravesend.
2247. FRICTION CLUTCH PULLEYS, W. Mather.—(*J. Hunter and Son, United States.*)
2248. MARKING-INK UTENSILS, J. Hickisson, London.
2249. OPTOMETERS, L. Engelhard, Berlin.
2250. AUTOMATIC COPYING LATHE, T. Millett, London.
2251. TUBES or CONDUITS for GAS, &c., CONDUCTORS, J. H. Johnson.—(*A. Léon, France.*)
2252. BRAKE for RAILWAY TRAINS, &c., T. G. Stevens, Dartford.
2253. TOOLS for FORMING the EXTERIOR of BOTTLE NECKS, T. Wickham and J. Nall, London.
2254. CLOTHES PEGS, J. Nall, G. Goodair, and T. Wickham, London.
2255. STOPPERING BOTTLES, &c., G. Goodair, T. Wickham, and J. Nall, London.
2256. TOOLS for FORMING the INTERIOR of BOTTLE MOUTHS, T. Wickham and J. Nall, London.
2257. TEXTILE FABRIC, F. H. Ford, A. N. Ford, and J. A. Archer, London.
2258. PENDULUMS, H. D. Sanders, London.
2259. REGENERATIVE GAS LAMPS, G. F. Redfern.—(*J. Cerpaux, Belgium.*)
2260. PRESSER WHEELS for KNITTING MACHINES, P. S. Kinsey, London.
2261. MACHINES for RULING PAPER, &c., E. L. Mann, London.
2262. RAILWAY and other LAMPS, J. Thorne and E. B. Burr, London.
2263. CAUSING FOUNTAINS to PLAY in COLOURS, J. M. B. Baker, London.

