LABOUR IN EUROPE.

No. II.

France.—France has made great advances in the construction of machinery, and the rise of wages in this branch of industry has in the last few years been over 20 per cent., especially in Rouen. This district may be said to be one of the busiest in France. In addition to the principal industries of cotton spinning and weaving there are many machine shops. The workmen are frugal, industrious, and sober. The feeling between employer and employed is good, and disputes are usually settled by mutual concessions. Women are employed in almost every calling, from agriculture to street-cleaning. The Bordeaux workmen are generally slow in execution. Their trade systems are primitive, work is accomplished with great attention to cumbersome details, and without that combination and division of labour and mechanical appliances which are recognised in England and the United States as almost indispensable. Everything is done on the principle of individual labour, hence the artisans excel only in those trades which afford scope for individuality. The working people of Marseilles and Southern France are patient, plodding, and steady. Women are employed in large numbers in factories, mills, and mines, though not upon such heavy work as in Germany. With the exception of the building trades, labour is unorganised, neither are there any co-operative stores, the working classes in this part of France not being strongly inclined towards such societies. What small associations exist are rather of a social than a business character. They are so weak in numbers, and the supply of labour in all trades so far exceeds the demand, that the employers have practical control of the question of wages and the conditions of labour. These questions are complicated by the residence in Marseilles of many thousands of Italians, who keep aloof from the French societies and work for lower wages, and no strike can be successful while this state of things continues to exist. In May, 1884, after a prolonged consideration of the subject, a statute was enacted for regulating workmen's guilds and associations in France. It does but little more than to allow workmen to form associations for the protection and the study of industrial interests without having to obtain the permission of the Government. It is too soon to estimate the effect of this statute upon labour organisations, but doubtless it will lead to their increase in number and strength, through their being legalised. Increased attention is being paid in France to technical education. Schools of a type lower than the existing technical schools are being established everywhere. These new schools, though virtually advanced schools, now rank as superior elementary schools, to which the pupils can claim admission without the payment of fees, and primary education has been made compulsory. The working hours in France are long, ranging from 60 to 84 hours a week; but in the latter case the day is often divided into two shifts.

Wages Paid per Week of Sixty Hours in Foundries, Ironworks, and Machine Shops in the Department of the Gironde, Marseilles, and Rouen.

	s.	d.
Department of Gironde:		
Boilermakers	22	6
Blacksmiths	23	7
Foreman (machine shops)	67	7
Foreman (foundries and ironworks)	42	7
Moulders	21	4
Machinists	31	0
Pattern-makers	26	9
Melters	29	7
Strikers	29	0
Tool-makers	26	9
Labourers	14	5
Marseilles—Foundries:		
Melters	24	2
Moulders	31	4
Finishers	19	4
Labourers	14	6
Boys	4	0
Machine shops:		
Blacksmiths	20	3
Fitters	21	2
Boilermakers	19	4
Rouen:		
Blacksmiths	25	0
Strikers	20	10
Millwrights	37	6
In furnaces and foundries the average wages are:		
Men	21	3
Boys	9	9

Wages Paid per Week of Sixty Hours in Mines near Rouen.

	Coal. s.	Coal. d.	Iron. s.	Iron. d.	Stone. s.	Stone. d.
Miners	16	3	16	9	21	9

Wages Paid per Week in Coal Mines in the District of Marseilles.

	s.	d.
In the mines (forty-two hours):		
Miners	16	1
Boys	14	6
Outside the mines (sixty hours):		
Women	7	1
Boys	4	10

Wages Paid per Week of Sixty Hours in Shipyards in the Department of Gironde and the District of Marseilles.

	s.	d.
Department of Gironde—Iron shipbuilding:		
Blacksmiths	28	1
Drillers	29	0
Foremen	42	7
Rivetters	15	5
Strikers	19	4
Labourers	14	5
Marseilles—Iron shipbuilding:		
Lathe hands and planers	21	9
Coppersmiths	21	9
Iron plateworkers	21	9
Rivetters	19	4
Punching hands	19	0
Blacksmiths and strikers	17	10

Belgium.—Belgium is a most active industrial nation. The occupations are diverse, the inhabitants economical and industrious. On the whole, harmony prevails between employers and employed. One notable exception is that of the ship carpenters of Antwerp. Masters and men have never been on good terms, and the breach between them has at times been so wide that much work has been driven away from Antwerp to other ports, because employers, having no reliance upon their workmen, could not contract for work through uncertainty as to the time and expense it would require. The cause of complaint is not so much a demand for increased wages, as delays caused by working in such an irregular manner that several days are consumed in doing one day's work. The hours of labour in industrial and mechanical employments are from eleven to thirteen a day. Men and women work upon an equality, except as to wages, in which the usual disparity prevails. Where men and women do the same kind of and as much work, the women receive on an average about a shilling a day less than the men. A peculiar feature of Belgian industry is that of working factories on principles partly paternal. One at Rugsbrook, near Brussels, may be taken as an example. The factory employs 3000 operatives. Three per cent. of the wages of all the workers is retained for an invalid and pension fund. This entitles every employé to the daily attendance of a physician during illness, free of charge. Invalids receive one-half of their wages. When a married workman dies his widow receives a pension for a certain period. Pensions for life are paid to invalided workmen after fifteen years continuous service. Food is supplied at a little over wholesale price, so as to cover the expense of distribution and preparation. There is a school and savings bank in connection with the factory, and workmen are assisted so as to be able to build their own houses. Other factories are carried on on principles more paternal still. One effect of this system is to place the workpeople unreservedly in the employers' hands. For instruction in drawing, especially as applied to constructive and decorative work, the opportunities are excellent, there being schools of drawing, modelling, carving, painting, &c., in many cities established at the expense of the municipalities, provided with the best appliances and teachers, and open to all comers free of charge. There are also numerous technical classes held in the evenings and on Sundays, which are well attended. The instruction thus obtained is exerting considerable influence on the capacity and intelligence of the workmen. The labourers of Ghent work twelve hours in summer and ten in winter. The average wages are for skilled mechanics 16s. 8d. and for labourers 12s. 6d. a week.

Wages Paid per Week of Sixty Hours in Foundries, Ironworks, and Machine Shops in the District of Brussels.

	s.	d.
Blast furnaces:		
Furnacemen	15	9
Other workmen	11	0
Boys	4	10
Rolling mills:		
First puddlers	24	2
Second puddlers	16	11
First rollers	32	2
First heaters	36	2
Other workmen	14	6
Boys	9	8
Machine and boiler shops:		
Blacksmiths	24	2
Strikers	14	6
Turners	24	2
Screw and nut-makers	16	11
Boilermakers	20	1
Machinists	24	2
Foundries:		
Model-makers	24	2
Moulders	19	4
Other workmen	14	6

Wages Paid by the Week in Ironworks in Antwerp.

	s.	d.
Ironworks:		
Puddlers	24	0
Firemen	19	3
Rollers	21	6
Steel works:		
Founders	27	0
Firemen	41	0
Rollers	27	0
Forges:		
Strikers	29	0
Smiths	24	0
Workshops:		
Pattern-makers	24	0
Finishers	21	6
Turners	21	6
Boilermakers:		
Platers	26	6
Rivetters	21	6
Naval docks:		
Platers	26	6
Rivetters	21	6

Wages Paid per Week in Coal-mining.

	Liege. 64 hours. s.	d.	Brussels. 72 hours. s.	d.	Antwerp. 60 hours. s.	d.
Miners	15	0	23	7	20	9
Women	14	2	9	0	12	9

Holland.—In Holland there are few statistics as to labour and wages, and much difficulty was therefore experienced in preparing the report. It should not be inferred from the indifference which prevails on these questions that the amelioration of the condition of the working classes occupies no place in the economy of either general or local institutions. On the contrary, much is being done, both by corporate bodies and individual employers, for their moral and physical improvement. The relations between employers and employed seem to be continually improving. The working classes are saving and trustworthy, and in everything connected with commerce and the sea they aim at attaining the best results. Many of the better class workmen own their own houses, and these as a rule contain three or four rooms. Trade-unions are numerous. One of the principal is the Grand Dutch Trades Union, which has for its objects the amalgamation of all trades, the limitation of the hours of labour, work of children, and the advancement of co-operation. It is understood that these trade unions are beneficial both to capital and labour. The development of industry and trade has been stimulated by the improvement of education, and the abolition of export and transit duties. Primary education is being more diffused every year, and receives increased support from the State. Secondary education is well provided for. Institutions for the encouragement of the sciences and fine arts are numerous. There are also several trade schools, where boys can learn the trades of blacksmith, cabinetmaker, carpenter, machinist, turner, &c. The first school of this description was established at Amsterdam as far back as 1861.

Wages Paid per Week of Sixty-six Hours in Foundries, Ironworks, and Machine Shops in Amsterdam.

	s.	d.
Foundry	19	6
Turners' shop	20	0
Pattern or model-makers' shop	20	6
Finishing shop	19	0
Blacksmiths' shop	22	11
Boiler-makers' shop	22	9
Labourer in yard	15	0

Wages Paid per Week of Sixty-six Hours in Shipyards in Amsterdam.

	s.	d.
Iron ships:		
Ironworkers	30	0
Labourers	16	8

Switzerland.—The working classes of Switzerland are generally trustworthy and steady. The organisation of labour is often based upon the idea of permanency, and workmen are accordingly engaged by the year. This makes the employé satisfied with smaller wages, and enables the employers to calculate with safety as regards contracts. From Basle the citizens are largely emigrating, and their places are supplied with Germans, who can live upon lower wages. Strikes are almost unknown, and what organisations exist are nearly all for benevolent or social purposes. The Factory Law of Switzerland fixes the hours of labour at eleven a day, and forbids the employment of children under fourteen years of age. Co-operative societies do not flourish in Switzerland. Societies are to be found among the working classes, but these are purely benefit or social. There is, however, a Swiss general trades union divided into sections for furthering the interests of the various trades. One object it has in view is the better regulation of apprenticeship and the training of workmen, also the obligatory examination of all trades. Through the admirably organised public school system of Switzerland education is disseminated among all classes. Much attention is given to technical education, and there are a few trade schools; but, on the whole, the subject is left entirely to the State. One of the principal industries of Zurich is the iron trade, and Swiss machinery enters into competition with that of other countries both at home and abroad. The following are the wages paid in one of the most celebrated machine shops of Zurich, whose productions are shipped to all parts of the world:—

Average Wages Paid per Week of Sixty-three Hours in a Leading Zurich Machine Factory.

	s.	d.
Founders	24	3
Cast iron cleaners	14	6
Car makers	14	6
Metal founders	19	3
Locksmiths	24	3
Turners	24	3
Planers	19	3
Moulders	19	3
Stampers	19	3
Cutlers	17	0
Smiths	24	3
Strikers	17	0
Boilermakers	21	9
Coppersmiths	24	3
Tinners	19	3

Wages Paid per Week in Foundries, Ironworks, and Machine Shops in St. Gall.

	s.	d.
Smiths	16	6
Turners	19	3
Locksmiths	19	3
Cutters and planers	19	1
Stampers and borers	19	1
Founders	22	0

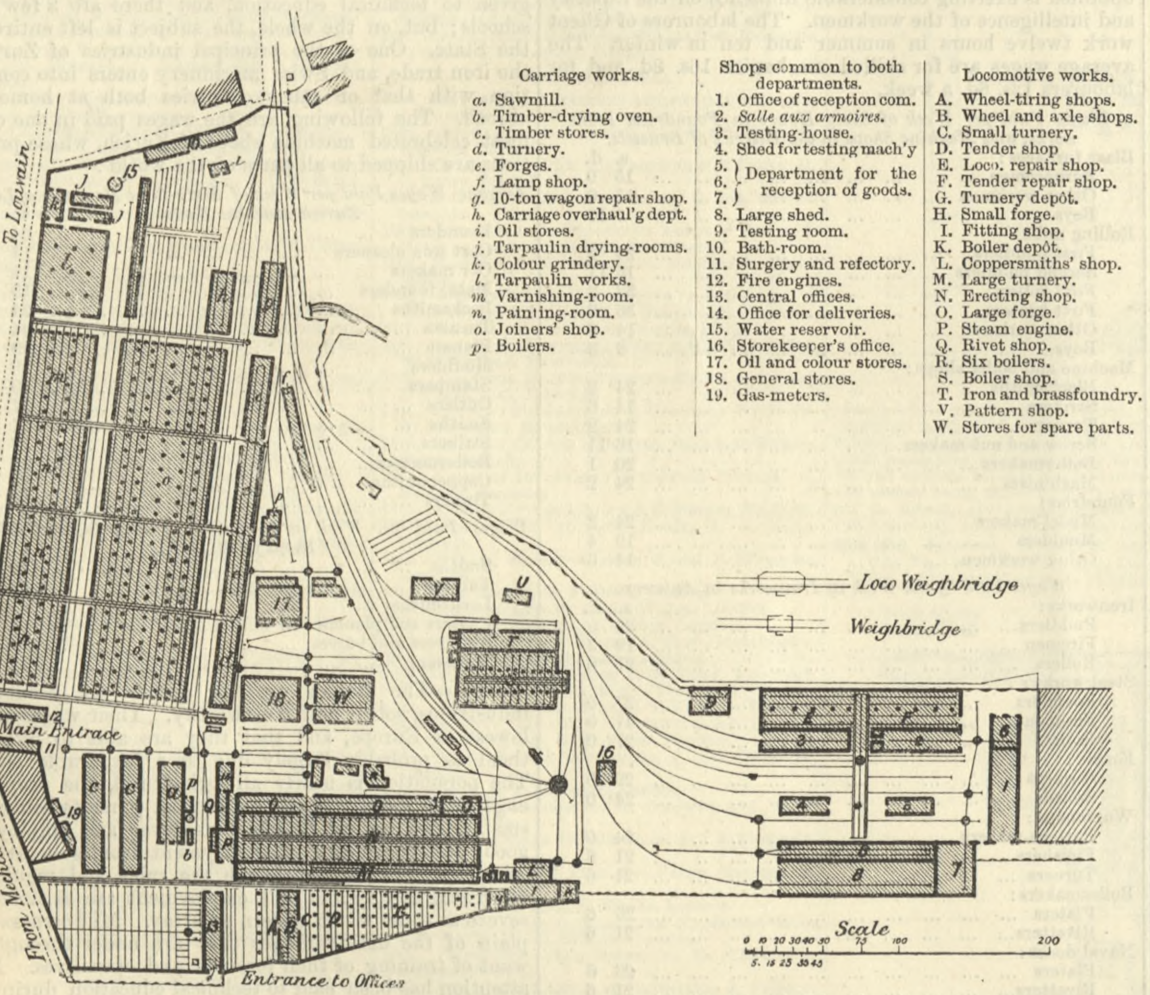
Italy.—The Italian working classes are economical, industrious, sober, and trustworthy. Their wages are the lowest in Europe, and that they are able to live upon them is probably largely due to a favourable climate. The population is nearly all agricultural, the proportion engaged in industrial and mechanical pursuits being very small. The feeling between employer and employed is good, and continuity in employment from generation to generation is common, though the rules and regulations governing factory and mill employment are as strict and severe as those which govern an army. Mill owners complain of the disadvantages they are under through the want of training of their foremen and operatives. Much attention has been paid to technical education during the past twenty-five years, and after numerous changes the technical and trade schools are daily gaining in number. But they are still far from serving the purpose intended, being regarded by the mass of labourers, who prefer their antiquated methods, as impracticable and useless. The Italian character is not considered favourable to continuous and systematic employment in factories and mills, and in some parts the rural population consider these occupations as degrading and unwholesome. There is a large amount of emigration, principally to Central and South America, and much of this is under the contract labour system. The importation of large gangs of labourers from Northern Italy into Austria and Germany is now a recognised phase of the labour question in this part of Europe. These imported hands are available only for the rougher kinds of work such as are digging, blasting, and railway making, but for these kinds of work they have no superiors in efficiency. The system is so well organised that from 5000 to 10,000 Italian workmen can be thrown into any given point in South Germany at a week or ten days' notice, and from all accounts too much cannot be said of the promptitude and thoroughness with which they do their work. The hours of labour are thirteen in summer and ten and a-half in winter. Except in foundries, where the necessity exists and night and day hands are employed, nightwork, after nine o'clock, is the exception. Italy presents but few extremes as to rates of wages; Sicily in the south and Piedmont in the north are almost equal in this respect. The wages paid in Turin may be taken as an approximation to the average wages prevailing in like trades throughout the principal cities of the kingdom. The wages paid per week of sixty hours in Turin are—Blacksmiths, 15s.; strikers, 14s. 2d.; brassfounders, 19s. 2d.; labourers, 15s.; nailmakers, hand, 13s. 4d. The wages paid per week in the arsenal at Spezzia are—Boilermakers, 25s.; blacksmiths, 17s. 6d.; coppersmiths, 19s.; labourers, 10s.; miners, 17s. 6d.; mechanics, 30s.

INTERNATIONAL RAILWAY CONGRESS AT BRUSSELS.

No. I.

The first International Congress on railway construction and working was held in August last at Brussels, under the patronage of Leopold I., King of the Belgians, and the Belgian Government. It was organised by the Minister of Railways, Posts, and Telegraphs, and by a Royal Commission nominated for that purpose. The meetings were held in the Palais des Académies, the platform of the great hall being adorned by busts of the present King and Queen; of Leopold I., who gave powerful support to the movement for introducing iron ways into Belgium, the first country after England that adopted them; of Charles Rogier, the Prime Minister, lately deceased, whose far-seeing prudence led him to urge their adoption; George Stephenson, who was present at the inauguration of the first line between Brussels and Mechlin or Malines; and the Belgian engineers, Simons and De Ridder, under whose superintendence the work was carried out.

A paper on what is called the "Arsenal," or locomotive and carriage works of the Belgian State Railways at Mechlin, was sent in by M. Teugels, chef de bureau, and M. Roussel, head of the testing department. The paper begins with a notice of the foundation and development of the national railway, from which it appears that, although so early as 1830, when Belgium became separated from Holland, a railway was projected by Teichman from Antwerp to the Rhine, it was not until 1834, after the advent to power as Minister of the Interior of Charles Rogier, the eminent citizen whose loss Belgium but lately mourned, that the Chamber of Representatives began the discussion of the project for a system of railways, which was approved on March 28th, 1834, by 56 votes to 28, and soon afterwards passed the Senate and received the Royal assent. The work was at once taken in hand by M. Simons and M. De Ridder; and the first section—20½ kiloms. = 13 miles—was opened on May 5th, 1835. The length of the State railways increased successively to 334 kiloms. in 1840, 624½ kiloms. in 1850, 748½ kiloms. in 1860, 868½ kiloms. in 1870, 2791½ kiloms. in 1880, and 3109½ kiloms., or nearly 2000 miles, at the beginning of last year.



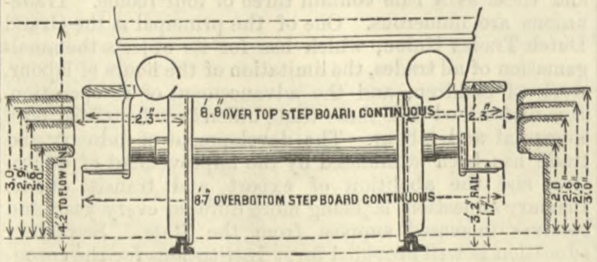
LOCOMOTIVE AND CARRIAGE SHOPS AT MECHLIN.

The metropolitan city of Mechlin, the starting point of the first railway, and now the point of intersection of the two main railway arteries of the kingdom, was also chosen as the site of the locomotive and carriage works, put under the management of M. Ragheno. The first shop—giving work to 200 hands selected from John Cockerill's works—was constructed in 1835, when the State railways only possessed four engines—Stephenson, La Flèche, and L'Elephant, made in England, and Le Belge, made at the Cockerill Works, Seraing, the first locomotive produced on the Continent. There were also about 100 passenger coaches, those of the first-class being "diligences," of the second "chars-à-banc," and of the third "wagons ouverts," the two former made in England, and the third at Mechlin. The table at the end of this article gives the leading dimensions of the principal types of locomotives now employed on the Belgian State Railways, with the kind of valve motion adopted in each. The drawings of two of these engines were reproduced on page 197 of vol. lx. (11th Sept. 1885); and those of the remainder will be published from time to time. The works—a plan of which is annexed—now cover an area of 21 hectares, or 52 acres. The machine tools have been supplied from time to time by Messrs. Kendall and Gent, Messrs. Smith and Coventry, and J. Whitworth and Co., of Manchester, MM. Carels Frères, of Ghent, and the Grafenstaden Company. The erecting shop has fifty-five pits, and is served by 290 men divided into twenty-six gangs. This shop has lately been supplied with three double emery grinders by Fontaine, of Bockenheim, which, by superseding files, lead to a great saving of time and expense. There is also a special shop, with ninety men, for repairing link motions and the Westinghouse brakes.

The testing department, in which stringent tests are carried out on all articles supplied to the railway and marine administrations, is provided with a 500-ton Kirkaldy machine made by Greenwood and Batley; a machine with a series of falling weights for rails, tires, and axles; a steam ram for springs; a Buckton spring-weighing machine; a cold plate-bending machine; three dynamometers; a cement-testing machine; a chain-testing machine, and a special apparatus for the study of fractures, &c. In 1882 a Ministerial decree placed the Kirkaldy machine at the disposal of companies and individuals for a sum of 10f. = 8s. for the first hour, and half that rate for each subsequent half-hour, in addition to the actual expenses incurred, while samples are prepared for double the cost of the time spent upon them. In tensile tests, the test-pieces must be at least 350mm. = 13·78in. long, and 30mm. = 1·18in. at the largest diameter. The testing department and laboratory were also placed at the disposal of the two international committees of the Antwerp Exhibition—one for raw materials, steam engines, boilers, and machinery; and the other for apparatus connected with the utilisation of electricity—for carrying out tests for all exhibitors who made application.

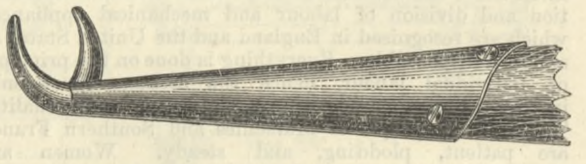
The Great Western Railway Company sent in a paper in reply to several questions on the programme. With regard to the third question, "Principles to be observed in the construction of rolling stock, so as to facilitate exchange," the company recommends observance of the following points:—(1) Uniformity of gauge. (2) Uniformity of loading gauge and that of buildings. (3) Uniformity in the height of buffers and couplings, and also their distance from the centre line. (4) Uniformity in the floor height of carriages and wagons. (5) The great advantage of adopting continuous brakes.

With regard to Question V.b. of the programme—the equipment of rolling stock for insuring the safety of passengers—Mr. J. Grierson observes that the continuous footboard prevents the danger of passengers falling between the platform and the carriage. Platforms in England vary from 9in. or 14in. to 2ft. 9in. from the rail level; but the tendency is now to increase their height. The Great Western Railway standard is 2ft. 9in., the height of the carriage floor above rails being 4ft. 2in. On account of the varying heights of platforms, it has been thought well to provide carriages with two continuous footboards. The accompanying sketch shows the end view of a carriage provided with two continuous


GREAT WESTERN RAILWAY PLATFORMS.

footboards, and also the different height of platforms on the Great Western Railway. The standard distance from the inside of the rail to the edge of the platform is 2ft. 3in.; but practically this distance varies from 1ft. 7in. to 2ft. 9in.

With respect to Question V.c., the G.W.R. Co. remarks that safety to the railway servants depends largely on observing rules and the maintenance of signals, on the influence introduced by the telegraph, and on the application of the interlocking system; but, in spite of all precautions, it is not possible to avoid accidents entirely. On English railways in 1884, out of 540 railway servants killed and 2319 injured, 29 were killed and 341 injured—or 5·31 and 14·7 per cent. of the whole respectively—while coupling and uncoupling. The men, though enjoined to use hooks for this purpose, do not as a rule take favourably to them, while opinions on their utility vary considerably. The accompanying sketch shows the form of hook for coupling that is generally in favour on the Great Western Railway system, and actually in use by way of trial at the principal stations.


GREAT WESTERN COUPLING HOOK.

A paper was sent in by L. E. Asser, engineer-in-chief for the permanent way of the Dutch Railway, "On the Safety Apparatus made and used by the Dutch Railway Company." The method of working distant points by rods has the disadvantages of requiring compensation for varying temperatures, of being limited as to distance, and of being costly in construction. The first apparatus for working points by an excentric moved by wire cords, constructed by Siemens and Halske, was used by the Dutch Railway Company in October, 1879; and it was soon decided to adopt the new system for a complicated junction near Amsterdam. As no difficulty was encountered with the steel wire cords, the present managing director of the company, M. Van Hasselt, assisted by the engineer, M. Tawrel, devised the apparatus described below and illustrated on page 141.

In Figs. 1 to 6, which show an apparatus for working distant points in conjunction with an automatic signal, the two wire cords a and a^1 are put in motion by a pulley lever A, this motion being transmitted to pulley B, keyed on the shaft C, which turns with it. This shaft carries the special eccentric D, moving between the two rollers E E fast on the rod F, which works the points. The eccentric D, which moves through 180 deg., is so constructed that 140 deg. suffice for working the points, so that a difference of temperature or tension would exert no injurious influence; but the points are not moved unless the shaft and the eccentric make a partial revolution. As the signal must show "danger" before the points are moved, and until they are completely moved, a pulley G, fast on the shaft C, has a flange H, Fig. 2, which butts against one of the cams I, carried by the shaft L of the signal, and causes it to turn so as to move the plate K towards the line, thus indicating "danger," a position which is maintained until the action is completed. When the points are completely set in their new position, the flange M on the top of the pulley G strikes the cam N, also fast on the shaft L of the signal, and turns the latter, while causing the arrow to assume a position contrary to that on the figure. The motion of the shaft L also raises the red and green glasses R and S, by means of the pulley P and the lever Q, so that at night a red light is shown during the working of the points and signal, and a white or green light respectively when they are in their two different positions.

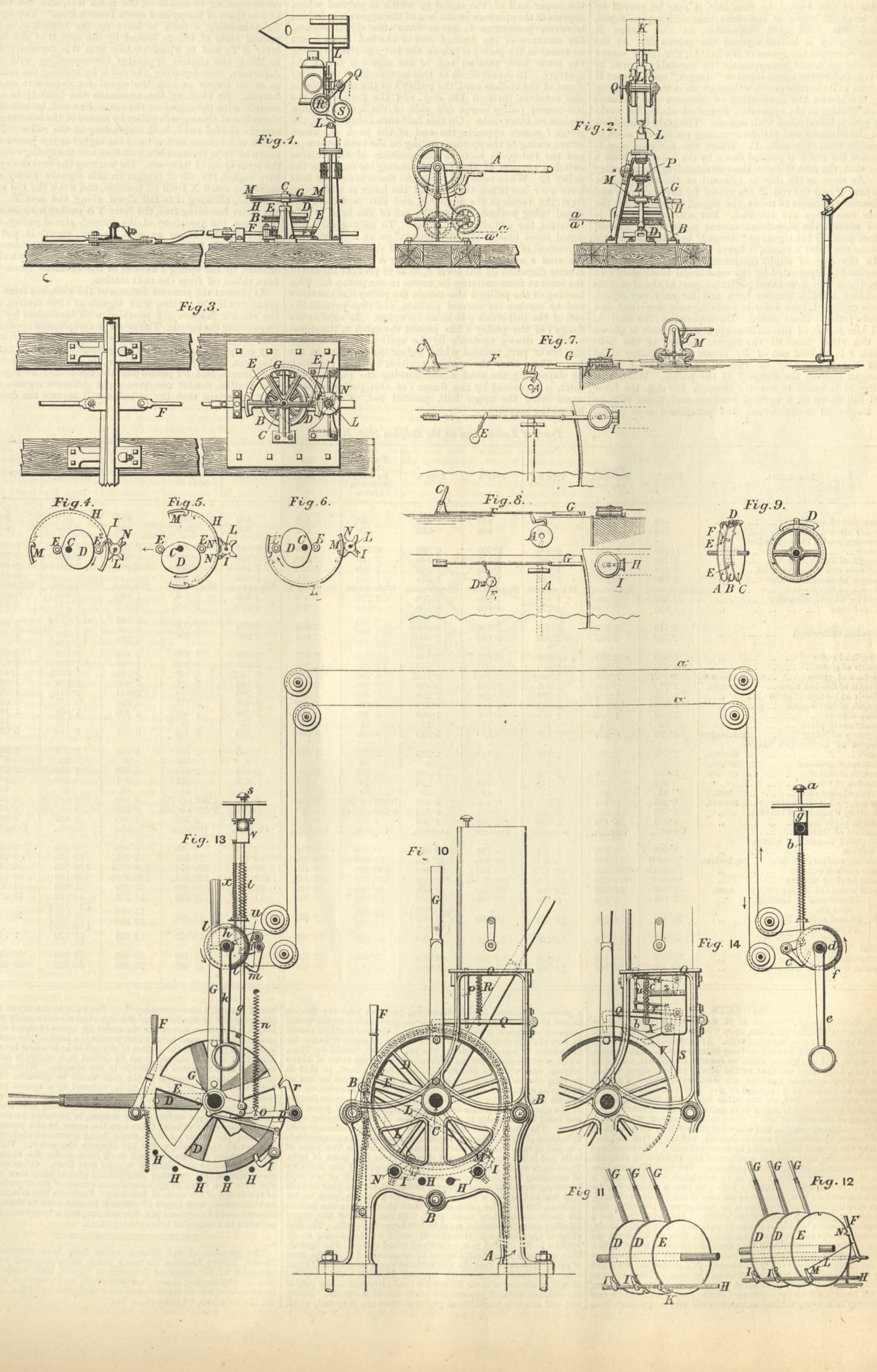
The apparatus, Figs. 10, 11, and 12, for working points interlocked with signals, consists of at least two cast iron frames A, connected by tie-rods B and by the fixed shaft C, on which turn the pulleys D for the points and E for the signals, Fig. 11, these pulleys having a groove for the chain worked by a wire cord. A pulley is turned by drawing the snug of the lever F out of its recess, and moving one of the levers G, which forms part of the pulley, until the snug enters a second notch. The interlocking of points and signals is effected as follows:—To each signal to be given corresponds a shaft H—see Fig. 10—opposite the pulleys D D of the points in connection with this signal, carrying a pawl I, while a pawl K engages in the signal pulley E, acting in the opposite direction. To move the signal pulley, the pawl K must be withdrawn, which cannot be done until the points are placed in such a position that each pawl I can enter its recess in the point pulleys. The signal will be maintained by the snug of the lever F entering the second recess of the pulley E. As this recess is smaller than the other, it will only allow the end N to enter; and the pawls I will not be thrown out, as many points as signals up to six being interlocked as may be required.

At Fig. 9 is an apparatus permitting of signals being worked from two different stations, and is useful when the same signal has to protect a turntable, or any other dangerous spot, and a point station. The three pulleys A, B, and C turn on the same shaft, the signal wires being placed in the groove of the middle pulley, while that from one of the stations passes over A, and that from the other station over C. In the normal condition, the anchor D, pivoted on the pulley B, is so arranged that each of its ends comes opposite a recess in pulley A or C. The first pulley moved—C, for instance—only causes the end corresponding to pulley A to enter its recess, thus locking the pulley with the signal, so that, when this pulley is moved in its turn, the signal will be shifted at the same time. The signal is taken off again when one of the pulleys is moved back to its original position, by studs E striking the pin F, which passes through the signal pulley B.

For protecting a turntable, it is sufficient that the apparatus prevent any moving of the signal until the turntable be locked, and, on the other hand, that it prevent any unlocking of the turntable while the signal is off. This arrangement is shown by Figs. 7 and 8, in which the disc A is keyed on the shaft of the turntable locking eccentrics, in such a manner that its recess only comes opposite the hook or pawl B when the turntable is locked, and when only the lever C may be shifted, after

INTERLOCKING POINTS AND SIGNALS ADOPTED BY THE DUTCH RAILWAY COMPANY.

(*For description see page* 140.)



having removed the key D from its recess to allow the plate E to pass. The lever C also causes the rod F and its bolt G to advance sufficiently far for the flange K of the pulley L to become free to turn in the recess of the bolt. In this case it may be moved by the lever M, while at the same time shifting the signal, which was until then impossible, as the flange K of the pulley L butted against the groove H. As the flange K enters the recess of the bolt G, the latter cannot be withdrawn, and consequently the turntable cannot be moved, before the signal is put at "danger," and the part H returns to its normal position through the action of a spring. Fig. 10 shows the application of Siemens and Halske's block system to the apparatus, described above, for working points interlocked with signals. The plate O is added, and the Siemens and Halske arresting pistons are made to coincide with the rods P. When the Siemens disc is blocked the rod P is pushed down by the piston in such a way that the arm Q locks the corresponding signal-pulley E. As soon as the disc is released at the signal station the arm Q and the rod P are raised by the spring R, and it becomes possible to move the signal, provided that the other conditions are satisfied. But when the signal is once moved, the signalman cannot again block himself before putting the signal at "danger," because, as the arm Q does not enter a recess, it keeps the rod P raised.

In the case of slight distances the arrangement just described is superseded by the mechanical block shown at Fig. 13, in which, to avoid confusion, part of the apparatus is shown with a quarter turn and for only one signal, while capital letters refer to parts already described, and small letters those added. On depressing the stud A, and the rod *b*, of the station apparatus, which is shown on the right hand of the figure, one end of the bell-crank *c* is moved out of its recess in the pulley *d*, so that the latter may be turned by the lever *e* being brought against the flange *f* of the pulley. When this pulley *d* is made to revolve through 180 deg. the lever will fall down in a vertical position, and there will be no means of withdrawing, the permission once given, except with the co-operation of the signal station, shown to the left of the figure. As the hooked end of the bell-crank *c* is kept out of its recess in the pulley *d*, so that its other end is depressed, drawing down the rod *b*, the upper half of the signal *g*, which is painted white, appears at the aperture in the box of the apparatus. When, however, permission is given from the signal station, the entrance of the hooked end of the bell crank *c* into its recess in the pulley *d* causes the rod *b* to rise, bringing the lower half, painted red, of the signal *g* before the aperture. In consequence of this movement of the pulley *d* and of the endless cord, the pulley *h* of the signal station also revolves through 180 deg., and the flange *i* of the last-named pulley leaves one side of the lever *k* to butt against its other side. On this half-turn being made, the recess *l* comes opposite the end of the hook *m*, which enters, owing to the spring *n* acting on the bent lever *o p r* and the rod *q*, as soon as the position of the various switches permits of the pawl *i* entering its recess in the pulley E. When once the rod *q* and the arm *o* of the bent lever *o p r* are lifted, the end *r* of the latter is withdrawn from the recess in the pulley E, and this permits of the signal being worked. When the end of the hook *m* is in its recess, the switches are locked. To release them the signal must first be put at "danger," so as to permit the movement of the bent lever *o p r*; and then, by depressing the stud *s* and the rod *t*, the pulley *h* is turned in the reverse direction by the lever *k*, so as to prevent the end of the hook *m* from entering its recess in the pulley *h*. This turning of the pulley *h* also causes the pulley *d* at the other end to assume its normal position, and thus permits the end of the bell crank *c* to enter its recess. As soon as the flange *i* of the pulley *h* has passed the catch *u*, the signal *v* will be drawn upwards by the spring *x*, so as to show the lower part, painted white, before the aperture in the box. Then, after the normal position has been regained, by depressing the stud *s* and turning the pulley *h*, the catch *u* is moved by the flange *i* of this pulley so as to again bring the upper half, painted red, of the signal before the aperture.

Fig. 14 shows an arrangement for protecting the junction of a branch with a line where the Siemens and Halske block system is adopted. At the junction signal-box there are four signal apertures in the table O—two corresponding to blocks on the main line, and the other two to those of the up and down branch lines. The signal for permitting a train to leave on the branch is, in the normal state of things, locked by the arm S of the bent lever S T; and to withdraw this arm it is necessary first to block the electric apparatus corresponding with the departure, thus lowering the rod *u* by turning the arm S, so as no longer to lock the signal for departure on the branch. By blocking the apparatus the hook Q in connection with the signal on the main line will be locked in the recess of this signal's pulley by means of the lever arm A and the slotted rod *b*, both depending on the rod *u*. This signal will remain locked until the signal at the junction is taken off from the next block station, and the spring *c* draws the lever Q out of its recess. On working the branch departure signal, the rib or feather on this signal's pulley will move the catch X from its position, and draw the rod *u* on one side, allowing it to fall down along the arm T. On the latter becoming free, the lever T S pushes with its arm S against the periphery of the branch signal pulley, and falls into the recess as soon as the signal is put at "danger." It follows that this signal cannot be taken off until the rod *u* be again raised above the arm T, which is effected by the spring *z* as soon as the Siemens block has been taken off from the next station.

At present the greatest distance of the switches from the apparatus is 600 metres, with signals at 1300 metres, and the station masters are provided with binoculars for distinguishing the signals. Thirty-seven complicated apparatus with 271 levers are already put down on the Dutch railway company's system, the most important being that at Haarlem, for a junction of three lines. It has twenty-four levers, half for points and the remainder for signals. The station master can give eight different signals, and may be certain that the switches will assume the desired position.

Types of Locomotives on the Belgian State Railways.

Locomotive.		Type 1.	Express 4-coupled engine.	Type 5.	Type 2.	Type 4.	Express engine for steep gradients. Type 6.	Type 28.	Type 29.	Goods engine. Type 25.	Type 20.	Type 20, modified.	Type 51.
Diameter of cylinder	mm.	430	435	320	450	450	500	450	450	500	480	500	380
Piston stroke	,,	560	610	460	600	600	600	600	600	600	550	550	460
Between centre lines of cylinders	metres.	0·760	0·530	0·500	0·500	0·500	0·570	0·500	0·500	0·570	2·004	2·004	0·500
Length of connecting-rod	,,	1·740	1·890	1·440	2·140	2·140	2·290	2·140	2·140	2·140	2·820	2·820	1·370
Between centre line of links	,,	0·154	1·030	1·000	1·160	1·160	1·080	1·160	1·160	1·080	2·004	2·004	1·100
Length of excentric-rods	,,	1·705	1·100	0·713	1·315	1·315	1·160	1·315	1·315	1·470	,,	,,	0·647
System of link motion		Stephenson.	Walschaert.	Walschaert.	Stephenson.	Stephenson.	Walschaert.	Stephenson.	Stephenson.	Walschaert.	Belpaire.	Belpaire.	Walschaert.
Driving wheels, diameter	,,	2·000	2·000	1·450	1·700	1·700	1·700	1·450	1·300	1·300	1·050	1·050	1·200
Wheel base	,,	4·630	5·150	4·270	4·000	8·400	6·650	4·000	4·000	4·200	4·500	7·230	3·100
Between each wheel	,,	2·310 2·320	2·650 2·500	1·950 2·320	2·000 2·000	2·200 2·000 2·000 2·200	2·350 1·900 2·400	2·000 2·000	2·000 2·000	2·000 2·200	1·500 1·500 1·500	1·500 1·500 1·500 2·730	1·640 1·460
Length of grate	,,	2·610	2·900	1·355	2·625	2·625	2·200	2·625	2·625	2·655	2·100	2·720	1·300
Width of grate	,,	1·070	1·100	1·070	1·055	1·055	2·800	1·055	1·055	1·900	1·800	1·860	1·070
Surface of grate	sq. metres.	2·7927	3·200	1·4498	2·7667	2·7667	6·700	2·7667	2·7667	5·149	3·780	5·0592	1·450
Length of fire-box shell	metres.	2·910	3·210	1·656	2·910	2·910	3·000	2·910	2·910	2·921	2·400	2·909	1·599
Width at bottom of ditto	,,	1·286	1·290	1·274	1·290	1·290	2·800	1·290	1·290	2·048	2·044	2·044	1·288
Length of boiler shell	,,	3·015	3·200	2·650	3·412	3·412	4·000	3·412	3·412	3·277	4·010	3·775	2·650
Mean diameter	,,	1·286	1·300	1·078	1·300	1·300	1·400	1·300	1·300	1·400	1·400	1·500	1·140
Thickness of plate	mm.	13	13	11	13	13	14	13	13	14	12	15½	11½
Capacity of boiler	cub. metres	4·770	6·100	2·827	5·580	5·580	8·500	5·580	5·580	6·400	6·892	9·180	3·034
Height of centre line above rail	metres.	2·165	2·305	1·785	2·125	2·125	2·370	1·975	1·900	2·178	2·244	2·300	1·860
Maximum pressure	atmos.	8	9·5	8	8	8	10	8	9	10	9	10	8
Length of tubes	metres.	3·100	3·510	2·750	3·510	3·510	4·000	3·510	3·510	3·510	4·000	4·010	2·750
Number of tubes		208	225	145	226	226	240	226	226	251	251	242	165
External diameter	mm.	45	45	45	45	45	50	45	45	45	45	45	45
Chimney diameter at top	metres.	0·465	0·490	0·290	0·465	0·465	1·300 × 0·768	0·465	0·465	1·300 × 0·768	0·500	1·300 × 0·670	0·340
Chimney diameter at bottom	,,	0·533	0·555	0·330	0·535	0·535	0·580 × 0·550	0·535	0·535	0·580 × 0·550	0·550	0·570 × 0·550	0·400
Height above rail	,,	4·300	4·400	3·650	4·300	4·300	4·300	4·300	4·300	4·300	4·300	4·300	3·848
Position of frame		Outside.	Outside.	Outside.	Outside.	Outside.	Outside.	Outside.	Outside.	Outside.	Inside.	Inside.	Outside.
Length of locomotive without buffers	,,	8·300	8·700	7·430	8·798	10·950	9·200	8·798	8·798	8·860	8·940	10·850	6·610
Heating surface, fire-box	sq. metres.	10·6400	11·700	5·8740	10·920	10·920	15·000	10·920	10·920	11·331	11·293	13·100	5·2944
Tube surface outside	,,	79·9042	109·300	49·3248	98·463	98·463	140·000	98·463	98·463	109·355	124·8103	135·000	56·1285
Total heating surface	,,	90·5442	121·000	55·1988	109·383	109·383	155·000	109·383	109·383	120·686	136·1033	148·100	61·4229
Total weight of engine empty.	tons.	31·050	37·000	26·000	35·800	43·000	50·000	32·100	31·800	39·800	39·700	57·800	24·300
Weight. Distributed over the several axles in running order. Leading..	,,	9·100	12·140	9·600	12·800	10·100	12·500	11·200	11·100	14·600	13·100	14·722	10·020
Middle ..	,,	13·400	14·390	11·600	14·400	13·000 14·000 13·600	14·000 14·500	12·800	12·300	14·800	13·000 13·600	14·722 15·136 15·300	10·860
Trailing...	,,	13·000	14·350	10·700	12·300	10·600	14·000	11·100	11·400	13·800	12·700	15·120	9·740
Total weight of engine in running order	,,	35·500	40·880	3·100	39·500	61·300	55·000	35·100	34·800	43·200	52·400	75·000	30·620
Useful weight for adhesion	,,	26·400	28·740	22·300	39·500	40·600	42·500	35·100	34·800	43·200	52·400	60·000	30·620

STREETS.

On Monday night, Professor R. H. Smith gave a popular lecture at Mason College, Birmingham, upon "Streets," in which he made a novel proposal regarding tram-rails. After describing the various constructions used for street surfaces in macadam, concrete, granite and wood, and comparing them as regards cleanliness, durability and cost, he pointed out that in the ideally perfect street surface two exactly opposite qualities are desiderata. Thus a certain amount of roughness is required to give good foot-hold or grip to horse and man. But, on the other hand, the highest possible degree of smoothness is desirable in order to diminish draught, and the wear of tire surfaces, and in order to lessen jolting, which wears out the springs of vehicles, and wears out the nerves of drivers, riders, and horses, by downright useless shaking, and the nerves and ears also of the general street public by incessant noise. He considered tram-lines the only possible solution of the problem to reconcile these apparently incompatible desiderata. Between the tram-lines you can have any suitable degree of roughness where alone it is wanted for foot-hold, and on the rails you have a smooth way for the wheels where smoothness does not lead to risk of horses slipping. But existing tramways are private or semi-private property; they cannot be generally used by the public. Moreover they are a decided nuisance to at least two large sections of the public, namely, carriage owners and cyclists, who, although they do not form the bulk of the community, still have the same rights as others, which rights ought to be respected. The nuisance arises from the existence of the groove. This is really unnecessary as a guidance. Cabs and carts continually run with one wheel on the tram rail and have no difficulty in keeping to it, although the other wheel is always being jolted by running on the rough part of the road. There is no real difficulty in keeping vehicles on narrow rails without guidance from a groove. Professor Smith, therefore, proposes that the grooves should be done away with, and the tram-lines made as much public property as the rest of the street surface. The rail surfaces should be very slightly dished—$\frac{1}{16}$in.—transversely, to make it easier for the wheels to keep the lines. The rail breadth should be 2½in., which is wide enough for all ordinary tires except those of heavy wagons, and which is not so wide as a horse's hoof, so that in crossing the rails, the horse can always find foot-hold on one or both sides of the rail and does not run the risk of slipping on the smooth surface. This narrowness of the rail is an essential feature of the system, wide public tram-lines being a hundred years old, and being impracticable in towns because of horses slipping upon them. The gauge of the rails would be that most commonly used by vehicles of all light descriptions and omnibusses. In narrow streets one pair of rails would be laid; in second-class streets two pairs of rails, and in the most important thoroughfares four pairs of rails. Three pairs would not be used anywhere because of the difficulty in regulating the traffic on the central pair. The rule of the road in driving would be as at present, except where one pair of rails only was laid, where a new rule would be necessary, such as, for instance, that vehicles going out of town should leave the line to let those coming into town pass. At each side of the street standing room for vehicles must be left beyond the rails. The first effect of the adoption of this system would be the altering of all vehicles in the district to the standard wheel gauge. The second, that the whole wheel traffic would be concentrated along the lines of rails. The third that the rail surfaces would be subject to rapid wear and would require very frequent renewal. This renewal should be effected without lifting the road surface at either side of the rail, and without appreciable hindrance to the traffic. Heavy and stiff cast iron longitudinal girder-sleepers are proposed, which would remain in place permanently. The rails on the top of these girders would be thin flat strips of tough steel all cut exactly to one length. These are screwed to the girder by conical-headed screws entering counter-sunk holes which permit the head of the screw to sink about ⅜in. below the surface of the rail so as to allow for wear. The screw holes in the rail must be drilled in a multiple drilling machine so as to insure exactitude in the spacing. Without this no promptitude in renewal of the rails would be possible. These holes after being drilled were to be widened by a special punch-drift in a steam forge-stamp, which would throw out on the under side of the rail an annular shoulder. This, fitting into a recess drilled in the upper surface of the sleeper, is intended to prevent any horizontal stress being thrown on the screw by the passage of vehicles, the whole of such stress being communicated to the sleepers by the shoulder, and not through the screw. Without this provision the screws would work loose under the to-and-fro strains caused by the rolling of vehicles over them. Other rails of small section laid on heavy longitudinal girders have been tried, and have been found to get loose in consequence of the imperfection of the design of the mode of fastening. Professor Smith said that on this system, each length of rail as it became worn to the proper amount could be replaced in a few minutes, and a long street could be relaid in a couple of hours at night time.

The premises at 449, Strand, which have been occupied by Messrs. Elliott Brothers for many years, being required by the extension of the American Exchange in Europe, their whole business of engineering, optical, mathematical, and electrical instrument makers will be carried on at their manufactory, 101 and 102, St. Martin's-lane, Charing-cross, W.C.

ROYAL ALBERT DOCKS EXTENSIONS.

THE energy and enterprise which characterise those English firms and companies that pursue a progressive policy, knowing the danger of remaining inactive and unappreciative of modern improvement and requirement, is well shown by the London and St. Katherine Docks Company, which in the past few years has added about 630 acres of docks to its possessions, of which no less than about 177 acres are water area. The old docks, St. Katharine's and London, a little below the Tower, have now much the relation of the grain of wheat from which the ear has grown when compared with the Royal Victoria and the Royal Albert Docks. The former of these two big docks, with its 90 acres of water, is a jetty dock 1000ft. in width and a depth of 25ft. 6in., and was for a long time considered one of the finest docks in the kingdom, and is to this day one of the best appointed and patronised. Like the two older and smaller docks, however, its capacity has been outstripped by the requirements of the large modern vessels, and hence the Royal Albert Dock, with its entrance basin and locks extending over a mile and a-half in length, and forming with the Victoria one vast dock two and three-quarters miles in length, was seen to be a necessity, and was constructed by the company only a few years ago, with a depth of 27ft. in the dock itself, while the depth in the Gallions entrance basin is 32ft., with a depth of 30ft. over the cill from it to the river. Already, however, considerable extension works have been found necessary or seen to be necessary in the near future, and hence extensive improvements by the construction of a new entrance, have been made, and at the same time an extension of the Gallions Reach end of the dock has been carried out.