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2264. TYPE-WRITER, W. Hewett, London.
2265. DRIVING MECHANISM for SPINNING and DOUBLING FRAMES, W. Taylor, Manchester.
2266. FITTINGS for WINDOW BLINDS, W. Lord, Middlesbrough.
2267. SPRINGS for PISTONS of STEAM ENGINES, R. Brown, South Shields.
2268. TRAM-CAR STARTER, J. Yates, London.
2269. REMOVING the CAPPINGS or SURFACE of SEALED HONEYCOMB, S. Simmins, Rottingdean.
2270. SEPARATING HONEY from the COMBS, S. Simmins, Rottingdean.
2271. DIFFERENTIAL SPEED for POTTERS' LATHES, A. Fielding, Longport.
2272. LIDS for HOLLOW VESSELS, W. Jennings and F. Evans, Sheffield.
2273. JOINT or FASTENING for MIRRORS, &c., F. R. Baker, Birmingham.
2274. HAT VENTILATORS, F. C. Bowen, London.
2275. METALLIC CLASP, T. Bates, Sheffield.
2276. AUTOMATIC VENT PEG or SPILE, J. W. M. Peyton, Bradford.
2277. ROTARY PUMPS, J. Bateman, jun., Glasgow.
2278. SYRUPING AERATED WATER BOTTLES, F. Lydon, Galway.
2279. SOLES of BOOTS and SHOES, A. Alexander, Abergavenny.
2280. TARGETS for RIFLE PRACTICE, T. B. Ralston and J. S. Knox, Glasgow.
2281. VENTILATION of SEWERS, J. B. McCallum and T. S. McCallum, Newcastle-on-Tyne.
2282. HOT-WATER HEATING APPARATUS, W. Oliphant, London.
2283. FOLDING and ADJUSTABLE CHAIR, E. Smith, West Dulwich.
2284. MOISTENING PAGES of LETTER BOOKS, H. W. Ward, Halifax.
2285. SAVING LIFE from DROWNING at SEA, C. W. Lees, London.
2286. HORSE HARNESS, W. J. Andrews, Walthamstow.
2287. DRIVING GEAR for POCKET SEWING MACHINES, E. G. Reuss, London.
2288. LOCK NUTS, J. Conlong, London.
2289. SHEATH KNIVES, C. Ibbotson, Sheffield.
2290. FIRE-PLACES, E. M. Young and G. B. Moss, Lincoln.
2291. VENTILATING APPARATUS, E. M. Young and G. B. Moss, Lincoln.
2292. SHAPING NECKS of BOTTLES, &c., W. P. Wilson, London.
2293. PIANOFORTE ACTIONS, F. Peterman, London.
2294. VELOCIPEDES, W. Smith and G. Hicking, London.
2295. CARTRIDGES, P. Ambjörn, London.
2296. CONTROLLING SLUICE WAYS, G. W. Carter, London.
2297. TREATMENT of SACCHARINE, A. and L. Q. Brin, London.
2298. SACCHARINE, A. and L. Q. Brin, London.
2299. DISINFECTANTS, H. W. Schafer, London.
2300. WINDOW and other FASTENERS, R. W. Pyne, London.
2301. SEWING MACHINES, E. Hammerstein, London.
2302. UTILISING METALLIC CEMENTS, &c., T. Smith, London.
2303. PLAYING TRIANGLES, W. F. Porter, London.
2304. RECEPTACLE for MATCHES, A. St. J. W. Wriford, London.
2305. POTTERY, &c., H. L. Doulton and W. Parker, London.
2306. METALLIC ALLOYS, T. Slater, London.
2307. CLOSING DOORS, D. Doyen, London.
2308. SHIRTS, A. R. Ramsey, London.
2309. KEYLESS WATCHES, A. Junghans, London.
2310. LIFEBOATS, J. T. Morris, Manchester.
2311. STEAM ENGINES, J. Bonicard, London.
2312. BORING MACHINE, R. Stanley, London.
2313. VAPORISING LIQUIDS, C. D. Abel.—(*The Gas Motoren-Fabrik Deutz, Germany.*)
2314. CLOSING the MOUTHS of JARS, L. Bettenant, London.
2315. VENTILATING APPARATUS, H H. Lake.—(*B. Holbrook and H. N. Mann, United States.*)
2316. CONDENSING SMOKE, H. H. Lake.—(*B. Roberts, United States.*)
2317. ANTI-FRICTION BEARINGS, H. H. Lake.—(*M. Randolf, United States.*)
2318. GELATINISING NITRO-GLYCERINE, H. H. Lake.—(*Deutsche-Sprengstoff Actiengesellschaft, Germany.*)
2319. REFRIGERATING MACHINES, A. Conacher, London.
2320. RAILWAY CARS, &c., S. Pitt.—(*G. Leve, United States.*)

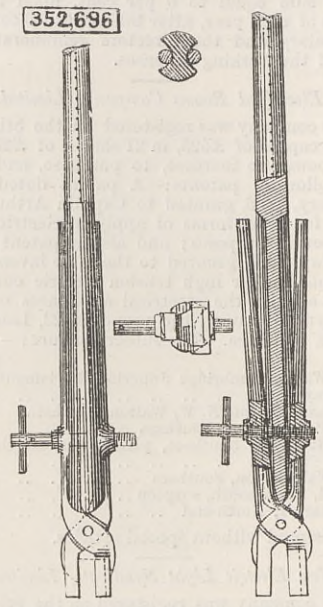
SELECTED AMERICAN PATENTS.

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

352,696. TOOL for HANDLING FORGINGS, INGOTS, &c., *E. Kerr, Pittsburg, Pa.—Filed September 1st*, 1886.

Claim.—(1) The combination of a pair of clamping jaws operated by reins or handles, a porter bar arranged between said reins, and means for securing the reins and porter bar together, substantially as set forth. (2) The comqination of a pair of clamping jaws and their reins or handles, a porter bar arranged between

352,696

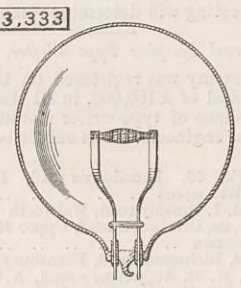


the reins, and a screw for closing the jaws and clamping the reins upon the porter bar, substantially as set forth. (3) The combination of a pair of clamping jaws and their operating reins or handles, a porter bar having longitudinal grooves in opposite sides, and means for simultaneously closing the jaws and forcing the reins into the grooves in the porter bar, substantially as set forth.