The Royal Albert Dock, completed in 1880, is specially constructed for the largest class of steamers. It covers 432 acres, of which 87 are water. About 142 acres are available for building purposes. It is a quay dock, 490ft. wide, with a depth of 27ft., and has quay berths for thirty-three vessels of the largest class. Its entrance is within about an hour's steaming from Gravesend. The basins being within the docks are not liable, as open tidal basins are, to the rise and fall of tide, and on account of their vicinity to the river are frequently preferred by shipowners for loading and discharging. The depth in Gallions basin—see plan page 146—is 32ft. Pumps throwing 125,000 gallons per minute have been erected at Gallions, by which the water in the above docks and basins is maintained at Trinity high-water, or raised above it when required for any unusually deep ship. There are two dry docks in the Royal Albert Dock, 502ft. and 410ft. in length, exclusive of a cut of 20ft. at the end of each. Already there are extensive factories belonging to various firms alongside the docks, and shipowners employ whomsoever they please to execute work in their vessels. The jetties and quays are lined with sheds, warehouses, and granaries, which, with those within the docks, afford a floor area of 3,040,000ft., and could store from 240,000 to 270,000 tons of goods, but the very large space required for goods in transit reduces this to between 140,000 and 162,000 tons, according to their description. In the Victoria Dock vaults fifty-eight chambers have been provided, and the necessary machinery and appliances for storing 42,000 refrigerated sheep. The northern railway companies run direct from these vaults. The docks are provided with no less than 110 travelling and ninety-two fixed cranes and jiggers; a travelling coal crane equal to 20 tons, a floating crane equal to 30 tons, and a pair of shears equal to 60 tons. The four largest steam tugs are fitted with steam fire engines, and patent and other fire hydrants and engines are provided along the quays. There is a complete system of goods lines throughout the docks, which centres in a goods yard in the Victoria Dock, and communicates with the general railway system of the country. Four passenger trains per hour from Fenchurch-street, and one from Liverpool-street, run between the City and the docks, and special trains for passengers are run as required from the ship's side. It gives some idea of the vast extent of the docks when it is said that there are four and shortly will be five stations within the docks. The new entrance works were commenced in May, 1884, and will be completed in a short time. They consist of an enlargement of the Gallions Basin from 12 to 15¼ acres, with two additional berths, making six instead of four. This portion is shown to the right of the line marked "wall to be removed" on the plan, page 146. They also consist of a new entrance from the Thames—with a lock parallel and contiguous to the present lock, and like it, 550ft. long and 80ft. wide, but with a depth of 36ft. instead of 30ft. on the cill at Trinity high water—and of a river wharf, stretching from this entrance 1120ft. down the Thames, with a depth alongside af 27ft. at low water, with a customs and railway station abutting upon it. The railway lines are continued along this wharf, and the largest vessels will be able to lie there at any time of tide to coal, or take in cargo, or embark or disembark passengers. Coasters and continental steamers will also be able to avail themselves of it in connection with the ocean steamers or otherwise.

This vast dock, 2¾ miles in length, is situated opposite to Woolwich, on a wide open and deep reach of the river, on the verge of the limit which permits goods to be conveyed from London by cart and van, within ordinary lighterage of the London and St. Katherine Docks and river wharves, and yet within easy distance of the sea.

In our impressions of the 5th and 12th inst. we gave respectively engravings showing plan, longitudinal and transverse vertical sections of the new entrance lock, with enlarged sections of some parts, and a number of engravings showing the construction of timber work, entrance jetties, and the river wharf. It may be here mentioned that on page 103, February 5th, giving horizontal and vertical sections of lock masonry, there are two details marked section on A B; the smaller of these is a section of the lock gate wheel path.

Two recesses are made 6ft. apart in the sides of the lock walls and across the gate platforms at each of the lock pits, to be used to form a temporary dam for repairs, in case repairs should ever be required in the lock or gate pits.

We now publish on page 147 further details of the construction of the entrance jetty, timber work, and sectional plan of the entrance end of the lock, showing the flushing culverts and part of the jetties. The dam shown across the mouth of the entrance has, of course, to be removed. On page 146 is at the top a plan of the river wharf in Gallions Reach, the new entrance to the lock at A, with the intervening jetty B between the new and the old entrance, and the railway sidings to the river wharf; lower in the same page is a part of the wharf plan. A general plan is given of the basin and new and existing entrance locks with the jetties as at first proposed. Since the work was far advanced it has been decided to construct a river wall between the timber wharf and the existing shore, and to level the ground up to this from the shore, and to construct the timber river wharf only indicated on the general plan by dotted lines. On the same page are given sections on lines marked on the general plan.

The concrete walls of the lock and basin on the water sides are faced with brickwork bonded into the concrete, the brickwork having been built up in stages and the concrete filled in against it. This was done to facilitate the making of the walls in preference to using wood shutters, as the cost of shutters to get on quickly with the work was found to be almost equal to the cost of the brick facing. Taking down the existing wall of the basin, as already mentioned, and shown in the plan on p. 146, is a feature of great interest in this work. The wall is 530ft. long, and varying in thickness from 16ft. at the base to 5ft. at the top, and 530ft. deep, with strong counterforts at 100ft. intervals at the back. The plan adopted is as follows:—A row of sheet piling is driven at the back the entire length of the wall, with tie piles behind at 10ft. intervals, and bolted together with tie bolts and walings. The piles are flanked by a bank of earthwork, forming a protection or dam behind the wall. The wall is being reduced two-thirds of its thickness by drilling holes and using small charges of gunpowder, leaving the concrete wall 4ft. thick shored to the piling. This portion of the wall is drilled at intervals to receive charges of powder or dynamite, to be thrown over in one simultaneous charge after the water has been let into the new works, and lifted by dredging and lifting grabs. The construction of the lock and basin walls, allowing for difference of depths, has been carried out on the lines of the drawings adopted by Mr. A. M. Rendel, M.I.C.E., for the Royal Albert Docks, opened on the 24th June, 1880. The present extensions are carried out by the company's engineer, Mr. Robert Carr, M.I.C.E., and the assistant engineer, Mr. Joseph Thomas. The hydraulic machinery was constructed by Messrs. Sir W. G. Armstrong, Mitchell, and Co.; the pumping machinery, by Messrs. Simpson and Co.; the lock-gates, by the Thames Ironworks Company; the granite, supplied by Messrs. J. Freeman and Sons; the sandstone, by Messrs. B. Whitaker and Sons. The bricks employed were of various kinds, the gault being supplied by Burham Brick and Cement Company; the stocks by Mr. Henry Chambers, and blue vitrified by Mr. Joseph Hamblet. The cement was supplied by Messrs. Knight, Bevan, and Sturge, and by Messrs. Francis and Co.; the timber was supplied by Messrs. J. M. Ross and Co.

ANCHOR GEAR OF THE S.S. ALGOMA.

THE accompanying engravings represent the new anchor and anchor gear of Messrs. S. Baxter and Co., of Great St. Helen's, London, as fitted to the steamship Algoma, the first English merchant ship so fitted. The gear has also been fitted to two German merchant vessels and two Brazilian ironclads. The Algoma is fitted with the complete system of patent anchor gear, consisting of vertical steam windlass, capstan, stockless anchors, and seatings for same. The anchors are shown in Figs. 1 and 2—one of them in Fig. 1 being in its place, where it is held by the big finger in its seating. The vertical windlass and capstan is seen in elevation and plan in Fig. 3, which show a double-cylinder engine driving by bevel gearing a shaft contained in the windlass and capstan-frame. Though not shown, it may be mentioned that the two vertical anchor chain windlasses are rotated by one large worm on the shaft driven by the engine, the worm gearing into the two wheels on vertical shafts thus ⊥o⊥. The horizontal shaft is continued, and by bevel gear drives the single capstan. The system is one the advantages of which are very great, as neither "cat" nor "fish" davits are required, the anchors being hove up within the ship by the steam windlass direct, where they remain ready for letting go again, thereby saving all loss of time in "fishing," "catting," and securing on deck, and the wear and tear of ropes and tackle. One man is sufficient for letting go the anchors, purchasing, and stowing them in any weather, operations which are always tedious and dangerous by the old method.

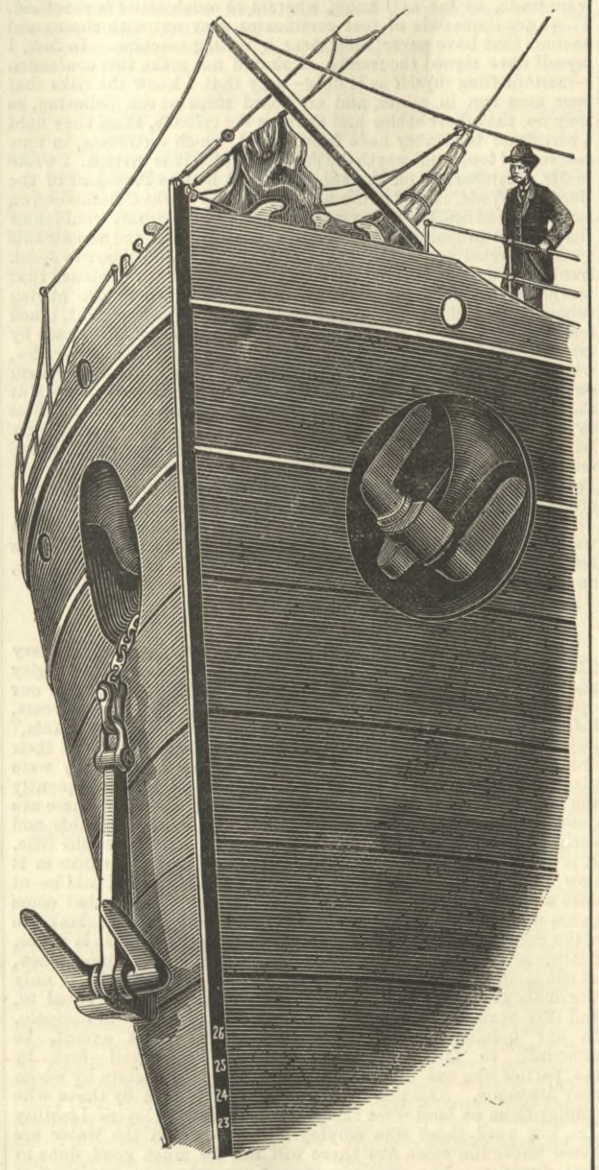


Fig. 1.—BAXTER'S ANCHORS ON THE S. S. ALGOMA.

There is a simple means for securing the anchors in the seatings to admit of disconnecting the cables from them when required for mooring to buoys or other purposes.

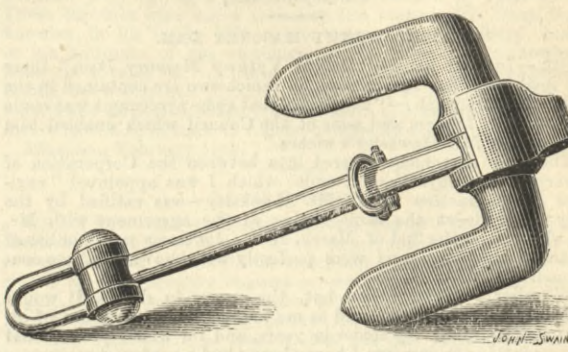
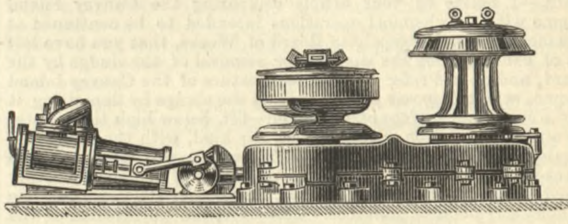
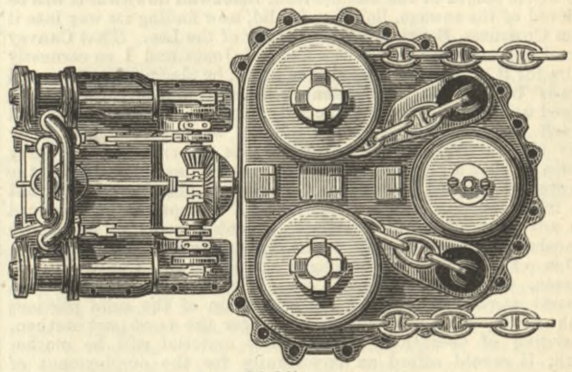


Fig. 2.—BAXTER'S STOCKLESS ANCHOR.

Lloyd's Committee specially visited the ship to see the anchors let go and hove in, and expressed themselves much pleased with the practical working of the system, and considered that the short time occupied for letting go, purchasing, and seating the anchors was highly advantageous.



SIDE ELEVATION



PLAN

Fig. 3.

TANK LOCOMOTIVES FOR THE MERSEY RAILWAY.

ON page 150 we illustrate one of five tank engines recently constructed for the Mersey Railway by Messrs. Beyer and Peacock. The conditions prescribed for working out the design were that the engine should haul a load of 150 tons, besides its own weight, up inclines of 1 in 27, and start with the load on such inclines. Provision should be made for condensing the exhaust steam. The extreme width of the engine should be kept within the usual limit, to enable it to run on the adjoining lines of railway. This last condition necessitated the fixing of the cylinders inside the frames, and thus mainly determined the type of the engine; which will be seen to have six coupled wheels, all placed under the boiler barrel between the smoke-box and fire-box, and a four-wheeled bogie placed at the hind end, an arrangement combining a short rigid with a long flexible wheel base, enabling the engine to run steadily even at high speeds, and pass easily through curves having a radius of ten chains on the main line and six chains on the sidings. The method of condensing the exhaust steam is similar to that which Messrs. Beyer and Peacock designed for the engines they constructed for working the Metropolitan and Metropolitan District underground railways.

Though several difficulties had to be overcome in working out the design, there is nothing whatever, either in the general arrangement or in the detail, which is not perfectly simple and straightforward, and every part is easily accessible. The engine is well proportioned, and all the wearing surfaces have been made amply sufficient. The slide valves are placed below the cylinders, an arrangement introduced upon the Manchester, Sheffield, and Lincolnshire Railway—then the Manchester and Sheffield—over forty years ago. The engines are fitted with steam reversing gear, as originally introduced by Mr. James Stirling. The following are the principal dimensions:—

Gauge of railway	4ft. 8½in.
Cylinders, inside	21in. diameter by 26in. stroke
Wheels, ten in number, six coupled, four in bogie.	
Wheels, leading	4ft. 7in. diameter } coupled.
Wheels, driving	4ft. 7in. " } coupled.
Wheels, trailing	4ft. 7in. " } coupled.
Wheels, bogie	3ft. diameter
Boiler	14ft. 3in. long by 4ft. 7in. diameter
Tubes, 199	2in. outside diameter
Copper fire-box, 6ft. long by 3ft. 6in. wide at bottom by 6ft. 4in. high at front by 5ft. 7½in. high at back.	
Heating surface, tubes	1516·22 square feet
Heating surface, fire-box	118·00 " "
Total	1634·22 " "
Area of fire-grate	21 " "
Tractive power equal to 208·5 lb. per pound cylinder pressure.	
Working boiler pressure 150 lb. per square inch.	
Water tank (condensing) contains 1250 gallons with 8in. air space.	
Fuel space	97 cubic feet

Weight in working condition and full water and coal tanks—

	tons.	qrs.	cwt.
On leading wheels	16	16	3
On driving wheels	17	10	0
On trailing wheels	17	5	0
On bogie, on the four wheels	16	5	2
Total	67	17	1
Quite empty	54	9	3

THE PATENT LAWS.—The President of the Board of Trade—Mr. Mundella—has re-appointed the Committee instituted by his predecessor—Mr. Stanhope—to inquire into the working of the Patent Laws, and has requested Baron Henry de Worms, M.P., to continue to act as chairman. Sir R. Webster, Q.C., M.P., will take the place of Lord Herschell, and Mr. Acland, the present Secretary to the Board of Trade, and Sir B. Samuelson, M.P., will be added to the Committee.

LETTERS TO THE EDITOR.

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

THE VYRNWY MASONRY DAM.

Sir,—In your article "On the Vyrnwy Masonry Dam" there are several serious inaccuracies, of which two are contained in the following paragraph:—"It appears that some agreement was made between Mr. Deacon and some of the Council which enabled him to disregard Mr. Hawksley's wishes."

The only agreement entered into between the Corporation of Liverpool and myself—and under which I was appointed "engineer in conjunction with" Mr. Hawksley—was ratified by the City Council—at the same sitting as the agreement with Mr. Hawksley—on the 2nd of March, 1881. Its terms were published in the daily papers, and were perfectly well-known to those concerned.

Whether I had, or had not, the power to do so, it would certainly never have occurred to me to disregard the wishes of an engineer so much my senior in years, and for whose professional and scientific attainments I have always had a profound respect.

Liverpool, February 17th. George F. Deacon.

LONDON SEWAGE.

Sir,—I notice in your article comparing the Canvey Island scheme with the chemical operations intended to be continued at Crossness by the Metropolitan Board of Works, that you have left out of consideration the disposal or removal of the sludge by the Board, and do not refer to the main feature of the Canvey Island scheme, which disposes of and utilises the sludge by depositing it on the low-lying surface of the island—6ft. below high tide—without any manipulation or removal of any kind, with the advantage of raising the surface, so that in 100 years it will be above tide instead of below it, and present the capability of being still further raised, to no very formidable height, for another 100 years to come without any possible nuisance. Moreover, the purification of the liquid sewage after the solid portion has been separated from it by deposition may just as easily be performed as its clarification on the island by intermittent filtration through soil. At the same time, the whole length of the Thames from Blackwall downwards will be relieved of the sewage, liquid and solid, now finding its way into it from Crossness, Barking, and the valley of the Lea. That Canvey Island possesses the capabilities Colonel Jones and I so earnestly claim for it we are most anxious to prove, by placing the plans and details before any independent competent authority mutually agreed upon; and as you and others concede to the colonel and myself some knowledge of the subject, we naturally ask, Why does the Metropolitan Board reject the information they may obtain by such a proceeding? I pledge myself as a member of the Institution of Civil Engineers of forty-four years' standing, that the information shall be worth having. I hope that it may lead the advocates of the chemical experimental works to reconsider the whole matter, and yield to the influence of sound economy.

One of the public advantages attending the Canvey Island scheme, though an incidental one, would be that, as the permanent works required for the separation of the solid portions of the sewage from the liquid would be for the most part earthen, consisting of operations of which the material will be mother earth, it would afford an opportunity for the employment of labourers now unemployed in London and the neighbourhood. I speak from experience gained during the time of the cotton famine, when the operatives of Lancashire and Cheshire found work to some extent in drainage and roadmaking.

J. Bailey Denton.

22, Whitehall-place, London, S.W., February 11th.

Sir,—Your journal of the 5th instant contains—page 108—a most valuable article on "The Canvey Island Scheme and the Metropolitan Board," regarding which, as an interested party, I should be glad to effer a few remarks. The internal evidence of semi-official origin contained in that article is the feature which makes it most valuable, and I desire to endorse its concluding remarks, which express a hope that the reticence hitherto observed by the Board and its officials may soon cease, and the statement that "something may be said for the skill and courage brought to bear" by the latter in support of a manifest predilection of certain members of the Board in favour of half-measures. These half-measures are opposed to the clear and definite conclusions which were arrived at by an exceptionally competent tribunal after full consideration of all the scientific evidence which, with the aid of counsel and all its great resources, the Board had ample opportunity of urging during a protracted inquiry by the Royal Commission of which Lord Bramwell was chairman.

It is the duty of Sir Joseph Bazalgette and Mr. Dibden, as officers of the Board, to consult the wishes and to carry out the policy of their employers, without concerning themselves as to remote consequences of such policy, the responsibility for which must, of course, rest with the Board of Works in its corporate capacity; and I desire especially to add my testimony to the skill and courage displayed by those gentlemen in discharging the duties of their respective offices.

You also deserve credit for clearly stating a comparison between the plans of the Board and the Canvey Island scheme from the point of view hitherto adopted by the Metropolitan Board; but it remains for me to take some exception to that point of view, and to show, if I can, that the picture has been distorted by the lens thus applied.

In the first place credit is taken on the Board's behalf as follows: "The figures available, we believe, are maximum figures, and the actual expenditure will be less. In other words, we may look for an amended estimate, in which the total will not be increased but diminished"—a very cheery observation, rather opposed to engineering experience, the benefit of which is not extended to the Canvey Island estimates, prepared many months before any figures had been given by the Board. Without for the moment contesting Sir Joseph Bazalgette's estimate of the daily volume of sewage to be treated—here given at 156,500,000 gals.—the fact remains that 200,000,000 gals., or nearly one-third greater volume, was stated to have formed the basis of the calculation for Canvey Island, which, nevertheless, is compared in your article with the Board's calculation for treatment of the lesser quantity, and no allowance whatever is made for that disparity.

Again: "It is calculated that this quantity [156,500,000 gals.] can be sufficiently clarified at the outfalls, the sewage disposed of, and the effluent deprived of all odour during the summer months at a total capital expenditure of a little under £1,000,000"—without one word being added as to the probable cost of removal and final disposal of the sludge, which must be a necessary and expensive item of cost in any scheme for dealing with the sewage at the present outfalls as a permanent measure.

It must be obvious to the most cursory reader that the above points should have been remarked upon in any fair comparison between the two estimates; but there are a great many other considerations which must be taken into account before any correct judgment can be arrived at; and although my partner and I most earnestly desire to lay full details of our project before any competent authority in whom the Board may have confidence, to weigh our calculations against any complete estimates which their officials may prepare for treatment of the sewage at the present outfalls, we must decline to be judged on any other terms after the above example of the erroneous conclusions which may otherwise be put forth. In making this statement we would guard against any supposition that we seek anything like arbitration between the Board and ourselves. We should not think of such a proposal, as any results must, of course, rest with the Board, whom we merely ask to obtain a report, for their own information, from some independent party who can satisfy himself by full inquiry.

Your article correctly quotes a strong statement made by us to members of the Board, to the effect that, if the expenditure involved in the chemical treatment of the sewage and the removal of the sludge to sea were compared with the outlay directly and indirectly attending the treatment of the sewage as a permanent measure on Canvey Island, it would be found that the former plan would cost the ratepayers at least double the outlay which would be incurred by the latter; but the article proceeds to take our proposed subsidy—of £110,000 a year—as the cost of such treatment, which is hardly correct, because in the letter from which that quotation is made there was no question of subsidy, but only of purchase of the island and compliance by the Board itself with the recommendations of the Royal Commission, while in return for the subsidy previously proposed we, as the article remarks, undertook to perform works which, however desirable, were still works of supererogation. I do not complain of your having overlooked this distinction, but in a matter of such importance it was necessary for us to weigh our words very carefully, and we are prepared to stand by them.

It does, as you say, "seem inconceivable that the Metropolitan Board should adopt a mode of dealing with the sewage costing twice as much as another plan, concerning which there is fair reason to believe that it is perfectly practicable;" and when it further appears that the cheaper plan would, once for all, free the Thames from Blackwall downwards throughout the year from the sewage at present poured into it, while the costlier one would, on the Board's own showing, continue the whole discharge of liquid sewage day by day, and deodorise—with questionable success—that liquid during the summer months only, such a course must indeed become incomprehensible; since the cheaper plan would afford the Board an unanswerable refutation for any complaints which may hereafter arise from difference of opinion as to summer deodorisation or assumed innocuousness of the liquid at other seasons, or from accidents which may occur under the best possible management.

In conclusion, I must notice a very important point for immediate consideration, and that is that the £1,000,000 capital proposed to be expended on works at present outfalls will—in the event of its being hereafter found necessary to extend the sewer for discharge of the liquid effluent below Hole Haven—be wasted, because, having constructed the sewer, it must manifestly be more economical to let the sludge float down that sewer with the liquid than to pay for its freight in steam barges for the same distance; and I state this thus clearly, because the contrary has been casually assumed in your article, without touching on the question of freight *versus* flotation, and simply on the ground that the Royal Commissioners left it an open question whether the precipitation should take place at the present outfalls or at a new one.

Wrexham, February 15th. Alfred S. Jones.

GOOD AND BAD CHAINS.

Sir,—My attention has been called to an article which appeared in the *Birmingham Gazette* of Tuesday, the 2nd inst., taken from The Engineer, on the subject of good and bad chains. As a practical chainmaker, and having had a wide experience, not only in the making, but in superintending the making and testing of chains, I regret to say that your remarks, although severe, are not near strong enough to condemn the iniquitous system carried on in the chain trade. There are few trades on which the safety of so many lives depend as the chain and anchor trade; and yet there is no trade, so far as I know, wherein so much fraud is practised. There are thousands of test certificates sent out with chains and anchors that have never been near a testing machine. In fact, I myself have signed thousands. I should not make this confession—incriminating myself as it does—only that I know the risks that poor men run in mines, and on board ships at sea, believing, as they do, that their cables and anchors are reliable, since they hold a certificate that they have been tested, which certificate, in nine cases out of ten, is not worth the paper on which it is written. I wrote to Mr. Chamberlain on this subject, when he was President of the Board of Trade. I also wrote to the secretary of the Commission on Loss of Life at Sea, tendering my evidence, which I believe would show that a great proportion of lives lost at sea are due to the abominable system carried on in the chain and anchor trades; but to speak frankly, I do not believe the Commission want any evidence that would tell against the shipowners, many of whom are buying rubbish called chain which will scarce bear its own weight, much less Lloyd's test. A good deal of the chains so sold are made by inexperienced persons who have been brought up in other trades, who undermine legitimate and practical workmen, and drive them out of the trade; for the skilled workman is expected to work at the same price as the scrap-maker—which he in many cases declines to do, and seeks employment in other fields of labour. I have little faith that the Royal Commission will ever do any good in the matter; but if the general public can be let to see what is going on, Parliament will soon have to take up Mr. Chamberlain's, or some other such measure, to protect the lives of our sailors.

I enclose my name and address, but for various reasons I do not want it made public. If you think it worth while to publish this letter, I will, with your permission, write again at an early date, and give further information. Valentine.

Brierley Hill, February 12th.

Sir,—We noticed the advertisement in your issue of January 22nd, and your comments thereon; and also Messrs. N. Hingley and Sons' letter in your issue of February 12th, which, in our opinion, hardly strikes at the root of the evil. In former years, before the passing of the "Chain Cables and Anchors Acts," buyers of cables and anchors were careful before giving out their orders to ascertain that the people in whose hands they were placed were competent to execute them properly, consequently the manufacturer's character was at stake; but now there are dozens of men in Worcestershire who call themselves cable and anchor manufacturers who are not one whit entitled to the title. It is only necessary for a man to have a shop and a few fires in it now to dub himself a cable and anchor manufacturer, and he at once advertises himself as such, and takes any orders that come in his way, and will not scruple for one moment to undertake to make them of any iron his customer may name, or, what is worse, guarantee the iron he uses equal to any brand in existence, when, at the same time, he will use an iron which in the market is only worth about one-half the price of that he guarantees it equal to, and it is against such opponents that we have now to compete. In our opinion the evil can, to a very great extent, be remedied, so far as this country is concerned—first by the parties who use the chains taking care to ascertain by whom they are made. And this to a great extent is done by those who employ them on land since the passing of the Employers' Liability Act, but until those who employ chains, &c., on the water are liable under the same Act there will not be much good done in that direction. We certainly cannot see why one employer of labour should be exempt and another not. Ships are built by the ton, including the chain cables and anchors; consequently in most cases it is a question of price simply. We may here say that on one occasion, when trying to induce a customer to take an extra quality, his reply was, "You can make the chains of wood if you like; all we require is a Board of Trade certificate as to their having passed the proof." Under these circumstances we do not see much chance of help in this direction, but Lloyd's and the Board of Trade can do a good deal. Let all users of chain be placed under the Employers' Liability Act, this will go a great way; then let the Board of Trade license all private machines as they did some years ago, and make it a misdemeanour to issue a certificate for any chain not proved in such a machine. Such machines should be examined annually by the Board of Trade engineer as to their efficiency. The fees would pay all the expenses. Then Lloyd's, before re-classing a vessel, should insist upon the cables and anchors being re-tested.

At present, when a cable has once passed the test and got a certificate, it is a cable for ever; and in some instances where a length is lost it is replaced by another, and still the cable is passed in its entirety under the original certificate. We ourselves know an instance where a part of a cable simply "private proof" was passed by Lloyd's surveyor under a public proof certificate. It is impossible for a Lloyd's surveyor, or any other man, to identify a cable in its entirety with the original certificate after it has been at work for some years, without the most minute examination, which it cannot undergo on board a ship, and more especially detect any defects that may have arisen during its work. We, and most of our customers, including railway companies, who use chains for cranes, have them taken off at certain dates and examined, and if necessary, repaired, annealed, and re-proved; and we think it quite as necessary, if not more so, to subject cables and anchors used on ships to the same examination periodically, more especially as in one case, if an accident occurs, it is probable that injury to limb may only occur, whereas in the other, where a cable fails, the loss of life and property cannot be calculated, and we have no hesitation in stating that numberless cables and anchors would utterly fail if re-tested after having been at work a time.

Now, as a proof of what is being done in the cable trade at the present time, cables are being sold, guaranteed to pass the Board of Trade test, including the freight to Liverpool and other ports, at a less price than our iron costs to begin with. This, we think, speaks for itself. We endorse all Messrs. N. Hingley and Sons' remarks generally as to different qualities of iron being used in the same chain to deceive, and as to false certificates; and especially we agree with them that Mr. Traill, the chief engineer of the Board of Trade, has done a vast amount towards the improvement in the make of cables, chains, and anchors; but if he had the power which he ought to have, he would do a vast deal more.

Henry P. Parkes and Co.

Tipton Green Chain and Anchor Works, Tipton, Staffordshire, February 17th.

Sir,—Having been a constant reader of your paper for about twenty-six years, I take the liberty of asking for a little information regarding brands of iron bars, plates, sheets, &c., as I find a difficulty in procuring the brands I require—or, rather, the iron is properly branded, but the quality is not what it should be. I think that this is a question which, if ventilated in your paper, would interest a great many business men situated like myself.

A few weeks ago I ordered some "B B Crown galvanised charcoal sheets," expecting to receive sheets that would work fairly well, but when the sheets came to hand I found them useless for my purpose, as they broke when bent. On inquiry at the merchants they informed me that it was my error, that "B B Crown sheets were an anomaly," no such brand being known in the market, and also informed me that the word "Crown" represented an iron which had no variations of quality such as best or best best, and this has placed me in an awkward position, as on looking over my stock I find iron plates from two different firms branded "Best Best Crown." If the opinion quoted is correct, these brands must be forgeries. Will any reader therefore kindly say if there is such an iron in the market as "Best Best Crown?" S. A.

February 11th.

PETROLEUM LAMPS.

Sir,—There are one or two points in your article on petroleum lamps that call for notice, especially one of the recommendations—the use of glass reservoirs, which is directly contrary to Sir F. Abel's recently published report. There is a burner about with the central air tube through the reservoir, but it is one of the longest, and therefore does not meet your contributor's views; and there is at least one burner which will burn at its maximum power as long as its oil supply lasts, but the ordinary servant cannot be induced to keep it or leave it in trim. I certainly should not have guessed that more attention had been paid to the appearance than to the efficiency of burners, judging by results, for they are one and all ugly enough. I have tried a great many sorts, and most of them will perform fairly with fair usage, which they rarely get. As to reducing the capacity of the reservoirs to four or five hours' supply, I cannot say I like the idea, and I am sure they will not sell. Between difficulties of invention and difficulties of trade, I am not sanguine of seeing the perfect burner; still less am I sanguine of being able to sell it if it comes.

London, February 13th. A Candlestick Maker.

FAIR TRADE AND NO TRADE.

Sir,—I would gladly take "Trader's" verification as final, and spare your columns and my own time; but he verifies nothing.

The first statement he is asked to verify is that we pay for our German imports with "English gold." I have said that we do nothing of the sort, for there is practically no export of English gold, but that we pay for them either (1) by English goods, or (2) by services rendered by our mercantile marine or by other English workers abroad, or (3) that we do not pay for them at all, but receive them as interest on English investments in foreign countries. If we do not pay for them in any of these ways I am afraid we must steal them, for we do not pay for them in gold.

If official returns can establish any fact, such as the amount of German imports, they can and do establish this one about the gold. But "Trader" is not abashed by a fact, however unfriendly, and he has much to say to the contrary—which shall be dealt with presently. Let it be understood that this gold export question is the centre and kernel of the matter, as the Fair-Traders usually present it. No one denies that we import much more value than we export, and if the difference were paid in gold then we should grow continually poorer in that commodity, and, having regard to its purchasing power and not to its intrinsic utility, which is small, we should be rapidly impoverished. But if we do not pay for our excess imports in either goods or in gold, I cannot conceive any conclusion except that they are either given to us, or lent to us, or sent to us as tribute of some kind. In neither case can their importation make us any poorer. The Fair-Trader, therefore, does well to insist that we are paying away gold, for on no other assumption has he the shadow of a case for his complaints against the preponderance of imports. But let it be recognised, when this assumption is destroyed, that his case is destroyed with it.

Waiving the positive evidence of the returns—one might as well waive the multiplication table, but "Trader" must be conceded something, or there will be not even a ghost to dispute with—one might think that the daily facts of life would dispose of this delusion. Ask any banker if he does not know, almost to a thousand pounds, what money, in the sense of gold or silver, is imported or exported in any month. Ask him if he thinks there is materially less gold in the country than formerly. Ask him if he thinks we sent away £161,000,000 in 1885, or £61,000,000 either—for "Trader's" figures are ambiguous. "Trader" says, indeed, that he has the best possible reasons for knowing that the German steel castings to which he referred were paid for in English gold—a commercial transaction pretty nearly unique, one might think. Did "Trader" really see the bag with the sovereigns in it that actually crossed the Channel? Remember that this is no unfair question. Cheques may be sent, bankers' drafts, bills of exchange—even bank notes—any of the things other than gold, which loose reasoners call money. But not one of these need involve the export of a single sovereign; they can all be, and they are, liquidated in goods. the ultimate effect being that Englishman A's bill is held by Englishman B, because A has imported goods from, and B has exported goods to, the German C, who has sent back to B the bill he received from A. I am aware that the operations of banking complicate this result a little, but substantially it is as stated.

If common experience—still waiving the returns—tells us that gold is not exported, common sense will tell us that there is no reason for exporting it. Surely it is obvious that other countries must send us more goods than we send them. In the first place we boast that we do the carrying trade of the world. Many millions a year must be received from foreigners for freight, over and above what is disbursed by shipowners in foreign parts. All this has to be remitted to England, and since we know it does not come in bullion—even "Trader" will allow that, for the bullion all moves outward according to him—it must necessarily come in goods. It is notorious that vast sums have been invested by English capitalists abroad, in foreign loans, in public companies, and in other enterprises, and the interest upon these investments has to be remitted here—in goods, of course. Every English commercial house which has branches abroad, earning profits and sending them home, must swell the import of unpaid-for goods. Every colonist remitting to his friends at home does the same. It has been said lately that the Irish in America remit to Ireland about eight million pounds a year. If the statement is true, let "Trader" remember that this comes in goods, for though the senders buy and remit drafts, money orders, and the like, their gold itself stops on the other side. It is exceedingly difficult to estimate the amount remitted in all these ways, but there is reason to believe that it fully equals the "balance against us," which so alarms "Trader" and those like-minded with him, when some necessary deductions to be presently considered have been made from the "balance."

We have thus common experience to tell us that we are not sending away gold to pay for such imports as are not balanced by by exports, and common sense to tell us that a large importation of goods not requiring to be paid for either by goods or by gold is exactly what might be expected. However, let us examine the reasoning by which experience is corrected and common sense proved wrong, and by which "Trader," reponsive to my challenge, "verifies" his statement that "we pay for what we import, not in goods made at home, but in money."

"Will 'M. H. R.,'" he asks, "explain how it is that the value of what we import enormously exceeds the value of what we export?" Well, I have just done that, and it has often been done before. Then he shows that in 1884 we imported from certain countries to the value of £78,000,000, to which we exported only £33,000,000, and he asks if the imports "acquired value while they were at sea." Yes, they did, conspicuously. The £78,000,000 is their value in the English market—that is, it includes the cost of bringing them here—in English ships for the most part—and the English importers' profit. It would be instructive to see the official returns of the foreign countries concerned. The £78,000,000 exported to us must there appear as a much more modest figure, while our £33,000,000 is swelled by the cost of freight and the foreign importers' profit to something which much more nearly balances the account. Says "Trader," "I must really ask 'M. H. R.' to occupy a scrap of his time in explaining this puzzle to me." But his next sentence gives the answer,—"It may be answered that the difference is represented by interest on British capital lent," &c., and he goes on to say, "but to concede this is to concede exactly that which I assert, namely, that British capital is, under the operation of Free Trade policy, finding employment for the foreigner instead of for the Englishman." I wish to call particular attention to this, as it will require further notice.

"Trader" does not say that he accepts the answer he quotes, but through the remainder of his letter there is little more to be found in avowed support of the gold payment fallacy. In the next paragraph, it is true, he nibbles at it again: "Thus in a single month we received goods worth ostensibly £8,000,000 in excess of the value of the goods which, according to 'M. H. R.,' paid for them," and he graciously adds that "'M. H. R.'s' contention is simply fatuous." But "M. H. R." contended for nothing of the kind. He said the balance was not paid for, and did not need to be paid for, by goods or by anything else; and—considering the reduction to which the £8,000,000 is subject for freight and for importers' profits—he regards the smallness of that month's tribute from foreign countries with astonishment, and even with regret.

Then "Trader" shows how imports and exports both fell off between January, 1885, and January, 1886:

	Imports.	Exports.
	£	£
January, 1885	35,669,000	21,875,527
January, 1886	28,983,000	20,693,890
Diminution	6,686,000	1,181,637

and he asks how I like this? I do not like it at all, because the story it tells is of a diminished volume of trade—very possibly diminished because in previous years the volume of trade was excessive and artificial, but none the less disastrous in its immediate effects. But it is worth while to point out that the diminution is chiefly in imports, which are such noxious things in "Trader's" eyes, and therefore it ought to leave us so much the richer in gold from his point of view. Relatively, the exports have increased, and if this month is not altogether peculiar, the probable explanation is that recently the investments of British capital abroad have increased. Capital invested abroad must go there, like all other remittances, in goods. The great years of the "leaps and bounds," the years of great exports, were the years of great foreign investments, when our capitalists lent hundreds of millions to foreign countries virtually to enable them to buy goods from us; in other words, sent out goods on credit, though it was one set of capitalists who found the money, and another set who made the goods and got paid for them. In those days we overstocked ourselves alike with works and with men, not recognising the temporary character of the foreign demand we ourselves had created, and now we pay the penalty. But the diminished exports of recent years show that British capital has not been going out of the country to any great extent, and if it begins to go now, its departure will be the result of many years of restricted trade, and not the cause of it.

But this is a digression, which I hope to follow up another time. I can only now follow "Trader" to his next paragraph, where the gold payment fallacy lifts its head again. "The hostile tariffs of Germany, France, &c., are specially intended to prevent us from paying with goods for goods received." I greatly doubt it. Bismarck is not quite blind. Still, he has tried mopping the Atlantic once or twice, and the "Culturkampf" is but just over—not a success—so he may have laid traps for English gold, but his doing so must really not be brought forward as an argument that he has obtained it, in the face of ample evidence to the contrary.

Then in his last paragraph but one "Trader" speaks of a landowner drawing his rents "in gold or its equivalent. Under Protection he will spend that gold in employing the labour of his fellow-countrymen to produce from raw materials what he requires, but under Free Trade he employs foreign workmen to labour for him." This, of course, is not an argument for the gold export theory, but a statement based upon its supposed truth, and so must be noticed here. Well, the supposed truth is not a truth, as we have seen. The landowner—whose rent, so far as this argument is concerned, might just as well be paid in wheat as in gold—no doubt buys many foreign manufactures. He pays for them by a cheque on his banker, given to the English importer. It is a thousand chances to one that the cheque is never paid in gold, or even in notes; it is simply set off, through the Clearing House, against cheques upon other banks, which the banker holds. The importer, either directly or indirectly, pays for his foreign goods by English ones, which English workmen have been employed to make. The fantastic assumption that he will pay his debt by exporting pig iron, in which labour counts for little, may be ignored until "Trader" gives figures from the Board of Trade returns to show that, comparatively, raw materials are the type of our exports, and highly-finished goods the types of our imports! Pending this, we need have no fear that the landowner, in buying foreign goods, does much harm to the workmen of his own country.

We know what "Trader" set out to verify; yet after having noticed every reference he makes to the gold-export doctrine, I feel justified in saying that from first to last he has not adduced one argument, good or bad, properly to be called so, in support of it, and I feel pretty well satisfied he no longer believes in it, though the statement is repeated once or twice, and is hinted at oftener. Interwoven with these assertions and hints, and suffering from the mixture, is a line of argument—as I will admit it to be, until I am able to examine it—directed to show that a protective tariff would give more work to our people, and that they are injured by the investment of British capital abroad. These matters, on their own merits, are well worth discussing, and if "Trader" will consent to separate his two issues, I shall be glad to discuss things further with him, though space forbids my taking up the second branch now. But if the assertion that we pay for our excess imports in gold, and so are becoming impoverished, is to be kept up, I must decline further argument. At any rate, I would wish to deal with it separately, and with a view to coming to agreement upon it before embarking on the other and more important discussion. It is with the hope of effecting this preliminary clearance of a fallacy which ruins any argument in which it finds place, that I have written so fully now. Postponement of "Trader's" second "verification" does not imply any lack of disagreement with it; but I do at least admit that his position is not there so transparently fallacious as when he explains and draws inferences from an export of gold which never takes place. M. H. R.

Surbiton, February 16th.

SIR,—I have read with interest the correspondence in your paper under the above heading, and, with your permission, will put a question to "Trader" on the subject.

	£
Suppose that I export goods to the value of	1,000
On which the freight is, say, £100, and that I realise a profit on them of, say, £100	200
Making the total for which they are sold abroad ...	1,200
For which my agent ships in return goods of the same value	1,200
On which freight home and my profit are as before...	200
Making the amount realised here	1,400
Or, to extend these figures on the basis of the amount of exports named in "Trader's" letter, viz., exports	213,000,000
While the amount realised from the goods shipped in return would be	298,200,000
Showing by the Board of Trade returns an excess of imports over exports of	85,200,000

Is it "Trader's" contention that this sum of £85,200,000 is a balance against or so much dead loss to this country? IRON.

February 15th.

SIR,—A "Trader" has to allow in comparing our exports and imports (1) for the cost of carriage of both, because England being chief carrier has to be paid somehow for the cost of carriage, and this payment figures in the imports; (2) for the profit on the trade; (3) for interest on loans and investments and remittances from the Colonies. All this was worked out by Mr. J. K. Cross in a speech which is, I believe, published by the Cobden Club, with some very curious results. To conclude, I will propose to "A Trader" this conundrum:—Let him take a manual of political geography and cast up the figures which are given for the exports of all the countries in the world, and then those which are given for the imports, and he will, I believe, find as I did when a schoolboy, that the latter largely exceed the former. How is this? Has the earth a cosmical trade, and can it be regulated by a tax on sunbeams and meteorites? W. A. S. B.

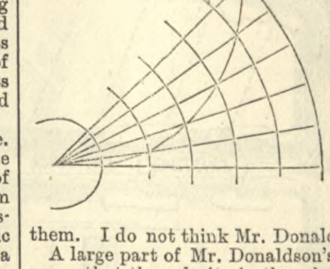
2, Gordon-place, Camden-grove, W., Feb. 13th.

REACTION WHEELS.

SIR,—Mr. Donaldson has got himself into a beautiful muddle. "The exuberance of his own verbosity" has carried him into regions where common sense is absent.

It hardly seems possible, yet so it is, that your correspondent does not know that angular velocity may be expressed in units such as an inch or a foot, as well as in degrees, minutes, and seconds. He has only to look into any text-book to find proof of this truth. Rankine's name seems to play the part of the proverbial red rag to your correspondent, yet I beg him to turn to page 3 of "The Steam Engine and other Prime Movers," and read the section on "Work in Terms of Angular Velocity." He will find that my use of the phrase is perfectly justifiable.

As Mr. Donaldson does not seem to be able to construct a curve for himself, I have done it for him. Possibly Mr. Donaldson will find errors in this, but they are due to the small scale of the diagram. If the curved arm has the same section all through—about which there is no practical difficulty—then to return to the example I have already used, namely, a wheel $38\frac{1}{4}$in. in diameter and 10ft. in circumference, while a molecule of water is traversing $\frac{38\frac{1}{4}}{2} = 19\frac{1}{16}$in. the orifice will have passed through the same distance, or roughly, one-sixth of a revolution. Describe a circle to any scale with a radius equivalent to $19\frac{1}{16}$in. Lay off on it two points $19\frac{1}{16}$in. apart; divide this space into as many aliquot parts as may be deemed desirable, and from each of these to the centre of the circle draw a line. Then describe an equal number of circles within the primary circle, and the curve can then be put in, passing through the points where the circles cut the successive radii.



I am sorry Mr. Donaldson fails to understand the figures in my last letter. It is quicker work to begin all over again, as I have done to make my meaning clear, than to explain them. I do not think Mr. Donaldson can be in doubt *now*.

A large part of Mr. Donaldson's letter is taken up by trying to prove that the velocity in the wheel will not be that at the orifice, and he ingeniously constructs hypothetical conditions, setting up ninepins to knock them down. Of course it is quite possible to construct a wheel in such a way that the curved arm would be a spiral, running round and round the central axis several times, and I believe that wheels have been so made, although I never saw one. My statements apply to wheels in which the velocity is constant or nearly so through the wheel, because such wheels will give a better result than those in which it is variable. But a considerable reduction in water velocity is allowable without in any way preventing the use of a curved arm. The length of the arm may be anything so long as it does not cover more than 180 deg.

In such a drum as that which I have sketched it is open to doubt that the water acquires a motion of rotation. I know it does not in glass models of Barker's mill, as far as the central tube is concerned. It is very difficult to impart rotation to water in a smooth vessel.

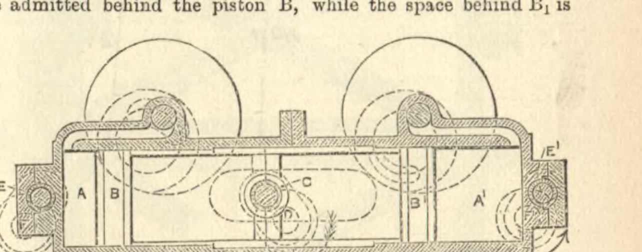
Mr. Donaldson is well known as holding a unique position concerning turbines. He maintains that in all cases their efficiency has been very much overrated. This view is based solely on mathematical reasoning, I believe. That is to say, he assumes certain things to be true which other engineers maintain are not true. There is on record a very large number of particulars of experiments made with turbines, both in this country and the United States. For example, I may cite the famous Lowell experiments. These results flatly contradict Mr. Donaldson. I venture now to ask him to give particulars of experiments which he has personally carried out, the results of which substantiate his theory. If that theory be sound there must be facts to prove its soundness. So far as I am aware, Mr. Donaldson has never yet cited any experiment made by himself which supports his views, save those which he carried out at Reading with turbines—Professor Thomson's—used in pumping and working on a fall of at most 3ft. 9in., and now and then drowned by back-water. These turbines were never tested on the brake. Mr. Donaldson, however, in his book—1876 edition—gives their efficiency, based on an estimate of the efficiency of the pumps, as somewhere between ·48 and ·42. It seems unlikely that so many engineers should be wrong and Mr. Donaldson right, so I hope he will do what I ask and give some practical data to prove that his statements have a solid basis to rest on outside his own brain.

Aberdare, February 15th. PYNE GRYPH.

ROTARY ENGINES.

SIR,—I have read with great interest the articles on "Rotary Engines," recently published in your paper, and judging from them it would appear that, with the exception of the steam turbines—which are not pressure engines properly so-called—a true rotary engine, that is to say an engine in which all the moving parts revolve at a uniform velocity, so that there is no alternate acceleration and retardation of masses, has not yet been invented. I therefore venture to call your attention to the following device, which, if it is not new—and in that case perhaps some of your readers will kindly notice the fact—is, I think, at least worthy of mention as a truly rotary engine. To construct an engine consisting essentially of "an enclosed space whose volume is capable of being alternately enlarged and contracted," and in which all the parts move in circles at a uniform velocity, might at first sight appear to be as impossible as to make a point travel in a straight line and in a circle at one and the same time. It is, however, quite feasible.

In the annexed sketch A and A_1 are two cylinders firmly bolted together and resting on the two crank pins E and E_1. The two pistons B and B_1 are likewise rigidly connected together, and are carried in the middle by the crank pin C. The three cranks E F, C D, and E_1 F_1, are all of equal lengths, and the centres of the three shafts F, D, and F_1 are placed in one straight line, the shafts, of course, resting in suitable fixed bearings. If now steam be admitted behind the piston B, while the space behind B_1 is



communicating with the exhaust, then the pressure of the steam will force the cylinders towards the left and the pistons towards the right, with the result that the three cranks will turn in the direction indicated by the arrows, the centre crank turning in the opposite direction to the two end cranks. When the pistons have come to the end of the stroke, the centre lines of the cylinders, pistons, and cranks will pass through the centres of three shafts. The engine is here on its dead centre, and the inertia of the moving parts will have to take it past that position, when steam will be admitted behind the piston B_1, while the space behind the piston B is allowed to exhaust. The steam pressure will now force the cylinders towards the right, and the pistons towards the left, while the three cranks will continue turning in the same respective directions as before.

It will be easily seen that every point in the cylinders and the pistons describes a circle, with the radius equal to the length of the cranks, the motion being in fact the same as the motion of the coupling-rod in a locomotive, only that the direction of the turning on the part of the pistons is contrary to that on the part of the cylinders. How this would act as a practical machine is a different question. There is, for instance, the objection that the pressure on the crank pins due to centrifugal force would be considerable; it might also be difficult to prevent the pistons from resting on the cylinders instead of on the crank pin C, in which case the pressures on the crank pins due to centrifugal force would no longer be uniform during the stroke. But one important difficulty in connection with engines going with a high number of revolutions—namely, the alternate acceleration and retardation of the moving parts—appears here to be entirely overcome. H.

Glasgow, February 3rd.

GOOD AND BAD WORK.