353,333. INCANDESCENT ELECTRIC LAMP, *Charles J. Van Depoele, Chicago, Ill.—Filed August 1st*, 1885.

Claim.—(1) An incandescent filament composed of an indefinite number of small fibres united at their outer ends and arranged in loose, imperfect, and discontinuous contact with each other throughout the remainder of their length, as described. (2) An incandescent filament composed of a bundle of loose

353,333

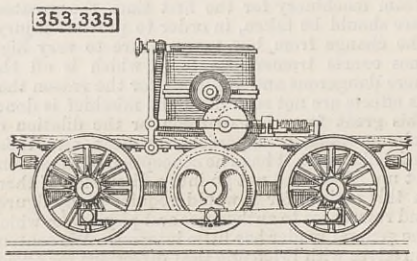


fibres united at each end, as described, and having a loose wrapping along its intermediate portion, as described. (3) An incandescent filament consisting of the combination of a bundle of loose fibres held together by a loose wrapping of thread and provided at its end with clips *d*, substantially as described.

353,335. ELECTRIC LOCOMOTIVE, *Charles J. Van Depoele, Chicago, Ill.—Filed April 28th*, 1886.

Claim.—(1) In an electric locomotive, the combination of an electric motor having one or more driving pulleys, main driving wheels, and connections, an intermediate shaft, to which the driving wheels are mechanically connected, and which is provided with one or more friction pulleys, one or more idle pulleys, and pivotted levers, to which the idle pulleys are connected, said levers being provided with adjusting screws, substantially as shown and described, whereby the idle pulleys are held between the motor and intermediate pulleys with the desired degree of pressure. (2) In an electric locomotive, the combination of an electric motor having a plurality of driving

353,335

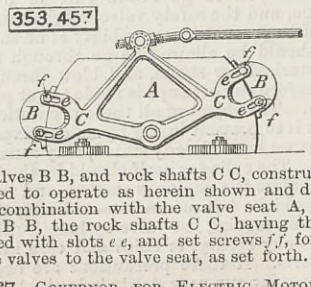


pulleys and of various sizes, driving wheels supporting the locomotive, an intermediate driving shaft provided with friction pulleys, and also mechanically connected to the driving wheels, a plurality of idle pulleys supported in movable frames, pivotted levers controlling the longitudinal movements of the pulley-bearing frames, and adjusting screws arranged to act directly upon the pivotted levers for bringing the desired connecting pulley into action, as set forth. (3) In an electric locomotive, the combination of an electric motor and an intermediate driving shaft, to which it is mechanically connected, main driving wheels, supporting springs between the said wheels and the intermediate shaft and motor, and vertically yielding mechanical connections between the main and intermediate driving wheels, as set forth.

353,457. DUPLEX STEAM VALVE, *Simeon Mills, Madison, Wis.—Filed May 21st*, 1886.

Claim.—(1) A duplex steam valve consisting of a double-faced convex valve seat A, the adjustable con-

353,457

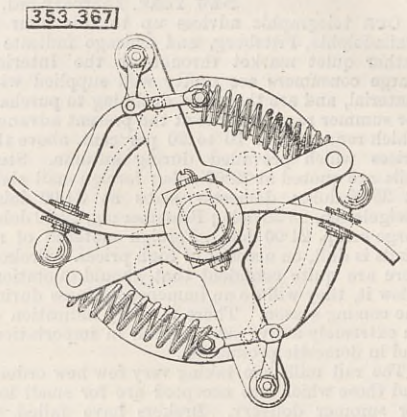


cave valves B B, and rock shafts C C, constructed and arranged to operate as herein shown and described. (2) In combination with the valve seat A, and the valves B B, the rock shafts C C, having their ends provided with slots *e e*, and set screws *f f*, for adjusting the valves to the valve seat, as set forth.

353,367. GOVERNOR FOR ELECTRIC MOTORS, *Alexander W. Meston, St. Louis, Mo.—Filed July 8th*, 1886.