SIR,—I have read with great interest your article on "Good and Bad Work." Good work, and by that I mean work which as far as quality of material, accuracy, and neatness of appearance goes is good, can be turned out for precisely the same amount of money as bad work. I have thoroughly sifted this question during the last year in my factory, and find this to be the result. The foreman of a shop which turns out bad work will generally be found to be either an ancient fossil or else devoid of energy or will power, or both together, and then it is a bad case. The consequence is, that the machine shop, instead of being organised on a system as on the Continent—I mean in departments, such as gauge-making, tool-making, and fitting—is simply a collection of workmen, some good, many bad, and devoid of all brain power or ordinary education. Where a proper system or organisation prevails in a machine shop no difficulty ought to be experienced, for when gauges are made to an approved model or drawing, and cutters and tools made to fit such gauges, the fitter's job should not be too hard, and with care and attention on the part of an ordinarily educated foreman the fittings should be successfully made. Unfortunately there is not enough education in the foreman class; a calculation, except by rule-of-thumb or guess is impossible to them, and it is thus that many parts, fittings, &c., intended to hold work and suffer wear, which should be of steel—which is cheap enough now—are made of cast iron. Take simply a vice for a milling machine. Many parts usually made of iron would be better in steel, for the wages spent on such parts are usually ten to forty times their value as regards material. Fittings and holders—I refer to lighter milling work—are not made nearly solid enough; better to approach clumsiness than otherwise. The remedy for the evil lies in education, and there should be a chance given to educate and train men for such posts as foremen and head fitters. In Germany notably the Government encourages technical education, and the "Gewerbeschule" is, I believe, free to any one paying rates and taxes. The foreman of to-day has to gather his experience anyhow, and it is just a foreman who should be young and active. Salary should never be a consideration, and in many shops it would be well to give the foreman a small interest in the concern. Organisation, as mentioned above, seems to be a vital point to English manufacturers. Factories with an intelligent organisation are holding their own against all competition, whilst on analysis it will be found that it is generally the slovenly ones that have to complain of bad trade. Order and organisation mean exercise of energy and will power directed by intelligence, and this is the key. I shall be pleased to see the discussion carried on, for the subject is of the highest importance, and would solve the whole problem of foreign competition at once, for the price of labour after all does not so much influence the cost of things as it has pleased some people to make out. A WORKER.

Birmingham, February 16th.

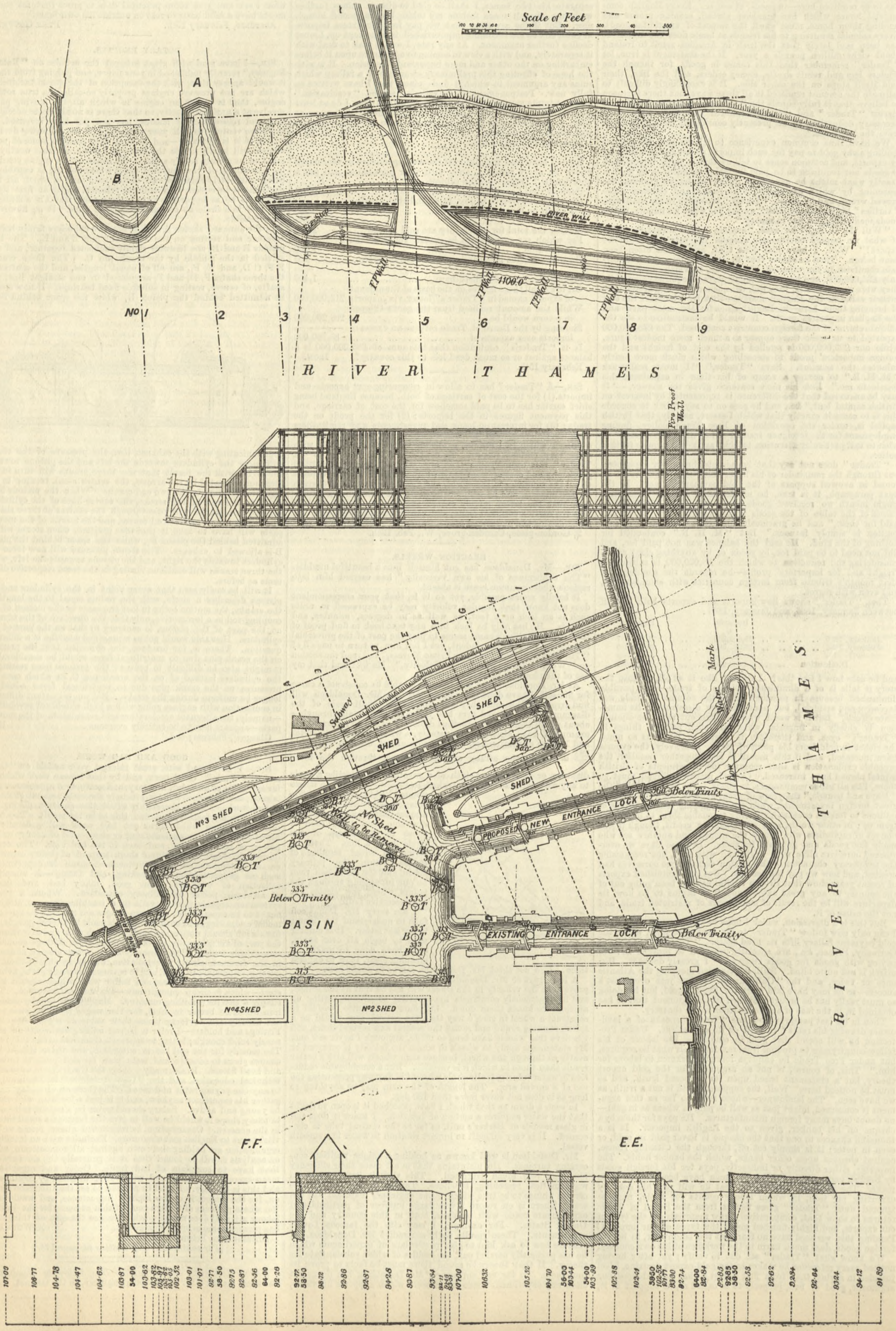
[*For continuation of Letters see page* 148.]

NAVAL ENGINEER APPOINTMENT.—The following appointme has been made:—W. G. Parsons, engineer, to the Gannet.

ROYAL ALBERT DOCKS EXTENSION WORKS.

MR. ROBERT CARR, M.I.C.E., ENGINEER.

(*For description see page 143.*)



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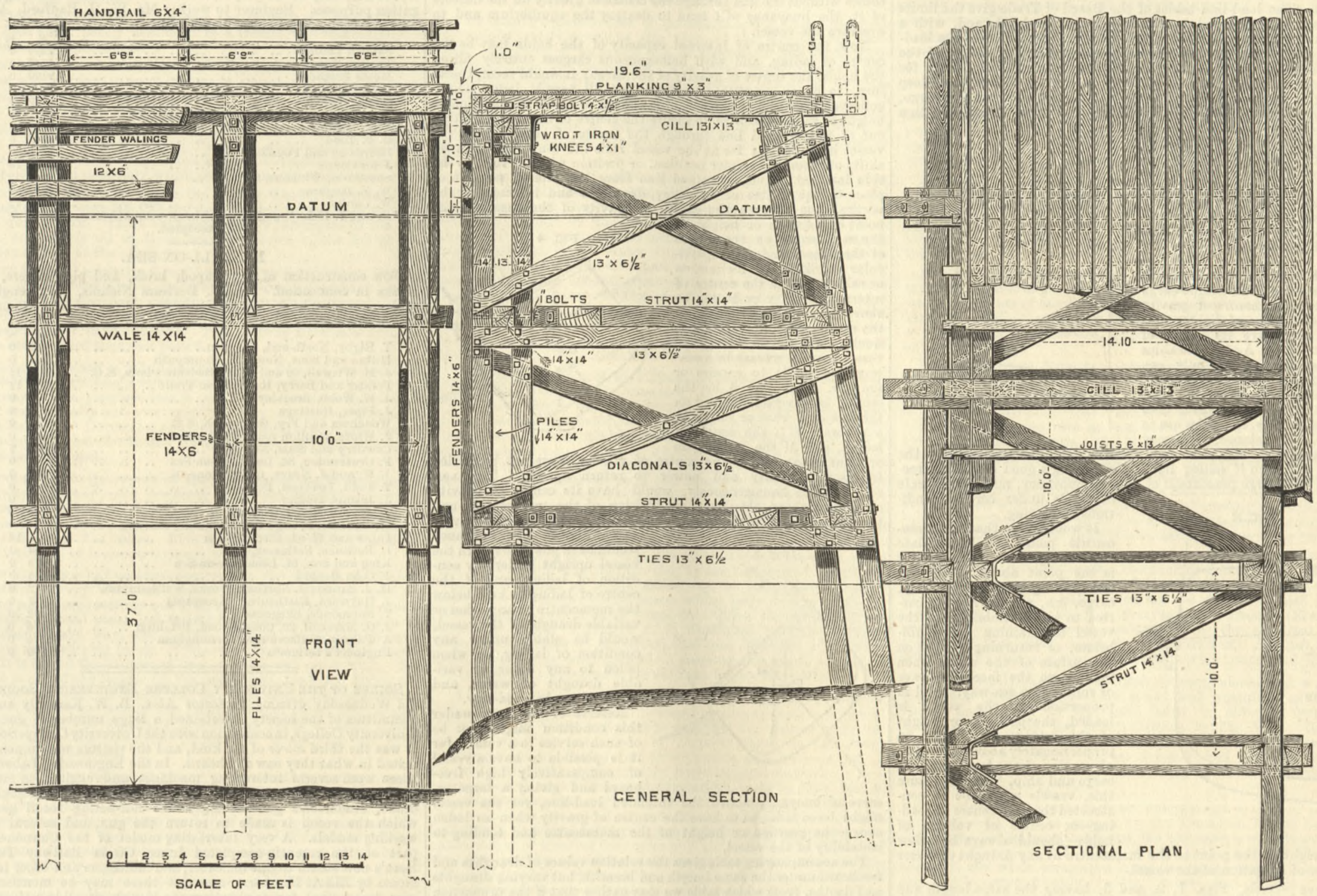
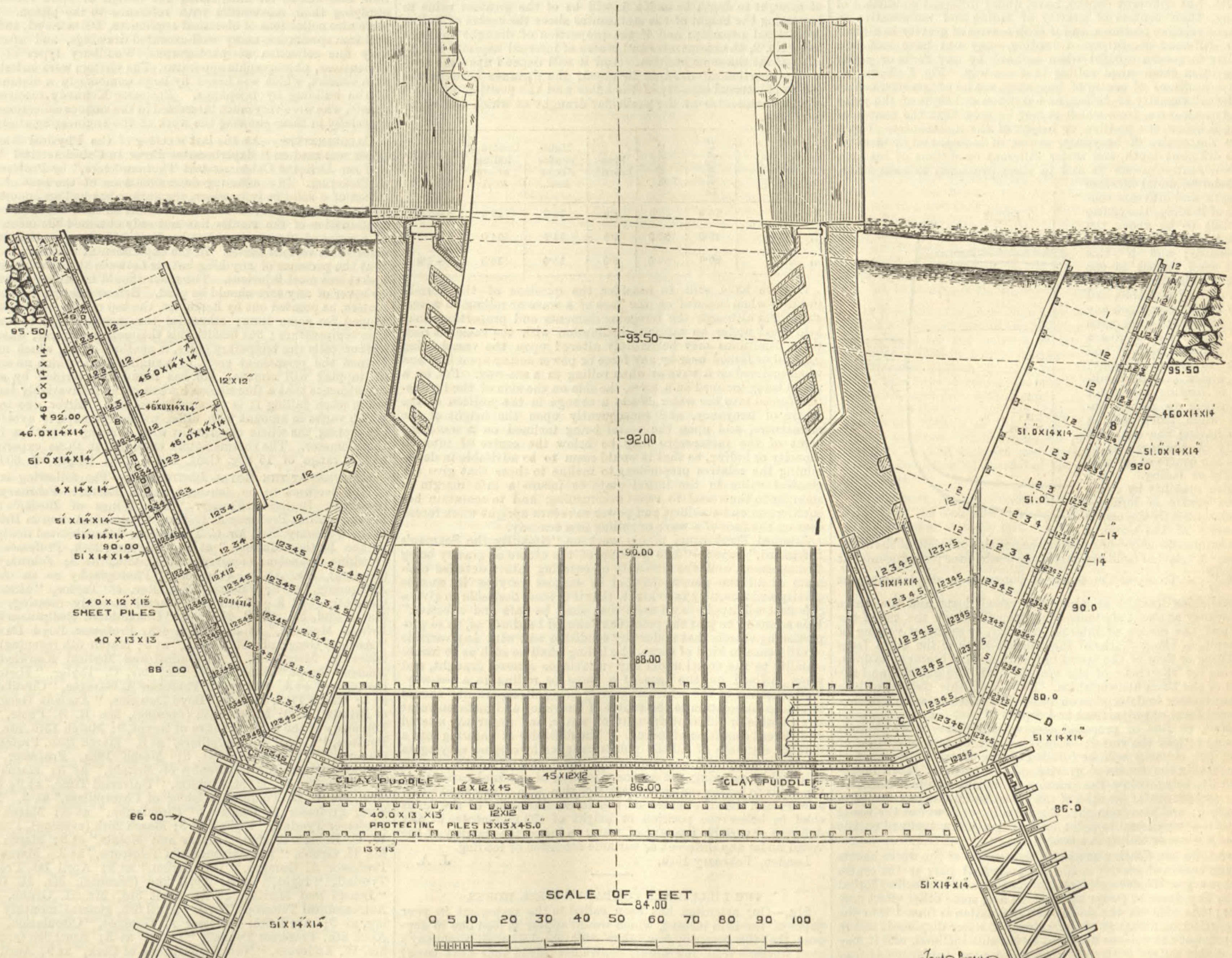




DETAIL OF TIMBER WHARFINGS SOLID ARMS OF JETTIES AND TIMBER COFFER DAM

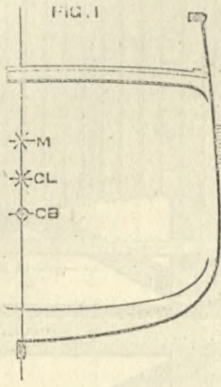
LETTERS TO THE EDITOR.

(*Continued from page* 145.)

THE STABILITY OF SHIPS UNDER DIFFERENT CONDITIONS OF LOADING.

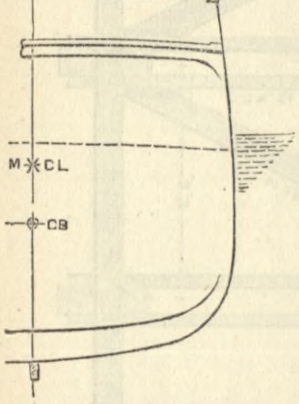
Sir,—The load-line tables of the Board of Trade give the limits a vessel may be loaded to with respect to the depth, and, with a certain percentage of reserve, buoyancy or freeboard over the load-line. But this does not determine the stability or safety of the vessel under different or variable conditions of loading; for although a vessel may be perfectly safe when loaded to a deep draught, having great bottom weight, with particular kind of cargo, the same vessel loaded to the same or a lesser draught, with a different or lighter kind of cargo, may not be stable although loaded to a draught allowed by the Board of Trade rules. And as vessels have to carry heavy dead-weight cargoes on one voyage, followed probably by cargoes of much lighter specific gravity on the next, the condition of loading might not be the same—as the heavier dead-weight cargo may have its centre of gravity low, the cargo of lighter gravity may have its centre of gravity high. And unless ships are constructed for only one sort or particular kind of cargo, this evidently must be; and under these conditions it does not seem how the rules are to apply. For instance, a ship may not be always loaded to her extreme load-line as given by the rules, and even if sailing light, and having a good height of freeboard with large percentage of reserve buoyancy, may not be safe or stable under certain conditions of loading.

FIG. 1



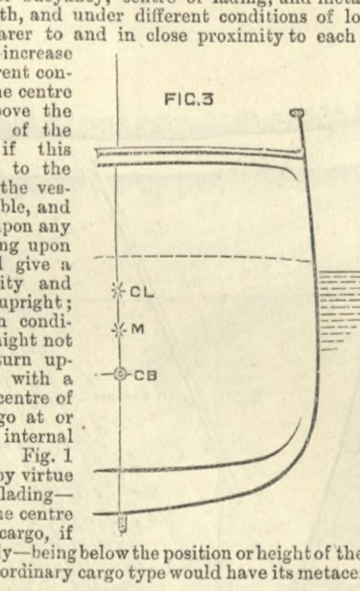
It would seem that the metacentric point should regulate the loading of all ships, as this is the point above which the centre of gravity of the ship, cargo, &c., should not be carried to insure stability and the vessel maintaining her equilibrium, or returning upright on the surface of the water when inclined on the face of a wave or rolling in a sea-way. And in proportion as the vessel is loaded, the position or height of the metacentre should be proportionately above the centre of gravity of the loading of the cargo and ship. And to insure this, vessels might be so constructed that the centre of loading—or centre of volume of holds—should always be below the height of the point of the metacentre at any draught of water or line of floatation of the vessel.

FIG. 2



Three vessels, Figs. 1, 2, and 3, having the same length and breadth, but different depths, have, under different conditions of loading, their centres of gravity of lading and metacentres in different relative positions, and if their centres of gravity be altered under different conditions of loading, may not have sufficient stability to return upright when inclined by any force or power acting upon them when rolling in a sea-way. Fig. 1 shows the relative positions of centre of buoyancy, centre of gravity, centre of internal capacity or lading, and position or height of the point of the metacentre, from which it may be seen that the centre of lading is below the position or height of the metacentre. Fig. 2 shows the centre of buoyancy, centre of lading, and metacentre under different depth, and under different conditions of loading, with the centres nearer to and in close proximity to each other. Fig. 3 shows, under increase of depth and different condition of loading, the centre of lading to be above the position or height of the metacentre; and if this vessel were loaded to the draught indicated, the vessel would be unstable, and liable to roll over upon any force or power acting upon her. Fig. 2 would give a little more stability and power to return upright; still, under certain conditions of loading, might not have power to return upright when laden with a cargo having the centre of gravity of the cargo at or about the centre of internal capacity or lading. Fig. 1 will give stability by virtue of the centre of lading—and consequently the centre of gravity of the cargo, if laden homogeneously—being below the position or height of the metacentre. A vessel of ordinary cargo type would have its metacentre at about $\frac{B^2}{d} \times {\cdot}08$ above the centre of buoyancy or displacement at the particular draught at which the vessel floats, and the centre of buoyancy at about six-tenths the draught above the top of the keel, and the centre of internal capacity, or centre of volume of the holds, at about $\frac{55}{100}$ths of the internal depth of the holds from the ceiling or floor of the vessel to the upper deck beams amidships, allowing for the sheer of the vessel's deck fore and aft, and the round of the beam athwartships. Now, with this data it will be an easy matter to determine on paper the relative values of any proposed form or proportions and depths of vessels to the proposed load-line, or line of proposed deepest immersion to which it is intended to load the vessel; whether under certain conditions of lading the element will be fulfilled of the centre of lading, and consequently the centre of gravity, of the cargo, if laden homogeneously, being below the position or height of the metacentre under any particular draught of the vessel and under any condition of loading; and also from this the stability or power of the vessel to return upright, and to resist overturning when inclined on the face of a wave or rolling in a sea-way.

FIG. 3



A vessel when floating at rest on the surface of the water has its common centre of gravity in the same vertical play as the centre of buoyancy or displacement, and if the vessel be inclined or forced over by any force or power acting upon her, some other effect may follow; the side on the side of the inclination is forced into the water, effecting a change of the volume of water displaced, and in the centre of the volume displaced to the side inclined, and it may be that this shifted centre of buoyancy or new displacement may be out of the line through the centre of gravity of the vessel and to either side of it. If after inclination the shifted centre of buoyancy comes without the line through the centre of gravity of the vessel on the side of the inclination, the buoyancy will be acting less on that side and tending to return the vessel to her upright position; but if after inclination the shifted centre of buoyancy under the inclination comes without the line through the centre of gravity of the vessel, &c, on the other side, the buoyancy will be forcing upon that side and tending to overturn the vessel. So also with a vessel rolling in a sea-way, if the centre of buoyancy comes without the line through the centre of gravity on the outside of it, the buoyancy will tend to destroy the equilibrium and to overturn the vessel.

Now, the centre of internal capacity of the holds may be the centre of lading, and with homogeneous cargoes entirely filling the holds, the centre of gravity of the cargo; it would seem, therefore, to be an essential condition for all vessels laden homogeneously that the centre of lading should be below the position or height of the metacentre to insure the centre of buoyancy shifting out of the vertical line through the centre of gravity when the vessel is so laden; for as the vessel rolls the centre of buoyancy shifts out from its former position, or position when at rest, to the side inclined. And a vertical line from the altered position or place of the centre of buoyancy, drawn to and intersecting the vertical line through the centre of gravity of the vessel, is the point or position or height of the metacentre on the centre of the vessel under the particular condition of inclination or rolling, and if the centre of internal capacity or lading be above the position or height of the metacentre under this particular condition of lading, the vessel may be uneasy in a sea-way, and liable to capsize or founder. Let Fig. 4 be the section of a vessel inclined on the face of a wave or rolling in a sea-way, C L the centre of lading, and M the metacentre or point above which the centre of gravity must not be carried to insure stability and power to return upright. This vessel, if laden homogeneously, would have its centre of gravity of weight above this point or position of the metacentre, and tending to overturn the vessel. But if the centres be respectively as in Fig. 5, the buoyancy would have power to return the vessel upright under any condition of lading, and if the centre of lading be kept below the metacentre at any other or variable draught of the vessel, would be stable under any condition of lading, or when laden to any other or variable draught of water, and when rolling in a sea-way.

FIG. 4

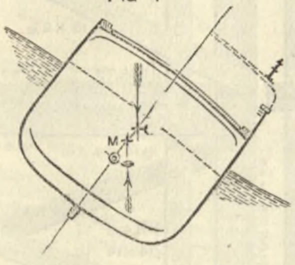
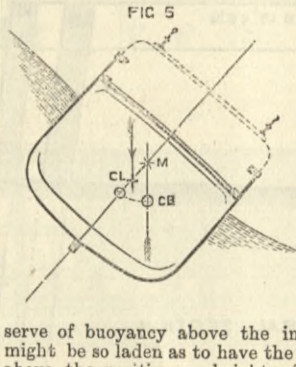


FIG. 5



Reserve of buoyancy under this condition might not be of such service to a vessel, for it is possible to have a vessel of comparatively high freeboard and giving a large reserve of buoyancy above the intended load-line, yet the vessel might be so laden as to have the centre of gravity when so laden above the position or height of the metacentre and tending to instability of the vessel.

The accompanying table gives the relative values of draughts and freeboard under the same length and breadth, but varying draughts and depths, from which table we may gather that if the proportion of draught to depth be as No. 1, will be of the greatest value in increasing the height of the metacentre above the centre of lading or internal capacity; and if the proportion of draught to depth be as No. 2, the metacentre and centre of internal capacity will be at or about the same position. And it will depend upon the relative proportion of *draught* to *depth*, the distance between the centre of internal capacity of the holds and the position or height of the metacentre at the particular draught at which the vessel may float.

	Breadth.	Draughts.	Depths.	Free-boards.	Meta-centre above keel.	Centre of lading above keel.	Difference between centres.
No. 1.	32·0	16·0	18·0	2·0	14·0	12·0	+2·0
,, 2.		18·0	22·0	4·0	14·5	14·0	+ ·5
,, 3.		20·0	26·0	6·0	15·0	16·0	−1·0

But we have still to consider the question of the vessel's stability when inclined on the face of a wave or rolling in a sea-way. For although the foregoing elements and proportions may hold good under an assumed inclination with the vessel at rest, these conditions may be entirely altered upon the vessel being inclined or forced over by any force or power acting upon her, and when inclined on a wave or when rolling in a sea-way. For on a vessel being inclined on a wave, the side on the side of the inclination forced into the water effects a change in the position of the centre of buoyancy, and consequently upon the height of the metacentre, and upon the vessel being inclined on a wave the point of the metacentre may be below the centre of internal capacity or lading, so that it would seem to be advisable in determining the relative proportions to incline to those that give the greatest value in the initial state to insure a safe margin of stability to the vessel to resist overturning, and to maintain her equilibrium and stability, and power to return upright when forced over on the face of a wave or rolling in a sea-way.

Admiral Fishbourne, in his work on "Stability the Seaman's Safeguard," says:—"The position of the centre of gravity being all-important, and the difficulty of entering into a detailed estimate of all the points changed by cargoes varying in specific gravity and quantity is so great, that it is most desirable to give a rule that will apply to all cases that shall be safe and effective." This seems to be just the point that should be aimed at, in so proportioning vessels that under any condition and with any variable or difference in kind of cargo, the lading shall be such as to insure stability to the vessel under any variable or altered draught, and when inclined on the face of a wave or rolling in a sea-way. "The position of the centre of gravity being all-important" should be studied in relation to the centre of buoyancy and metacentre at any variable or different draught of water, and under any altered or different condition of lading. "The difficulty of entering into a detailed estimate of all the points changed by cargoes varying in specific gravity and quantity is difficult," still sufficient may be obtained by assuming the centre of volume of internal capacity of the holds to be the centre of gravity of the cargo of any kind whatsoever; and that the centre of the internal capacity of the holds shall be below the position or height of the metacentre at any different or variable draught of water to insure the stability of the vessel under any different or variable condition of loading.

London, February 15th. J. A.

THE LILLESHALL COMPANY'S STEEL WORKS.

Sir,—Our attention has been called to the statement in your paper of the 12th instant, which would appear to lead one to suppose that this company has taken over the Lilleshall Company's steel works. Will you kindly contradict this in your next issue? We may mention that Mr. Ellis has had the charge of these works for some time.

W. Bullock, Secretary,
For the Snedshill Iron Company.

Shifnal, Shropshire, February 15th.

TENDERS.

BELPER RURAL SANITARY AUTHORITY.

List of tenders received on Feb. 9th for construction of two main outfall pipe sewers at Swanwick, near Alfreton, and also for works necessary in the preparation of certain land for sewage irrigation purposes. Engineer to works: Mr. W. H. Radford, Assoc. M. Inst. C.E., Angel-row, Birmingham.

	£	s.	d.
Samuel Thumbs	2250	0	0
Thomas Smart	2140	0	0
Meats Brothers	2100	0	0
Foster and Barry	2020	0	0
Charles Green	1829	0	0
John Roe	1777	11	8
John Hawley	1774	0	0
G. F. Todd	1757	0	0
Beardsley and Pounder	1716	0	0
John Coupe	1664	10	6
Shortland, Williams, and Co.	1644	18	0
W. E. Hopkins	1547	0	0
W. Cordon	1530	12	0
*R. and J. Holmes and Co., Shirland, near Alfreton	1239	0	0

* Accepted.

BEXHILL-ON-SEA.

For construction of egg-shaped, brick, and pipe sewers, with works in connection. Mr. H. Bertram Nichols, C.E., engineer, Grosvenor-chambers, Corporation-street, Birmingham. Quantities by the engineer.

	£	s.	d.
T. Rigby, North-end, Croydon	7675	0	0
Hilton and Sons, Newport, Monmouth	7393	0	0
J. M. Wiswell, 30 and 31, St. Swithin's-lane, E.C.	6944	13	8
Forster and Barry, Radcliffe-on-Trent	6927	12	9
J. W. Webb, Brockley, S.E.	6770	0	0
J. Piper, Hastings	6745	8	0
Woodham and Fry, Greenwich, S.E.	6697	0	0
J. White, Boulton-road, Handsworth	6600	0	0
Cowdery and Sons, Newent	6514	5	3
F. Cruttenden, St. Leonard's-on-Sea	6497	0	0
J. W. and J. Neave, Leytonstone, E.	6440	0	0
T. Todd, Lea-road, Bexhill	6396	0	0
J. Jevons, Dudley	6355	0	0
T. Adams, Moorgate-street, E.C.	6100	0	0
W. Cunliffe, Sewage Outfall Works, Barking	6084	4	0
Innes and Wood, Birmingham	5978	12	6
L. Bottoms, Battersea, S.W.	5969	0	0
King and Son, St. Leonard's-on-Sea	5875	0	0
J. Cole, Bexhill	5845	0	0
H. J. Saunders, Northam Works, Southampton	5612	0	0
J. Hayward, Eastbourne (Accepted)	5477	0	0
T. Simmonds, Skegness	5432	10	0
J. G. Marshall, 29, College-road, Brighton	5376	0	0
A. Palmer, Colmore-row, Birmingham	5375	0	0
Engineer's estimate	5690	0	0

Soiree of the University College Engineering Society.—On Wednesday evening Professor Alex. B. W. Kennedy and the committee of the society entertained a large number of guests at University College, in connection with the University College Society. It was the third *soirée* of the kind, and the visitors were much interested in what they saw and heard. In the Engineering Laboratory there were several interesting machines and engines in motion, including the testing machine, Pearse's friction still, Westinghouse brake, Anderson's gun carriage, with self-acting recoil gear by which the recoil is made to return the gun, and several other working models. A very interesting model of the Cannon-street part of the recently-completed Inner Circle Railway Tunnel, Born's new steam engine indicator, and indicators and other instruments by Elliott Brothers; amongst these may be mentioned a new instrument for facilitating the design of slide valves, and studying their movements with reference to the piston. There were also collections of electrical appliances, Delta metal, and steel and iron specimens, many well-executed drawings, and upstairs a very fine collection of photographs, Woodbury types of large dimensions, photographic apparatus. The visitors were entertained at a concert, which was heard by large numbers in a distant part of the building by telephone. Professor Kennedy received the guests, who were very much interested in the various collections, and especially in those showing the work of the engineering students.

Calorimeters.—At the last meeting of the Physical Society a paper was read on "Experimental Error in Calorimetrical Work, and on Delicate Calorimetrical Thermometers," by Professor U. S. Pickering. In conducting determinations of the heat of dissolution of a solid body in water, the author has had an opportunity of detecting the sources of error incident on such work, and by an examination of the results has not only obtained the mean error of a series of observations, but has been able to apportionate this error to its various causes. In the experimental work it was found that the presence of anything but air between the calorimeter and jacket was most injurious. The space should be entirely open, and no cover of any sort should be used. Before reading the thermometers, as pointed out by Berthelot, the top of the stem should be tapped for some time; otherwise the mercury lags behind the true temperature; but besides this thermometric error, which the author calls the temporary error, is another effect, which may be termed the permanent error, of a similar kind, which no amount of tapping will remove. He has found and verified by special experiments that a thermometer when rising is invariably too low, while when falling it is invariably too high. Error due to this, which varies in amount with different instruments, is avoided by conducting the whole experiment with a rising or with a falling thermometer. The thermometers employed in these experiments had a range of 15 deg. Cent. and a total length of 600 mm.

Lectures at the Royal Institution.—The following is a list of the lectures to be delivered before Easter:—February 19th (evening), Professor Flower, "The Wings of Birds," at 9; February 20th, Professor A. Geikie, "Volcanic Action in Britain," at 3. February 23rd, Mr. C. T. Newton, "Unexhibited Sculptures in the British Museum," at 3; February 25th, Professor Boyd Dawkins, "Ancient Geography of Britain," at 3; February 26th (evening), Mr. A. A. Common, "Photography as an Aid to Astronomy," at 9; February 27th, Rev. C. Taylor, "History of Geometry," at 3. March 1st, general monthly meeting, at 5; March 2nd, Mr. C. T. Newton, "Unexhibited Sculptures in the British Museum," at 3; March 4th, Professor Boyd Dawkins, "Ancient Geography of Britain," at 3; March 5th (evening), Professor A. Macalister, "Anatomical and Medical Knowledge of Ancient Egypt," at 9; March 6th, Rev. C. Taylor, "History of Geometry," at 3. March 9th, Professor A. Gamgee, "Circulation," at 3; March 11th, Professor Boyd Dawkins, "Ancient Geography of Britain," at 3; March 12th (evening), Mr. R. S. Poole, "The Discovery of the Biblical Cities of Egypt, 9; March 13th, Mr. E. B. Poulton, "Colour of Caterpillars," at 3. March 16th, Professor A. Gamgee, "Circulation," at 3; March 18th, Professor Boyd Dawkins, "Ancient Geography of Britain," at 3; March 19th (evening), Mr. W. H. M. Christie, "Universal Time," at 9; March 20th, Mr. E. B. Poulton, "Colour of Caterpillars," at 3. March 23rd, Professor A. Gamgee, "Circulation," at 3; March 25th, Professor Tyndall, "Light," at 3; March 26th (evening), Professor W. C. Roberts-Austen, "Fluids and Metals," at 9; March 27th, Mr. H. Grubb, "The Astronomical Telescope," at 3. March 30th, Professor A. Gamgee, "Circulation," at 3; April 1st, Professor Tyndall, "Light," at 3; April 2nd (evening), Mr. H. Grubb, "Lenses and Mirrors, at 9; April 3rd, Mr. H. Grubb, "The Astronomical Telescope," at 3. April 5th, general monthly meeting, at 5; April 6th, Professor A. Gamgee, "Circulation," at 3; April 8th, Professor Tyndall, "Light," at 3; April 9th (evening), Mr. W. Anderson, "New Applications of Cork," at 9; April 10th, Professor O. Lodge, "Fuel and Smoke," at 3. April 13th, Professor A. Gamgee, "Circulation," at 3; April 15th, Professor Tyndall, "Light," at 3; April 16th (evening), Sir H. E. Roscoe, at 9; April 17th, Professor O. Lodge, "Fuel and Smoke," at 3.

RAILWAY MATTERS.

THE Illawarra Railway has been opened as far as Como, thirteen miles from Sydney.

FORTY miles of extension of the Manitoba and South-Western Colonisation Railway, from Carman to Holland, were opened for traffic on the 15th inst.

THE railway between Tunis and the frontier of Algeria was, on the 13th inst., partly destroyed by a freshet, and communication is constantly interrupted.

THE contractor for the Derwent Valley Railway, the *Colonies and India* says, refuses to erect bridges in accordance with the plans provided by the Government unless he has a written guarantee that he will be held blameless for accidents.

THE Bill for bringing about a working union between the Chatham and Dover, and London, Brighton, and South Coast Railways, with powers to the South-Eastern Company to enter such union, has been definitely withdrawn for the present session.

FROM the figures given by the Mersey Tunnel Company, it is estimated that over 300,000 people travelled in the lifts in their first week's work. There were over 200,000 passengers by the railway, and nearly all of them travelled down in the lift at one station and up at the other.

THE Ceylon Legislative Council was expected to close on January 19th, when, the *Colonies and India* says, the Governor was to proceed on his journey up country with the view to inspect the tea districts, and to see how that industry might be promoted by the introduction of light railways. The Railway Extension Bill has been read a third time and passed.

DISAPPOINTMENT is felt in Calcutta at the delay of the Secretary of State in sanctioning a commencement of the Bengal and Nagpore Railway. The promised line is one of the greatest importance, both commercially and strategically. It is strongly supported by the Chamber of Commerce and the mercantile community, and it is understood that the Indian Government has advocated its being undertaken at once.

ACCORDING to the report of the directors of the North London Railway Company, read yesterday at Euston, the mileage run by the company's trains was 890,088 by passenger trains and 149,208 by goods and mineral trains. The company runs twelve miles of line and leases five miles. Five miles are laid with four lines. The total cost of locomotive power was £43,496·7.

ON Tuesday a bad accident occurred in the London and North-Western Railway Works at Crewe. A crane was being used for lifting some large castings out of the steel-pits. One of the pieces, weighing several tons, had been lifted, when the crane and its foundation gave way, and, with a mass of masonry, fell upon several men working below. Three were found dreadfully injured, and it is feared the injuries of two of them will prove fatal. The crane is one of the largest in the steelworks, used for lifting the greatest weights. It is said that no extra strain had been placed upon it, but on one side of the building it had pulled away a large portion of the wall, leaving a hole several yards square. Cranes depending on the transverse strength of brick walls are never trustworthy machines.

THE following judgment was given by the Comptroller-General of Patents on the 26th ult. concerning Whiteley's railway stair and other treads, and similar applications of india-rubber:—"Having heard Mr. Dutton on behalf of the applicants, and Mr. Giles on behalf of the opponent, I am of opinion that the alleged invention of the applicants is substantially the same as the inventions previously patented by the opponent, by letters patent Nos. 9207 and 13,457 respectively of the year 1884, and I therefore refuse to seal a patent on the present application." The successful opponent in this case is Mr. Joseph Whiteley, of Clowes-street Works, Salford, the patentee of improvements in india-rubber steps, treads, noseings for stairs, steamship and railway carriage steps, matting, flooring, and wearing surfaces.

THE report of the directors of the Midland Railway Company to be presented to-day, shows that the company possessed at the end of December, 1885, 1732 engines, 1440 tenders, 332 first-class carriages, 893 composites, 1199 third-class, 76 travelling post-office tenders and vans, 352 horse-boxes, 318 carriage trucks, 540 passenger brake vans, or a total of 3710 passenger train vehicles. Of goods wagons the company possessed 1485 cattle trucks, 35,231 goods wagons, 1124 covered goods wagons, 39,027 coke and coal trucks, 18 creosote tanks, 2035 timber trucks, 1049 brake vans, or a total of 79,969 vehicles for merchandise and mineral traffic. The horses and carting stock included 3166 horses, 2297 drays and carts. The total receipts amounted to £3,846,049 16s. The locomotive power cost £533,977 16s., of which £116,493 10s. was for coal and coke. The completed miles of railway owned by the company reached 1661·25, and the miles worked by the company's engines reached 1852. The total passenger train mileage was 7,271,324 and goods 10,100,979, or a total train mileage of 17,372,303.

THE supporters of the St. Gothard Tunnel, says the Paris correspondent of the *Times*, are now taking advantage of some petty accidents to begin a bitter war against the defenders of the Mont Cenis Tunnel. It will next, perhaps, be Mont Cenis which in its turn will launch against St. Gothard the insinuations of which it now complains. The truth is, that the Lyons Railway Company is not bound to pass Mont Cenis. Its engines stop at Modane, and it is Italy which is bound under international treaties to work the railway between Bardonnechia and Modane. Now, as for some time asphyxia and death under Mont Cenis have been spoken of, careful inquiries show their utter baselessness. The Italian company has employed Beugniot engines and a well-known fuel for the goods trains. Now these remain a long while in the tunnel, and it has twice happened that the railway officials accompanying them have suffered from serious symptoms of asphyxia in consequence of the character of the engines and the fuel used, and also in consequence of the casual state of the atmosphere; but the two sufferers promptly recovered on getting out of the tunnel. Immediate complaints, however, were made by the French company, and the Italian company changed both engine and fuel. Since this was done no inconvenience has been reported. It should be added that these accidents have not occurred to the passenger trains.

ON Tuesday the half-yearly meeting of the Forth Bridge Railway Company was held in Edinburgh. The chairman, in moving the adoption of the reports, said the works of the bridge were progressing satisfactorily, the foundations being very nearly ready for the superstructure. He congratulated the shareholders on the very successful way in which the foundations had been laid, and expressed the hope that the superstructure might go on equally favourably. The engineer's report stated that the twelve great piers for carrying the 1700ft. spans were finished with the exception of a few courses of masonry on the Inchgarvie south-east pier and the Queensferry north-west pier, the work on the latter pier being much delayed by the tilting and subsequent bursting of the caisson. All the other piers were built to the height of the under side of the viaduct girders. On the north side of the Forth the five girders were being raised gradually to the required height, and although the length of the girders is 800ft., and the weight 1000 tons, they were lifted in one piece by the hydraulic appliances provided as easily and as safely as a small girder was lifted by an ordinary crane. On the south side of the Forth the viaduct girders were ready to be lifted in the same manner. During the past six months about 6500 tons of steel had been delivered at Queensferry. The report was adopted, and the meeting authorised the conversion into stock of the existing shares in the capital of the company. The shareholders approved of a Bill proposed to be introduced into Parliament for the purpose of extending the time for the completion of the Forth Bridge Railway.

NOTES AND MEMORANDA.

THE conductivity of serpentine is very variable; the value of its specific resistance in terms of the mercury unit is found to lie between the limits of 20 and 30,000 millions; its use as a perfect insulator is thus undesirable. Marble does not appear to conduct electricity under any observed conditions.

THE specific conductivities of potassium and sodium hydroxides are approximately equal, as also those of the halogen and nitric acid. Solutions of ammonia and of phosphoric and acetic acids are exceedingly bad conductors. The curve representing the conductivity of sulphuric acid shows minimum points of inflexion corresponding with the formation of the monohydrate H_2SO_4, H_2O. the pure acid H_2SO_4, and the anhydride respectively. The temperature coefficients of alkalis and acids, with the exception of sulphuric acid, are also (*Journal of the Chemical Society*) approximately equal.

IN their report on the river water supplied to London during January, Mr. William Crookes, F.R.S., Dr. William Odling, and Dr. C. Meymott Tidy say:—"Despite the flooded state of the rivers, consequent on the thawing of the late heavy fall of snow, there was not any appreciable increase in the proportion of organic matter present in the water supply of the month; the mean amount of organic carbon found in the Thames-derived supply being ·183 part in 100,000 parts of the water, as against a mean amount of ·170 part in the preceding month. The increased storage capabilities and improved filtering arrangements now available to the companies seem to have rendered the effects of the varying state of the river itself, for the most part, far less marked than was commonly noticeable even but a few years ago."

AT a recent meeting of the Physical Society a paper was read on "Some New Forms of Calorimeters," by Professor W. F. Barrett. These instruments were constructed for the accurate and ready determinations of specific heats, notably those of liquids. In the first form the bulb of a thermometer is blown into the form of a cup, of about 4 c.c. capacity, which thus acts as a calorimeter. Into this cup the liquid is dropped directly from a burette, its temperature being observed by a thermometer in the burette, the mouth of which is closed by the end of the bulb of the thermometer, which is ground, and thus acts the part of a stopper, so that on raising the thermometer the liquid flows from the burette into the cup. The thermometer itself forms a balance; the horizontal stem acting as the beam is supported by a knife edge, and a pan is attached to the further end, by the addition of weights to which the weight of liquid added can be ascertained. In the second form a simple thermometer with a large bulb is used, the latter dipping into a silver vessel, into which the liquid is introduced as before. Professor S. P. Thompson exhibited a glass calorimeter, similar in construction to that of Favre and Silbermann. Water is used instead of mercury, the great density of which renders it unsuitable for use in so large a glass vessel.

A LECTURE was recently delivered to the Chemical Society on "Methods of Bacteriological Research from a Biologist's Point of View," by Dr. Klein, F.R.S., who said that the enormous amount of work that has been done by chemists since the memorable investigations of Pasteur on fermentation and putrefaction, if viewed in the light of the modern bacteriological methods, is in a great measure unsatisfactory and imperfect, more so than will be conceded by chemists. Specific chemical action is ascribed to certain organisms, because these were found present in the substances examined, no regard being paid as to whether these organisms were alone active or whether they were only concomitant and dependent on the activity of others. To determine whether a definite chemical process is produced by a definite organism, and which, it is necessary to prove—(1) that the substances to be acted upon are at the outset free of any accidental organism; (2) that the particular organism to which the definite chemical activity is ascribed is the only one concerned in this process. The methods used must fulfil these elementary conditions, that is to say:—(1) The materials used must be sterile at the outset, and protected from accidental contamination; (2) the specific organism must be obtained in pure cultivations, and this purified organism must be capable of producing the specific chemical change. Viewed in this light few of the assertions hitherto made bear criticism.

AN early prediction (1862) of the decay of the Egyptian obelisks when removed, was made by Dr. Alfred Stelzner, of St. Petersburg. "You know, perhaps, that the Alexander column in St. Petersburg was transported from Finland to St. Petersburg in the thirties of this century at a senseless cost, and, with the assistance of thousands of men, was erected. But even in a few years the granite did sad honour to its Finnish name of 'Rappakivi,' *i.e.*, the lazy-stone. The granite commenced to weather, and weathered merrily on in spite of all technical and scientific commissions; and one can well say that the years of the proud monument are numbered. General Helmersen says the granite contains many large felspar crystals. But the felspar is triclinic, and therefore expands, under the great differences of temperature between the St. Petersburg summer and winter, differently in the directions of its three axes; hence comes the crumbling, owing to the uneqnal molecular movement throughout the entire mass of the monolith. If this explanation is correct, then from the similarity of the rocks from Finland and Syene, and the great differences between the summer and winter temperature which exist also in New York, an unsuspected danger threatens the old Egyptian monolith, which has always hitherto stood in a mild and equable climate. Perhaps, also, it will succumb to the weakness of old age, for the London Needle of Cleopatra is said to be beginning already to crumble in its new home."

ACCORDING to General Abbott's Report on the Flood Rock Explosion, 48,537 lb. of dynamite No. 1 and 240,399 lb. of rackarock, equivalent in all to about 150 tons of dynamite, were stowed away in the galleries within the rock, and simply a touch on a telegraphic key by little Miss Mary Newton set the whole mass into instant explosion. At all the observing stations the observers watched a surface of mercury in which the reflection of some small, well-defined object could be seen. The arrival of the disturbance shook the mercury, and caused the reflected images to disappear. The reports generally agree that the maximum of disturbance was very quickly or immediately reached, and none of them express serious doubt of the accuracy of their determinations. The following table exhibits the results:—

Station.	Distance in miles.	Interval of transmission.	Velocity in miles per second.
Willet's Point, L.I.	8·33	8·5	0·98
Pearsalls "	16·78	6·6	2·54
Bay Shore "	56·65	13·0	2·82
Patchogue "	48·52	15·4	3·15
Goat Island, R.I.	144·89	58·8	2·46
Harvard Observatory, Mass. ..	182·68	219·8	0·83
West Point, N.Y.	42·34	13·6 10·9 10·9	3·11 3·88 3·88
Hamilton Coll., N.Y.	174·37	45·0 45·2	3·88 3·86
Princeton, N.J.	48+	51	0·94

These wave velocities are anything but accordant, and no satisfactory reason can be given for their variation; but they all agree in showing velocities that are higher than those deduced from observations on natural earthquakes; and from this General Abbott feels confirmed, in his deductions from the explosions of certain torpedoes and at Hallett's Point in 1876, that the more violent the initial shock the higher is the velocity of transmission.

MISCELLANEA.

ON Monday, 22nd February, at 7.30 p.m., at Exeter Hall, Mr. T. Graham Gribble will give a lecture "On American Pin-connected Truss Bridges."

MESSRS. CHUBB AND SONS have been appointed makers of strong rooms, safes, and locks to the Colonial and Indian Exhibition Commission.

MESSRS. WARD, LOCK, AND CO. are about to publish a new popular library of literary treasures. The aim is—a popular library of the choicest literary treasures to be found in the English language at threepence.

THE Bulls Bridge Ironworks, Moxley, has just passed into the hands of Mr. Jeavons, of Harris and Jeavons, Bradley. The late proprietors—Mr. W. Molineaux and partners—will confine their operations to their Caponfields Works, where they will somewhat increase their out-turn of sheets, hoops, strips, and bars.

A DIAGRAM, showing at a glance the rise and fall in the average prices of English pig lead from 1767 to 1885 has just been published by Mr. T. Sopwith, M.I.C.E., and he has also published one showing the average prices of copper, spelter, and Spanish lead in England since 1855. Some quantity statistics are also given on this diagram.

APROPOS of nomenclature and definitions, the *Electrical World* says that several of our transatlantic contemporaries have entered into a discussion of the definition of "primary" and "secondary" battery. While there can be little room for ambiguity in regard to their practical application, the terms might as well be definitely adjudicated upon.

MESSRS. JOSEPH RODGERS AND SONS, the well-known cutlery establishment, have declared a dividend of 12 per cent. per annum, against 14½ per cent. last year. Messrs. John Round and Son—silver and electro-plate—have declared 10 per cent. per annum, which is at the same rate as last year. Messrs. Round and Son have added the Britannia metal to their other business.

THERE is little ground for surprise at the progress made by the electric light in America when the price paid for gas is considered A list of the prices per thousand cubic feet shows that the lowest price charged is 4s., namely, at Baltimore, Pittsburgh and Chicago. From this price it ranges up to 16s. at Galveston and San Antonio, Texas. The most usual price is 10s., and an average may be taken at 8s.

A "SUN-and-Planet" engine, designed by James Watt, has still a place in the famous brewery of Messrs. Whitbread and Co. in Chiswell-street, and is still performing the duty for which it was constructed in 1785. The *City Press* says:—"Though there have been alterations to increase its power, all the principal parts remain as they were originally manufactured. A metal tablet affixed to the engine gives an account of its invention and history.

AN excellently-executed coloured diagram, showing at a glance the actual prices and average prices and quantities of make, import and export of iron and steel in different forms in England since 1830, has been published by Mr. W. G. Fossick. The diagram is the most elaborate of its kind, and has now been published several years. It was designed and compiled by Mr. R. R. Mabson, F.G.S., and besides the statistics, a chronology of events since 1830 is given.

IT is stated in Canada that an independent system of electric telegraph will soon be opened by the Canadian Pacific Railway Company. As a commencement the company is already erecting between Montreal and Winnipeg wires of exceptionally large capacity, and when completed these two cities will be in as close and quick communication as are Toronto and Montreal. The facilities of communication, too, between Montreal and Ottawa, already large, are in process of being more than doubled.

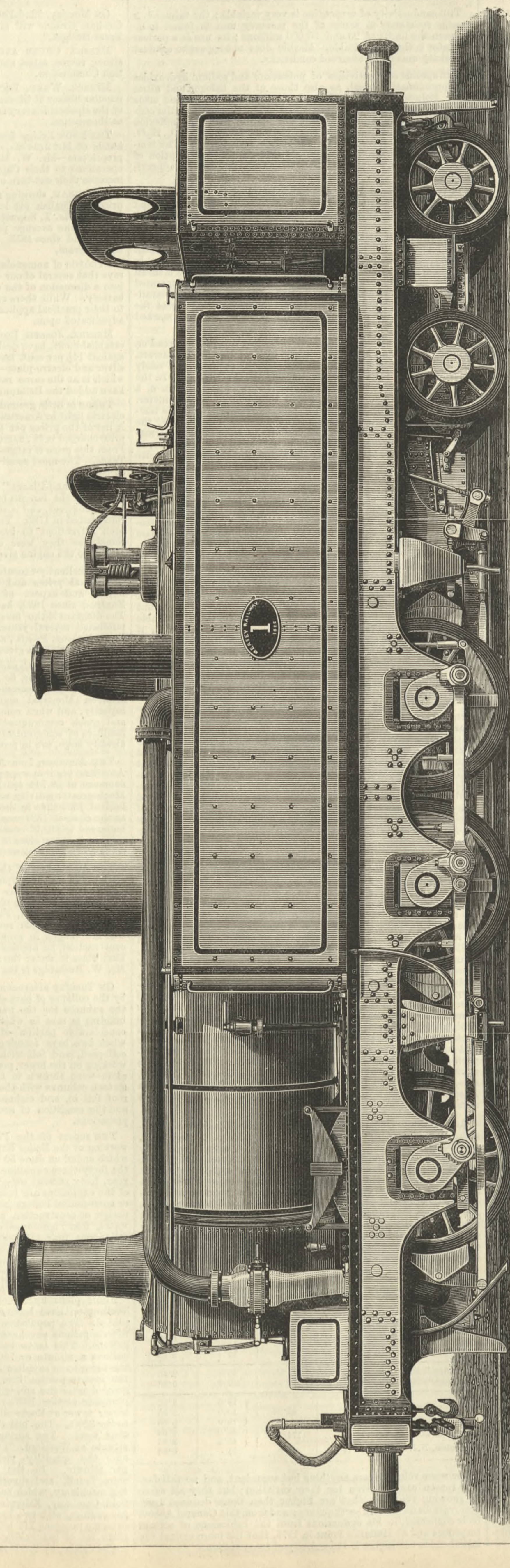
THE American Iron Association reports that 4,529,869 tons of American pig iron were produced in 1885; this amount showing a decrease of 59,744 tons, as compared with the return for 1884. Much greater activity was shown in iron making during the last half of 1885 than in the first half. The unsold stock of pig iron at the close of 1884 was 593,000 tons, which on June 30th last had increased to 692,916 tons. But the better demand had diminished this stock at the close of 1885 to 416,512 tons. Two hundred and seventy-six furnaces were then in blast, and 315 were idle.