Claim.—The combination, with an electric motor, of a loose power transmitting device, an interposed mechanical resistance whose force varies with the speed of the shaft, and a switch or commutator controlled by the movement of said interposed mechanism, whereby the equilibrium or balance between power

353,367



and load is maintained, notwithstanding a change of either, substantially as and for the purposes specified.

353,490. DOUBLE TUBE INJECTOR, *John R. Goehring, Philadelphia, Pa.—Filed August 9th*, 1886.

Claim.—An injector having two or more sets of steam nozzles and combining tubes, the nozzles receiving steam simultaneously in starting the injector, and the overflow passages being formed wholly in the rear

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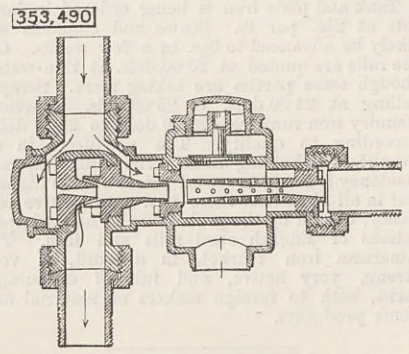

combining tube of the series, and having an area equal to or greater than the combined areas of the steam nozzles, all substantially as specified.

353,649. ELECTRIC CURRENT INDICATOR, *Montgomery Waddell, Coburg, Ontario, Canada.—Filed April 8th*, 1885.

Claim.—In an electric current meter or indicator, the combination, with a pendulum, of a horizontally-

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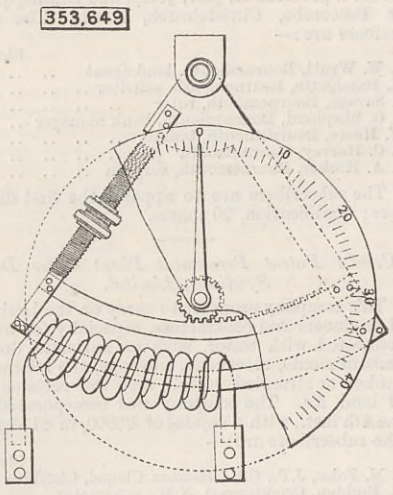
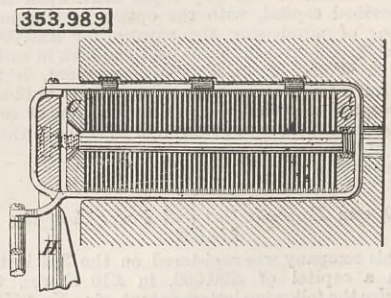


projecting curved solenoid core carried by such pendulum and a curved coil in an electric circuit acting upon such core, substantially as set forth.

353,989. ANNULAR ARMATURE for DYNAMO-ELECTRIC MACHINES, *Elmer A. Sperry, Chicago, Ill.—Filed June 9th*, 1883.

Claim.—(1) An annular armature having a core formed of two laterally-external metallic binding rings and groups of intermediate thin metallic segments, which are insulated from each other, and the loop-like bar conductors bent around said core and insulated therefrom, said conductors being connected to a commutator, substantially as set forth. (2) In an annular armature, the combination, with the external rings C and C¹, and interposed insulated thin metallic segments held together by suitable bolts to form a core, of the spider arms H, provided with T-heads secured to the ring C, and suitable conductors arranged about said core and provided with means for electrical con-

353,989



nection to a commutator, substantially as described. (3) An annular armature having a core formed of a series of laterally-adjacent circles of flat metallic segments, each circle being insulated from adjacent circles, and the segments of each particular circle being all in the same plane and insulated from each other at their ends, substantially as described. (4) In an annular armature, the combination, with laterally-exterior binding rings, of a series of rings, each composed of segments of thin sheet iron lying in the same plane, and insulated from each other at their ends and from laterally-adjacent segments and the binding rings, insulated bolts which secure the binding rings in place to clamp the said circles between them, suitable insulated conductors arranged about said core and provided with commutator connections, and radial arms for supporting the armature as a whole by one of its lateral edges, substantially as described.