THE Archbishop of Canterbury has promised to deliver to the students of the Metropolitan Drawing-classes the Queen's prizes, awarded by the Science and Art Department, South Kensington. The meeting will take place on Friday, March 5th, at eight o'clock, in the Memorial-hall, Farringdon-street. These classes, which are held in twenty-four centres, consist of about 800 working men, who are taught in evening classes the principles of drawing and construction, as applied to the building and engineering trades. Each class is under the management of a local science committee. Mr. W. Busbridge is the superintendent of the classes.

ON Tuesday afternoon some excitement was caused in Liverpool by the collapse of part of the building which was being erected in the suburbs for the purpose of the Shipping Exhibition. The building is that in which the Antwerp Exhibition was held. A considerable portion of the iron framework had been erected, when two bays forming the north-western or foreign annexe collapsed, and fell with a crash. A large number of men were working on the lower portion of the building, and those who were aloft were thrown to the ground with much violence. In all sixteen columns with the attached girders and beams bearing the roof fell in, and eighteen men were injured. One man has died, and the condition of several of the rest is stated to be extremely precarious.

THE report of the President of the Board of Trade upon the working of the Boiler Explosions Act, 1882, for the twelve months which ended on June 30 last, has been issued as a Blue-book. By the forty-three explosions which were reported upon during the year, forty persons were killed and sixty-two injured. The causes of the explosions are broadly classified as follows:—Deterioration or corrosion of boilers and safety valves, twenty cases; defective design or construction of boiler or fittings, eleven; shortness of water, four; ignorance or neglect of attendants, four; and miscellaneous, four. It was not found necessary to institute legal proceedings under any section of the Act during the year, and no formal inquiry of the kind provided for by section 6, sub-section 2, was held, the preliminary investigations having been found fully sufficient to trace the explosions to their true causes.

FROM plans by Mr. E. Pritchard the new waterworks at Wellington have been carried out and are now practically completed. The population to be supplied is or may be 5000, and fifteen gallons per head per day needs a daily supply of 75,000 gallons. This is to be pumped in ten hours at a rate of 125 gallons a minute or 7500 gallons per hour. The highest part of the town to be supplied has a surface level of 260ft. above datum, the lowest portion being 190ft. The level of the spring or the ground near the spring is 207ft.; the level of the ground at pumping station 196ft.; the surface level of the ground of the water tower at Rockwell-green 250ft., and the water level of the tower 320ft. The hill district represents 500ft. to 600ft. above that level. The spring from which the water is obtained is situate at Westford. The water comes from the red sandstone, and the quantity yielded in the driest season 75 gallons per minute. In the construction of the well other springs were found, and diverted to the main spring. The pumping machinery, which has been supplied and erected by the Glenfield Company, Kilmarnock, comprises two 9-horse power Otto gas engines, with two independent sets of three-throw pumps, the extreme pumping lift being 130ft. To work the engines a complete set of gas-making plant has been provided, adjoining the engine-house, by the Dowson Economic Gas Company.



TANK LOCOMOTIVE FOR THE MERSEY TUNNEL RAILWAY.

MESSRS. BEYER AND PEACOCK, GORTON FOUNDRY, MANCHESTER, ENGINEERS.

(For description see page 143.)

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THE ENGINEER, February 19th, 1886.

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

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

A SUBSCRIBER (Ballina).—*No.*

J. R. C.—*Thanks. Well-known.*

N. V.—*If the surveyor is acting within the terms of the specification you have no remedy. If he is not, consult a solicitor.*

T. A. (Littleborough).—*If you like to send us a description of your invention in confidence, we shall be happy to advise you.*

S. D.—*We cannot recommend special firms. If you advertise for what you want you will obtain a large number of answers, from which you must select according to your own judgment.*

J. P. AND S. *Your query would only evoke a host of replies from inventors, each claiming that what he had to sell was the best. You would obtain no information of any value. Nor is it, indeed, possible to answer your question; so much depends on the conditions under which the boiler is used and the nature of the fuel burned.*

YOUNG FITTER.—*It is probable that your watch can only be demagnetised by a watchmaker. In some cases watches have been made all right by holding them in a horizontal position close to the field magnet of a dynamo, turning them rapidly round between the fingers, and slowing withdrawing the watch at the same time from the magnet. If your watch is very bad you cannot make it worse by trying this.*

STEEL BARS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers inform me where I can obtain a few Siemens or Bessemer steel bars, &c., at a small advance on the price per ton?

INITIAL.

COMPRESSED PAPER.

(*To the Editor of The Engineer.*)

SIR,—I shall be glad if any of your readers can give me the address of makers of compressed paper, or other composition, which can be moulded into rollers, and which is not affected by exposure to the weather.

February 17th. J. P.

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Advertisements cannot be Inserted unless Delivered before Six o'clock on Thursday Evening in each Week.

Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. George Leopold Riche; all other letters to be addressed to the Editor of THE ENGINEER, 163, *Strand.*

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Tuesday, Feb. 23rd, at 8 p.m.: Ordinary meeting. Paper to be further discussed, "The River Seine," by Mr. L. F. Vernon-Harcourt, M.A., M. Inst. C.E. Friday, Feb. 26th, at 7.30 p.m.: Students' meeting. Paper to be read, "Stability of Voussoir Arches," by Mr. Henry A. Cutler, Stud. Inst. C.E. Mr. William Henry Barlow, F.R.S., Past-President Inst. C.E., in the chair.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS, 25, Great George-street, S.W.—Thursday, Feb. 25th, at 8 p.m.: Continued discussion "On the Self-induction of an Electric Current in Relation to the Nature and Form of its Conductor," by Professor D. E. Hughes, F.R.S, president.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, Feb. 22nd, at 8 p.m.: Cantor Lectures. "Science Teaching," by Professor F. Guthrie, F.R.S. Lecture II.—Knowledge about common stuffs and things. Wednesday, Feb. 24th, at 8 p.m.: Twelfth ordinary meeting. "The Employment of Autographic Records in Testing Materials," by Professor W. C. Unwin. Thursday, Feb. 25th, at 8 p.m.: Applied Chemistry and Physics Section. "Photography and the Spectroscope in their Applications to Chemical Analysis," by Professor W. N. Hartley, F.R.S.

THE ENGINEER.

FEBRUARY 19, 1886.

GOOD AND BAD CHAINS.

THE correspondence evoked by the article "On Chains" which appeared in our impression for January 22nd, leaves no room for doubt that very disgraceful frauds are perpetrated in the chain trade; and we are not surprised to find respectable firms beginning to ask that some steps should be taken to put a stop to practices which cannot be too vigorously reprobated. It is much more easy, however, to ask that something should be done, than it is to say what that something should be. We publish to-day a letter which suggests that the Employers' Liability Act should be extended to shipowners. It is clear, however, that if such an extension of the provisions of the Act were to take place at all, it must extend beyond chains and anchors. In a word, it must be thorough. We are by no means prepared to advocate any such legislative interference with shipowners. The matter has already been discussed in connection with Mr. Chamberlain's proposals; and it was easily shown that little analogy exists between the case of an employer on shore and an employer at sea. The operation of the Act as against the latter might be, and probably would be, productive of great hardship. But we are disposed to think that some scheme might be formulated by which the Marine Department of the Board of Trade could do more than has yet been done to ensure proper cables and anchors being used. As matters stand at present, chains are sold which are said to be of excellent iron, whereas they are mere rubbish. The existing system of test appears to be quite inadequate to secure good chains. For example, there are cables in the market which will stand the proof test, and yet have been known to break when suffered to fall on a ship's deck, and to give way like cast iron if twisted when an anchor is being weighed. Such chains are made of iron which has no ductility. It will probably stand 20 to 21 tons in the testing machine, and break with an extension of about 3 per cent. Chains tested at Lloyd's proof-houses have not only to stand a sufficient tensile strain, but to undergo a searching examination as well; and the fact that these proof-houses are the terror of the dishonest maker is shown by the number of private testing places established in all parts of the country where chains are made. The Board of Trade ought to be empowered to insist on all cables and chains used for any purpose involving risk of life being tested either at a Government proof-house or a Lloyd's proof-house. It may be said that the chain really tested would have another substituted for it: but it would not be impossible to provide a private mark, to imitate which would be felony. Watch chains can be bought, every link of which is hall marked, and it would involve very little trouble or expense to hall mark, so to speak, every link of a large cable and every tenth link or so of smaller chain. This would secure the use of good ground tackle at sea; and as to chains used on shore it might easily be made, under the Employers' Liability Act, to go hard with any employer who could not prove that a broken chain had passed the Board of Trade test. We by no means assert that these suggestions are the best that can be made. They are the best and most practical with which we are acquainted. It rests with our correspondents to suggest other plans.

In dealing with this important question it must not be forgotten that the chain makers are not the only people to blame. The receiver is as bad as the thief, and the purchaser who cuts down prices to impossible figures cannot be surprised if he gets an inferior article, as pointed out by Messrs. H. P. Parkes and Co. There are cables and chains offered for sale at a price which would not pay for the bar iron of which they profess to be made. These chains are knowingly bought by many persons, because they can assert that they have used every precaution to obtain excellence, and they are too wise to ask questions. It suffices for their purpose that they have had invoiced to them such and such chains made of iron carrying a brand with a world-wide reputation. As to what the price of such iron may be, they do not trouble their heads. Others, again, buy innocently in sheer downright ignorance; they have no knowledge whatever of the price of iron. They take what they get, and are quite content that they have done their best. We were once asked by a man why he should give a long price for chains when he could get the best in the market for a short one; and we have no doubt whatever that he believed he got what he bargained for, and considered himself a very clever fellow too. We know that an incredible amount of ignorance exists among users of chains of all kinds concerning what they ought to cost; and we have not the smallest doubt that the correspondence now going on in our columns will do more to prevent fraud, for a time at all events, than legal enactments could. To large numbers of our readers the revelations contained in our columns have, beyond question, come with a rude shock. The proper course to be pursued by the honest chain and cable makers is to diffuse, as fully as possible, information concerning the difference between good and bad chains. For instance, some of our correspondents ought to give the actual figures showing the net cost of chains and cables of good and of bad iron. Purchasers would, from these figures, see at once that nothing but rubbish can be supplied at the prices but too often paid.

This case presents itself in a two-fold aspect. We have to consider the action taken by both the maker and the purchaser. That the latter wants a good chain at a low price is proved by the fact that he always expects to get a chain made of some iron with a fine reputation. We are informed that it is very difficult to sell a cheap chain unless it professes to be a good one; and, curiously enough, in some cases the cheaper the chain the more anxious is the purchaser about the brand. There are always people who believe in getting bargains. In the chain trade, at any rate, they do a great deal of harm, for they hold out a premium to dishonesty. Such men require to be protected against themselves. Other purchasers pay fair prices, and ought to get much better chains than they do. These men require to be protected, not against themselves, but against the chain-makers, and how best to do this is the crucial point. The "hall-marking" of chains, which we have suggested, would be fatal to dishonesty in manufacture. The chain would have to be what it professed to be, or it would not stand the test. The price would, however, be augmented, and against this very strong objections would no doubt be urged in certain quarters. There is, however, really no objection to the use of cheap and presumably bad chains under certain conditions. No such conditions exist on board ship, and on land a bad chain would be used at the owner's pecuniary risk.

Sailors and workmen are, however, not the only individuals who have a grievance against the fraudulent chain-makers or sellers. Firms of high reputations are seriously injured. Not only do they lose the sale of iron which they ought to sell, but the stuff actually sold ruins reputations that have taken generations to acquire. The extent to which frauds of this kind are practised is not fully understood. Not long since a member of a firm of ironmasters met for the first time a broker in a large way of business. The latter in the course of conversation said, "Well, we ought to see more of each other, for I sell a good deal of your special brand." "Indeed," was the reply, "I did not know that. How much do you call a good deal?" "Well," answered the broker, "I disposed of about 600 tons last year." The ironmaster pondered over this thing, and on returning he referred to the books of the firm, and found that the broker had really purchased from the firm just 30 tons. We leave our readers to explain the discrepancy. Possibly the broker had purchased 570 tons of the special iron from some other broker. Possibly he had not. The story is true, however. It is, we think, time that a determined effort was made by first-class firms to put an end to the frauds which are slowly sapping their vitals. We could name one brand of iron now which has for a very long period indeed enjoyed a splendid reputation, and the sale of which in one district abroad promises soon to be at an end; and this simply because the market in question has been flooded with worthless rubbish bearing the celebrated brand in question. The very name of this iron has become a bye-word and a reproach, and its place is being filled by German bars. We have no doubt that this is in no sense or way an isolated case. If the respectable firms would take the trouble to make facts known, and above all if they would band themselves together to hunt down and prosecute with the utmost rigour everyone trading on their reputations, a great change for the better would soon be wrought. If this is not done very serious consequences may be anticipated in countries and districts where English iron now finds a good market. Let us, for example, take Burmah. All eyes are centred on it as a splendid future market. Eastern nations can make no use of an inferior iron. What will happen to the reputation of English iron if Burmah is flooded with wretched bars which will work neither cold nor under the hammer; at once red short and cold short, and bearing the brands of the best houses in England? Will not the natives be quick to say—"If this is the best iron England can make, we must look elsewhere for a supply?" Vigorous action is needed to put a stop to frauds which have been suffered to assume serious proportions. May we hope that the ventilation of the whole subject in our pages will be only the first step towards the wished-for end?

UNAPPROVED ARMOUR-CLADS.

ONE of those awkward things designated "an open secret" has lately appeared with regard to the projected armour-clads the Trafalgar and the Nile. These two ships, the construction of which is just being commenced, will be the largest ships in the British Navy, and will each cost, with her armament, a million sterling. It might be supposed that the construction of these enormous and costly vessels would not be entered upon without the most careful consideration of everything which can appertain to their efficiency as engines of war. Larger than the Inflexible—though not to any marked extent—these ships might be expected to embody, in their structure and equipment, the most advanced ideas as to offensive and defensive power. In nothing ought these ships to fall behind their competitors, whether at home or abroad. Yet on the very threshold of this affair we are met with the astounding statement that the design on which these two sister ships are to be constructed is *minus* the approval of the late Director of Naval Construction, Sir N. Barnaby, and also of that gentleman's successor, Mr. W. H. White. Neither of these eminent naval architects identifies his reputation with these coming armour-clads. Neither one nor the other designed them, and we believe we are right in saying that the opposition of Sir N. Barnaby to the construction of these ships was and is of a very emphatic character. With regard to Mr. W. H. White, it may be sufficient to say that he simply withholds his concurrence from the proposal to build ships of such a type. The question arises, therefore —

Who designed these ships? Not only so, but who is to be held responsible for them when they are finished? The design could not have dropped from the clouds; but we fear that the responsibility concerning it is of a very hazy description. We need not suppose that the design is actually bad *per se*. It is sufficient to fear that it is bad relatively. A Lord Mayor's coach might be very admirably planned and properly built, but it would be a very poor substitute for a locomotive. This is the kind of objection which applies to the Nile and the Trafalgar. They may be very good ships in themselves, but the British Navy wants something else. As the most costly and the largest ships in the whole fleet, they ought not merely to exhibit superiority to the other ships of the navy, but they ought to show the maximum effect producible from the expenditure that is to be devoted to them. In this they will infallibly fail, and their inception is marked by absurdity, as falling dismally short of what is required of the latest and most costly of British iron-clads.

We shall doubtless be asked for the particulars on which this indictment is founded. First, with regard to the armour. It is said that these ships are to have steel-faced armour 20in. thick. This is no great achievement, seeing that the Inflexible has armour of 24in. The latter, being of iron, is probably inferior to the steel-faced plates of the new ships. But why not retain the thickness of 2ft. as a maximum, and couple with this the increased resisting power due to the face of steel? The 110-ton guns of the Italian Navy have penetrated 19in. of steel-faced armour, so strongly backed that we may rest assured the 20in. on the Trafalgar or the Nile would yield to the blow. But this does not end the story. The armour is not 20in. everywhere. A concession has been made to Sir Edward Reed by lengthening the belt along the water-line, with the inevitable result of thinning the armour upon the citadel. As a consequence, the heart of the ship is accessible to the enemy's fire. It is putting armour upon a man's legs and thinning the breastplate. The man may save his shins and get his heart pierced. After all, the belt does not extend the whole length of the ship, at least one-third of the water-line being left without this defence, the sole protection there being the under-water armoured deck, for which Sir E. Reed generally expresses such profound contempt. From a consideration of the armour we may proceed to a survey of the guns. Here, indeed, we witness a falling off of a most extraordinary character. The Inflexible carries her four guns of 80 tons each. But these two armour-clads, embodying somebody's latest ideas, are to have nothing heavier than breech-loaders of 66 or 68 tons, four being in each ship, carried in two turrets. That these guns are more powerful than those of the Inflexible is no answer to the objection that they are not so powerful as they ought to be. How do they stand in comparison with the 110-ton guns of the Italian fleet? Even our own Benbow, one of the despised "Admiral" class, will carry a couple of 110-ton guns. Again, in the element of speed what do we find? The projected rate is 16 knots. An attempt is made to get up a belief that the speed will be 18 knots. But this is mere conjecture, and when we remember that the practice now is to make the contractor specifically undertake the highest practicable speed, or very nearly so, there is no reason to expect that the coming ships will exceed the proposed rate by any important amount. Perhaps half a knot more may be looked for, but nothing further is probable. That the wish should be father to the thought concerning this higher rate of speed is readily accounted for. The Italia, just about to commence her steam trials, is expected to realise 18 knots, and anything less from the British ships would be intolerable. Commenced eight or nine years ago, the Italian monsters, Italia and Lepanto, took their start in a period when there was less light on the armour-clad question than now exists. The year 1886 is not as 1877 or 1878, so far as naval armaments are concerned. We do not say that a ship of 12,000 tons displacement can be reasonably expected to vie upon all points with one of 13,500, but assuredly she ought not to lag so far behind as to carry guns of 68 tons instead of 110 tons, and to have a speed of 16 knots as opposed to 18, with armour somewhat thinner than that of the foreigner.

We grant that the armour-clad question is one of great difficulty. So it has been from the first; but more especially now. The difficulty culminates at last in a conflict of opinion between the Board of Admiralty and its technical advisers. It may be said that the question is rather one of policy than of naval architecture. To a certain extent this may be true, yet one element overlaps the other in a manner which renders a complete severance impossible. Sir N. Barnaby does not absolutely object to armour-clads, neither does Mr. W. H. White. But seeing that we have a certain number of armour-clads already in the navy, the question arises as to what is the real need of the present hour. The two authorities just named are perhaps better able to estimate the merits and defects of different classes of ships than the usual members of a Board of Admiralty. Minds technically trained may be supposed to discern with peculiar readiness the weak points in a ship of given design. The defects which now beset the armour-clad are doubtless realised with peculiar keenness by those who have most to do with the introduction of such ships. If ever there was need for a Committee of Inquiry into this matter, it is now. Some years ago we had a Committee on Designs for Ships-of-War. Such a committee need be appointed again, and there is this happy feature with regard to the suggestion, that it has the support both of Sir E. Reed and Mr. W. H. White, while to these names may be doubtless added that of Sir N. Barnaby. In the current number of *Harper's Magazine* Sir E. Reed has an article on "The British Navy," which partially revives the old controversy concerning the Inflexible, and reiterates to the full the furious criticisms put forth by the writer in his letters to the *Times* with regard to the "Admiral" class of armour-clads as well as other ships. Sir Edward declares that the "whole series of so-called first-class iron-clads, of which only about one-third of the length has been protected by armour, are quite unfit to take a place in any European line of battle." The present condition of the British Navy is spoken of as "deplorable." One cause of this degeneracy is said to be the sustained attempt of successive Governments to keep the naval expenditure within or near to a fixed annual amount. Hence, the size and cost of our first-class ships have been cut down to suit a financial pressure. Of course, this argument makes no reflection on the naval architects concerned in designing the ships in question. But Sir E. Reed complains that another source of mischief has consisted in reducing the extent of armour carried by the principal vessels, rendering them, in his opinion, quite unfit to take part, with any reasonable hope of success, in any general engagement. Certain ships which the authorities consider to be armoured Sir E. Reed refuses to recognise as such, and in this way as many as a dozen are struck off the list, namely, the Ajax, Agamemnon, Anson, Benbow, Camperdown, Collingwood, Colossus, Edinburgh, Howe, Rodney, Imperieuse, and Warspite. To this there is an addition of two ships of 10,400 tons displacement, with 18in. armour, and five cruisers of 5000 tons displacement, with 10in. armour, recently ordered by the Admiralty to be built by contract. The objection to these ships is that, although they have some armour on their sides, "they are liable to capsize at sea from injuries inflicted on their unarmoured parts." The Inflexible is omitted from the list, "out of compassion upon those officers of the Admiralty who have long ago repented those trying compromises with conscience, by aid of which they expressed some slight confidence in her ability to float upright with her unarmoured ends badly damaged." With this sarcastic stroke, Sir E. Reed intimates that although his condemnation of the Inflexible has been refuted by a thoroughly qualified tribunal, he is "of the same opinion still."

That Sir E. Reed should be thus disposed to criticise ships which do not represent his own ideas, is, of course, to be expected. But to this we have now to add that two responsible advisers of the Admiralty are far from satisfied with certain recent designs. Sir N. Barnaby is free now to say what he likes, but the question is not merely one between himself and Sir E. Reed. These two authorities may controvert each other to any extent, but the interest of the public lies in knowing what is the real state of the Navy, and what are the prospects for the future. If our ships are defective, as Sir E. Reed declares, the fact should be placed beyond the reach of controversy. If the attack is unreasonable and groundless, let the public mind be reassured. If the coming Nile and Trafalgar, though uncondemned by Sir E. Reed, are not what they ought to be, let the design be altered while alteration is practicable. A properly constituted committee to investigate all these points is the need of the hour. If such a committee should be appointed—as we trust will be the case—one result, we expect, will be this, that they will advise caution in laying down any more armour-clads. But if such a committee is to be of any service, it must be more expeditious in doing its work, and more unanimous in its verdict, than committees of the kind have been heretofore. Better no committee at all than one which will merely serve as an excuse to baffle inquiry.

TRIPLE EXPANSION ENGINES.

The literature of the triple expansion engine is at present extremely limited. Indeed, all that has been written on the subject might be put within the covers of a very small volume. It is comprised in certain papers read before engineering societies, and articles which have appeared from time to time in our own and other technical journals. It is with the more pleasure, consequently, that we have read a pamphlet, "Etude sur les Machines Compound à Triple Expansion," by Mons. Maurice Demoulin, and published by Messrs. Baudry and C., Rue des Saintes-Pères, Paris. The position held by Mons. Demoulin with the Société Ateliers et Chantiers de la Loire, has enabled him to write with a competent knowledge of his subject, and we can strongly recommend the work to those of our readers interested in steam navigation. It is not our intention to review the pamphlet here, but it contains some statements the accuracy of which seems to us to be open to question. These statements have not, we think, originated with Mons. Demoulin, and his responsibility for them is perhaps one of adoption only.

It is commonly assumed that one of the reasons, if not the reason, why the compound engine is more economical than the simple engine, is that the range of temperature in the cylinders is smaller. As Mons. Demoulin puts it, the condensing power of the cylinders of a compound engine is less than that of the cylinder of a simple engine; and he gives a table illustrating this theory by a practical example. No doubt to a certain extent he is right. He assumes an initial pressure of 127 lb. per square inch, a back pressure of 4 lb., and a total range of expansion 10. He then states the case for three different engines of the same power. The first has a single cylinder, with a stroke of 1 metre, and a diameter of 1·5 metre; the second is a compound engine, with a stroke of 1 metre, a high-pressure ·75 metre, and a low-pressure cylinder 1·5 metre in diameter; and lastly, a triple expansion engine, with a stroke of 1 metre, and cylinders ·61, ·96, and 1·5 metre diameter respectively. He multiplies the surface in each cylinder by the range of temperature in it, and adds all the products together, getting as the coefficient of condensation in the single-cylinder engine 895·98, in the double-cylinder 686·34, and in the triple expansion 585·06, showing an advantage of 15 per cent. possessed by the double over the single-cylinder, and 34 per cent. possessed by the triple-cylinder over the first. This calculation is based on the amount of surface in each cylinder. The large cylinder is the same in all the engines. Its diameter is 59in.; its condensing surface, allowing for clearance, will be 7412 square inches for the cylinder walls, and 10,932 square inches for two piston faces and two covers, or 127·3 square feet. We have made no allowance for passages or piston-rods; yet Mons. Demoulin makes the surface only 8·22 square metres, or 88·5 square feet. Multiplying 127·3 square feet by the range of temperature due to a fall of pressure from 127 lb. to 4 lb., we have 24,441, in round numbers, as the coefficient of condensation of the single-cylinder engine. In the triple expansion engine the high-pressure cylinder has a surface calculated in the same way of 33·5 square feet, but Mons. Demoulin makes the surface only 26·88ft. The intermediate cylinder has by our calculations a surface of 64 square feet; by Mons. Demoulin's, 46 square feet. He assumes the fall in pressure in the first cylinder to be from 127 lb. to 50 lb. The range of temperature is 64 deg. The fall in the intermediate cylinder he assumes at 50 lb. to 21 lb., or 51 deg., and for the low-pressure cylinder 21 lb. to 4 lb., or 77 deg.

Multiplying the areas by the ranges of temperature, we have for the high-pressure cylinder $33·5 \times 65 = 2177$ as its coefficient of condensation. For the intermediate cylinder we have $64 \times 51 = 3264$, and for the low-pressure $127·3 \times 77 = 9802$. Summing up, we have 15,243 as the coefficient of condensation in the triple expansion engine, a result different from that given by Mons. Demoulin. It seems probable that he has in his calculations forgotten to include the surfaces of the pistons, which are quite as potent for condensing purposes as the surfaces of the cylinders. The influence of the passages is also very considerable, especially in some types of engine in which the ports are very long; the high-pressure slide being some way from the cylinder, as, for example, in the engines of the Arabian, an excellent lithograph of which is given by Mons. Demoulin. Indeed the proportion borne by port and valve surface to that of the cylinder is often very large, and ought not to be neglected. His calculation is also to some extent invalidated by the fact that he has in all cases taken the terminal pressure in one cylinder as the initial pressure in the next, which it never can be. The range of temperature in each cylinder will therefore be less than he has made it, so that he has sacrificed a point in his own favour, balanced, perhaps, by the circumstance that inasmuch as there is a continual rise and fall of temperature in the intermediate receiver or receivers, there is probably condensation and re-evaporation going on there, of which he has taken no notice.

All calculations of this kind are, however, vitiated by the remarkable fact that condensation in the high-pressure cylinder of a triple expansion engine is known to be not less than that which takes place in the single-cylinder engine. It is not, perhaps, easy to explain the cause. It is possible, however, that the whole body of steam comes more freely in contact with the metal of the small than can be the case with a large cylinder. It has, at all events, long been known that the efficiency of a jacket augments as the diameter of the cylinder decreases, and this can only be because cylinder condensation diminishes as the diameter of the cylinder is increased. It matters nothing, be it understood, how initial condensation takes place, so long as it does take place. That is to say, the loss of efficiency would be the same whether part of the condensation took place in each cylinder of a triple engine or all in one. The boiler does not know what becomes of the steam, and if, as is sometimes the case, over 40 per cent. of the whole is condensed in the high-pressure cylinder, the loss falls directly on the boiler, and will be the same as though 40 per cent. had been condensed in a single-cylinder engine. But it is very well known that, be the condensation what it may, the resulting water does not to the end remain water in the engine. A portion, at all events, is sure to be re-evaporated. The economy of the compound engine depends on the fact that the resulting steam is used expansively in the second, or in the second and third cylinders. Mons. Demoulin recognises this himself, for he says:—"Les moteurs à detente multiple doivent leur supériorité économique, en partie aux causes que nous avons signalées, en partie à un fait tres important qui, jusqu'á nos jour, a echappé à la plupart des savants et des ingénieurs, et qui consiste en ce *la vapeur condensée au petit cylindre agit, après sa réévaporation, sur les pistons des cylindres d'expansion pendant tout la course et avec une détente qui lui est propre*, puisque l'introduction est limitée à une fraction de la course. Avec la machine monocylindre, au contraire, la vapeur produite par la réévaporation pendant l'expansion, dans le cylindre, de l'eau de condensation, *ne se détand, mais agit simplement comme si elle était fournée, a pleine admission par une chaudiere distincte*, a la pression correspondant; on perd ainsi un notable quantité de calories." The italics are Mons. Demoulin's. We believe that we were the first to place this fact before English readers, though it was about the same time announced in the United States. In one word, the compound engine is more economical than the simple engine working with the same range of temperature $T - t$, because in the former the principle of expansion is more fully carried out.

THE SOUTH STAFFORDSHIRE MILL AND FORGE WAGES BOARD.

The presidency of the South Staffordshire and East Worcestershire Mill and Forge Wages Board—one of the most important industrial posts in the country—has this week become vacant. On Wednesday the formal resignation of Mr. Thomas Avery was read before the annual meeting of the board in Wolverhampton, and was, with many expressions of regret, accepted. Encouraging testimony to the good work the board has done in the past by the prevention or settlement of labour disputes was borne by the retiring president in his resignation letter. In times of trade difficulty there will generally be found some sections of the very wide districts thereon represented who will not be loyal to the decisions arrived at by their accredited delegates. This has been peculiarly manifest just lately. On the whole, however, the existence of what Mr. Avery well terms "a tribunal of conciliation instead of force," cannot fail to be of immense service in an important industrial district like South Staffordshire. Mr. Avery's term of office has not been easy, but the board will not easily find another man to fill the post of president-arbitrator with as much impartiality and forbearance as has lately been exercised. It is satisfactory, however, to know that a gentleman of undoubted qualifications, but whose nam for obvious reasons we do not yet disclose, has been selected as the individual to whom the vacant position shall be first offered.

AN HYDRAULIC ENGINEERING SUGGESTION.

A NEW matter for the consideration of the traders of the Midlands arises out of the question of communication between Birmingham and the seaboard. It is an engineering query that will have to be met directly that anything definite is decided upon, "Where are we to get the water for our new waterway?" In anticipation of such an inquiry, we would suggest that no better source could be found than the South Staffordshire Drainage Commission. It is generally understood that the Commissioners have an immense quantity of water now thrown upon their hands in consequence of their lately providing increased pumping facilities; but it is probably not so generally known what is the exact extent of this available power. The Mines Drainage Commissioners are now raising no fewer than 12,000,000 of gallons a day, or 480 "locks," and at such a level as no other water is raised to in the Midland counties. We state this fact, and leave the matter for the consideration of those who may have to be immediately concerned with the provision of improved canal communications in the Midlands.

COMPOUND LOCOMOTIVES.

THERE is reason to believe that the compound locomotive is not so new as many engineers think. Mr. T. Kitson, who was locomotive superintendent for the Grand Luxemburg before it was absorbed in the Belgian State Railways, has communicated to us the following incident, which occurred quite thirty years ago, on the Great Eastern Railway, while Mr. John Hunter was locomotive superintendent. On the occasion of overhauling an excellent goods engine, with 5ft. wheels and 15in. outside cylinders, one of the latter was provided with a liner, so as to reduce the diameter to about 13in. Steam at boiler pressure was admitted into this—now the smaller cylinder—and was allowed to expand into that of the original diameter by a pipe leading from the exhaust of the high-pressure to the valve chamber of the low-pressure cylinder. The engine was one of three—numbered 190, 191, and 192—made by Robert Stephenson and Co., of Newcastle, and altered in the Stratford shops. It ran regularly with goods trains between Stratford and Norwich, and made its presence known from a distance by two beats of the exhaust instead of four.

CONVENTION OF MILLERS AND MILLING ENGINEERS.

A GREAT convention of millers and milling engineers will be held in Dublin on June 8th, 9th, 10th, and 11th. It is expected that about 500 British millers will attend. Various papers will be read and a large number of mills visited. As the Irish wheats are softer than foreign grown wheats, Mr. Hibbard, of Gloucester, has promised to read a paper on "The Suitability of the Roller System to treat Soft and Mellow Wheats." A paper will also be read by Mr. Gilbert Little, manager of the Carter Automatic Firm of Milling Engineers, the inventors of the English roller system, on "Utilising the Latent Abilities of the Operatives engaged in Milling." This paper, it is understood, will formulate a scheme by means of which any working miller or millwright who invents or improves any machine will be awarded a sum of money according to the value of the invention or improvement.

LITERATURE.

Monografie Tecniche. G. B. BIADEGO. Verona. Libreria Munster. 1885.

THIS volume deals with bridge construction. It gives in great detail the calculations and the tests of several recent iron bridges erected in Italy. It describes also some of the wonderful old masonry bridges that are the pride of the Italian descendants of the Romans, and are perhaps unsurpassed in the modern history of masonry as regards either design or workmanship.

It is a volume, the like of which, unfortunately, is rarely published in England. The get up of the book, with its 500 large pages of text and its splendid atlas of twenty-eight plates, each at least 10in. by 24in., is necessarily expensive, and if Italian publishers find a large sale for such literature, it is more, we fear, than English publishers would succeed in doing. If it is a financial success in Italy, the Italians must be more eager students of the higher engineering than we are. We can only regret that we have not yet come up to their level in this respect.

The first bridge dealt with is an iron arch over the Adige, at Verona. This river is subject to very violent floods, which have often carried away the old stonework structures. A minute historical notice of previous bridges on the same site begins the chapter. In the new bridge the roadway is nearly level, being a flat circular arc with a rise of 1·1 metre in a span of 86·8 metres between the lower parts of the masonry. The circular arch which supports this roadway has a span of 88·8 metres, and a rise of 10 metres, its radius of curvature being 103½ metres. Its section is uniform throughout. It is in reality a trellis box-girder, 1·3 metres deep, 0·7 metre wide, and having top and bottom member composed each of four ½in. plates, and four 3½in. angle irons. The level of the roadway is 2½ metres above the abutments of the main arch. The road is hung from the arch by verticals, no attempt being made to stiffen the bridge by triangulation between arch and roadway. The maximum stresses prescribed by the Public Works Council were 6 kilos. per square millimetre for bending stresses, and 5 for shear. The live load prescribed for the calculations is 400 kilos. per square metre, equivalent to 82 lb. per square foot; but the bridge was really calculated for a load of 560 instead of 400. The permanent dead load was nearly 1½ times this possible maximum live load. The horizontal component of the abutment thrust is calculated by the formula—

$$\frac{p\,l^2}{2\,H}\left\{1-\frac{\frac{I}{A}\left(1+\frac{4\,H^2}{3\,l^2}\right)}{\frac{8}{15}\,H^2+\frac{I}{A}}\right\}$$

in which p is the total load per metre run, l the half span, H the rise of the arch, I the moment of inertia of the section, and A its area. This formula is calculated on the assumption that the abutments do not give way in the smallest degree under the thrust. The principle of the calculations is that the pair of abutment thrusts have such magnitudes that if they existed by themselves they would produce a contraction of the span equal to the elongation of the span that would result from the separate action of the vertical loads and the balancing vertical components of the abutment thrusts. The calculation, of course, involves the modulus of elasticity of the material of the arch and also the modulus of yielding of the abutments. Neither of these moduli appear, however, in the above formula because the yield of the abutments is put equal to zero. Elaborate calculations are given of the bending moments, normal and shear forces, position of centre of pressure, and stresses on outside and inside edges of each section of the arch. These are worked out both for the case of the whole span being loaded and for that of the load covering one half only of the span. The rise of the arch and the alterations of the above various stresses produced by variation of temperature are also calculated. The stability of the abutments is dealt with graphically. The total cost of the bridge was nearly £10,000—L260,000—of which the metal work cost about four-fifths. The metal used in the bridge was over 400,000 kilos. in weight.

Another somewhat remarkable bridge described is a light arch with a span of 83 metres over a rapid torrent. The rise is 10·8 metres, and the arch is struck to two different radii. The roadway passes over the crown of the arch, which is only 20in. deep at the centre. The roadway longitudinal girders are connected stiffly with the main arch by triangulation of very substantial cross-sectional dimensions. The whole is thus converted into a pair of very stiff girders, connected at the centre by a weak flexible section. That is, the central section, although amply strong enough to resist the horizontal thrust through it, has very little stiffness against bending, and the engineers assume that the crown can rise and fall with variation of temperature practically as freely as if there were a hinge at the centre. For this bridge similar full details and calculations are given. In describing other bridges a large amount of information is given as to the work done in sinking screw piles, the progress of the work being plotted out in curves in a very interesting manner.

It seems very curious that amidst all these elaborate calculations no attempt appears to have been made to deal with the problem of wind pressures. Of course, the bridges are provided with wind bracing, but no calculations are given of the forces arising from winds, nor of the necessary sections to resist them.

All these bridges were tested for deflection in various ways, and the records of these tests were obtained by ingenious autographic apparatus. Properly-constructed pencil-holders were clamped to the various important points of each bridge, and these pencils were made to scribe curves on sheets of paper, either held fixed or kept moving at a uniform rate by clockwork. The paper sheets were mounted on apparatus fixed to the centreing that had been used during the erection. Thus autographic records were obtained of the various deflections caused by different motionless loads, of the oscillations produced by various rolling loads, and of the deformations due to change of temperature. These last temperature-deflection records cannot be counted as so trustworthy as the others, because the wooden centreing which supported the paper drums must have been affected by the change of temperature as well as the bridge itself, although not to nearly so great a degree. From those curves it is most interesting to compare the effects of motionless and rolling loads, the latter running at various velocities.

The latter part of the book contains descriptions of old masonry bridges, illustrated by capital drawings. One of these has a span of 48·7 metres, with a rise of 12·1 metres—160ft. by 39·7ft. Another has 72·25 metres span, with 20·7 metres rise, the radius being 42 metres—237ft., 67·9ft., and 137·7ft. Both of these are circular arches. The building of the latter was finished in A.D. 1377, and it was destroyed in A.D. 1416 by a military operation. It had thus a life of only thirty-nine years. It was at Tresso, and spanned the river Adda. The former is the largest span of a bridge of three spans leading over the river Adige, at Verona, to the Castel Vecchio. It was built in A.D. 1354. This bridge still stands.

PRIVATE BILLS IN PARLIAMENT.

WITH the re-assembling of Parliament, attention will be again directed to the position of Private Bills; and there having been so much delay in getting the Legislature into working condition, the parties to these measures will be anxious to learn what chance of progress there may be. As we have previously stated, there has been a sufficient allotment of Bills to the respective Houses to enable both to get to work as soon as they can appoint their Committees; and considering the uncertainty there is as to how long the present Parliament will last, the sooner operations are begun the better it will be all round. Of the total Bills divided between the Lords and Commons, about two-thirds are given to the Lower House, and with the exception of the Hyde Park Subway all the principal Metropolitan and the leading provincial Bills will "originate" in the Commons—the Channel Tunnel and the Ship Canal Bills being among the number. Four Bills have already collapsed, viz., the Brighton, Rottingdean, and Newhaven Railway; the Blackpool Corporation; the Portland Water; and the Southampton Corporation Dock Bills.

At the last meeting of the Metropolitan Board of Works, an interesting discussion took place upon some portions of the London Street Tramways Extensions and North Metropolitan Tramways Bill, which we have described in a previous article. The whole subject having been referred for examination to the Works and General Purposes Committee, that body recommended the Board to assent to the first-named Bill, on condition that the Company gave an undertaking to omit from their scheme the power to make tramways in a part of Chalk Farm-road, Adelaide-road, and Gray's-inn road; that they inserted a clause providing that the proposed line along the Highgate-road should not be made until the Archway had been widened to the satisfaction of the Board and of the St. Pancras Vestry; to defer making the Junction-road section till that road had been widened to the satisfaction of the Board and of the Islington Vestry; and to further amend the Bill as required by the Board. Mr. Phillips proposed to omit the stipulation as to the Gray's-inn-road section, and this amendment being carried the rest of the report was adopted. In a similar manner the Committee dealt with the Bill of the North Metropolitan Company, advising the assent of the Board if the company would omit the portions of their scheme in Theobald's-road, Gray's-inn-road, and Leman-street. Mr. Phillips again intervened, and moved that the company be also required, as a condition of assent, to omit some other lines projected, and to undertake that the Theobald's-road section should not go further west than Devonshire-street. This amendment was also carried, and thus reduced, the report of the Committee was agreed to.

The West London Electric Lighting Bill will be opposed by the vestries of St. James's, Westminster, St. Martin-in-the Fields, and St. George's, Hanover-square; and the Conservators of the River Thames have petitioned against the London, Tilbury, and Southend Railway Bill. Memorials have been deposited against the East London Water Bill by the Poplar District Board of Works, the Waltham Holy Cross Local Board, by E. Lee and Herbert Walker, and the Great Eastern Railway Company; by the Great Eastern Railway against the Greenwich and Millwall Subway Bill; by the vestry of St. Martin-in-the-Fields against the Horse Guards'-avenue Bill; and by the Surbiton Improvement Commissioners against the London and South-Western Railway Bill. The Bill of the Rhymney Railway Company, for the construction of new lines into the Monmouthshire valleys, at a cost of £800,000, is to be opposed, at least by some of the shareholders, who are of opinion that such an expenditure ought not to be incurred unless the company first obtained guarantees from the colliery and ironworks proprietors that they would send their traffic over the new lines instead of over the Great Western system as they now do. This is a somewhat novel condition to set up, but the proximity of so formidable a competitor as the Great Western may well make the Rhymney Company cautious.

The City Commissioners of Sewers intend to petition against the East London, Lambeth, and Southwark and Vauxhall Water Bills in order to secure a *locus standi* before the Committees, with a view, *inter alia*, to so altering the law that consumers shall only pay for the water used, and not according to their rateable value. This water question is likely to be vigorously raised this year in various forms, and not alone in regard to London. The Oldham Corporation, for instance, are promoting a scheme for extending their supply, and within the last few days opposition has sprung up from a very unexpected quarter. The Corporation, it seems, have arranged to purchase a reservoir at a spot on the banks of a stream which flows into the Calder, near Elland in Yorkshire; but they seek power to construct three other reservoirs on the same stream. The Calder, however, flows through the busy town of Dewsbury, and the inhabitants of that borough have suddenly resolved to petition against such a diversion of water, on the ground that the proposed scale of compensation is much too small (viz., 9 in.), and that already the flow of water is not sufficient to deal adequately with the sewage coming down from numerous towns and villages past Dewsbury. On similar and on other grounds, the Wakefield Corporation, and the Aire and Calder, and Calder and Hebble Navigation Companies also intend to oppose the Bill.

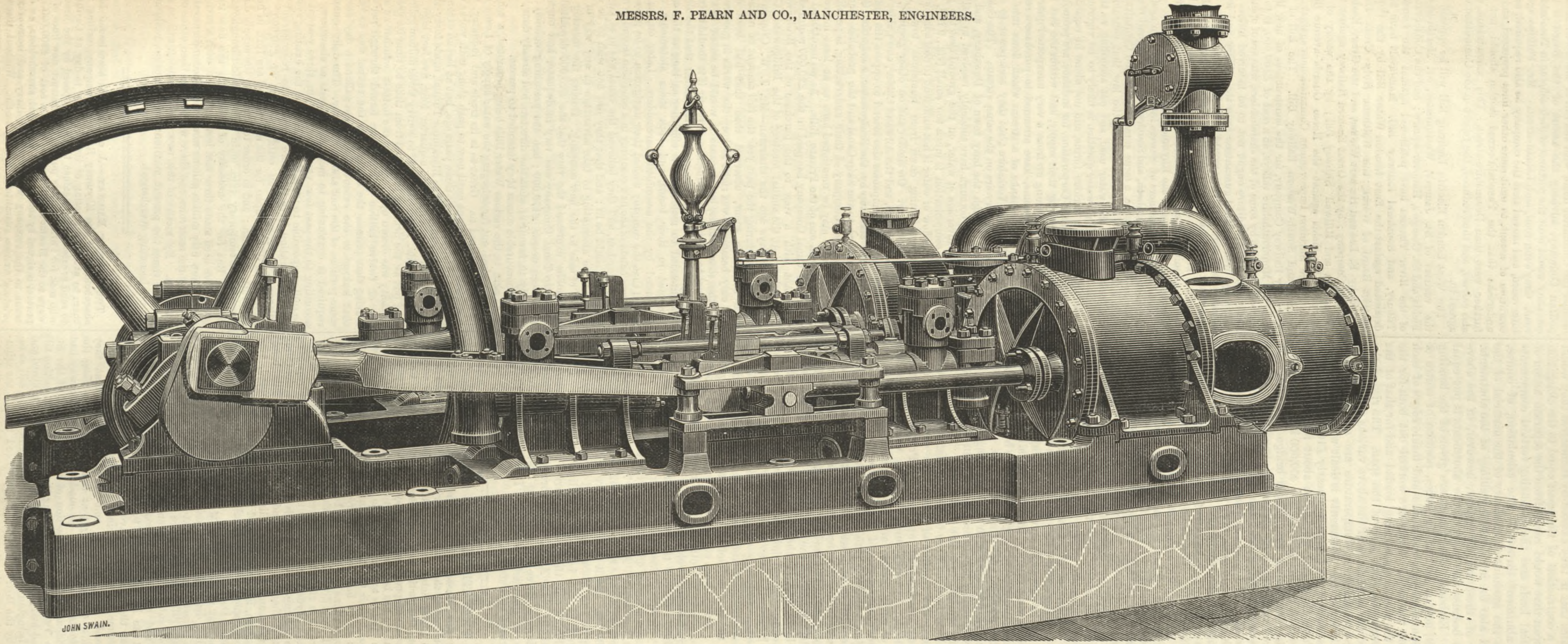
The attitude taken up by the Bridgewater Navigation Company, with regard to the Ship Canal and the probable acquisition by the Canal Company of their undertaking, is peculiarly interesting, and may be mentioned here as at least indirectly connected with one of the Private Bills. As we mentioned last week, the Canal Company has paid in the £20,000 required by their Act with a view to the purchase of the Bridgewater Navigation. At the annual meeting of the Bridgewater Company a few days ago the chairman—Mr. J. W. Cropper—in stating that during the past year the full amount of maintenance had been spent, observed that that had been done not only because it was right to keep the works in good repair for the shareholders, but because it would be unfair to allow the canal to fall into anything like disrepair if it should be taken over by the Ship Canal Company. He added that the directors intended to maintain this efficiency as long as the canal remained in their hands, and both these statements were applauded by the assembled shareholders. Later on, he observed that the company wished their navigation to be placed in the very hands of the new company in a condition second to none in the kingdom, and they believed the canal was in as good a state as it could be in; and that they did not wish to be supposed to be attempting to take advantage in any way of the terms of sale to the new company. During the meeting one shareholder expressed the view that the £20,000 deposited by the Ship Canal Company was very inadequate, and ought to have been nearer £170,000; but the prevailing opinion was strongly in favour of what the directors had already done, and of the honourable course they intended to pursue.

As akin to the various Water Bills being promoted, a scheme being worked out for enlarging the water supply of Leeds may be briefly referred to. Great as is its trade and industry, that town has been content until now to push along with works constructed as long as forty-three years ago, but at last an extension has become imperative. The Blackmoor Tunnel, made forty-three years ago, is only a mile and a-quarter long, five feet high, and three feet wide. It was designed to convey three million gallons a day, but as the demand increased from time to time its greater capacity was drawn upon, until in the hottest weather an average of twelve million gallons were forced through per day. During that process the strain upon the tunnel was so severe that leakage to the extent of a million gallons a day ensued, some portions of the roof also giving way. The daily quantity required is continuing to increase in Leeds as elsewhere, and, according to the past few years' increase, in three years it will be quite impossible to meet the demand by the existing system. The Corporation have therefore resolved to re-construct and enlarge the tunnel, at an estimated cost of £90,000. The dimensions decided upon for the new tunnel are 15ft. in height and 12ft. in width; and in order to keep up the supply during the work, a temporary 40in. main will be laid throughout the tunnel. But for the necessity of this main the new tunnel must have been made three feet less in height, with a saving of £8000, but fifty million gallons would have become unavailable in one of the reservoirs, and there would have been other disadvantages. By means of this new work provision will be made for four times the present maximum consumption, without the tunnel becoming overcharged.

THE RHYMNEY RAILWAY.—A circular has been issued to the shareholders of the Rhymney Railway Company, calling upon them to attend a meeting of the company to-day at Cardiff, or to send proxies voting against the Bill proposed by the directors, who seek for Parliamentary powers to construct new lines of railways to the Monmouthshire valleys, at a cost of £800,000. The protest is signed by some of the principal shareholders, as disastrous to the company without the colliery and ironworks proprietors' written guarantees of their traffic. Without these they would have to fight the Great Western Railway Company, which now conveys the traffic.

STEAM PUMP FOR HIGH-PRESSURE HYDRAULIC MACHINERY

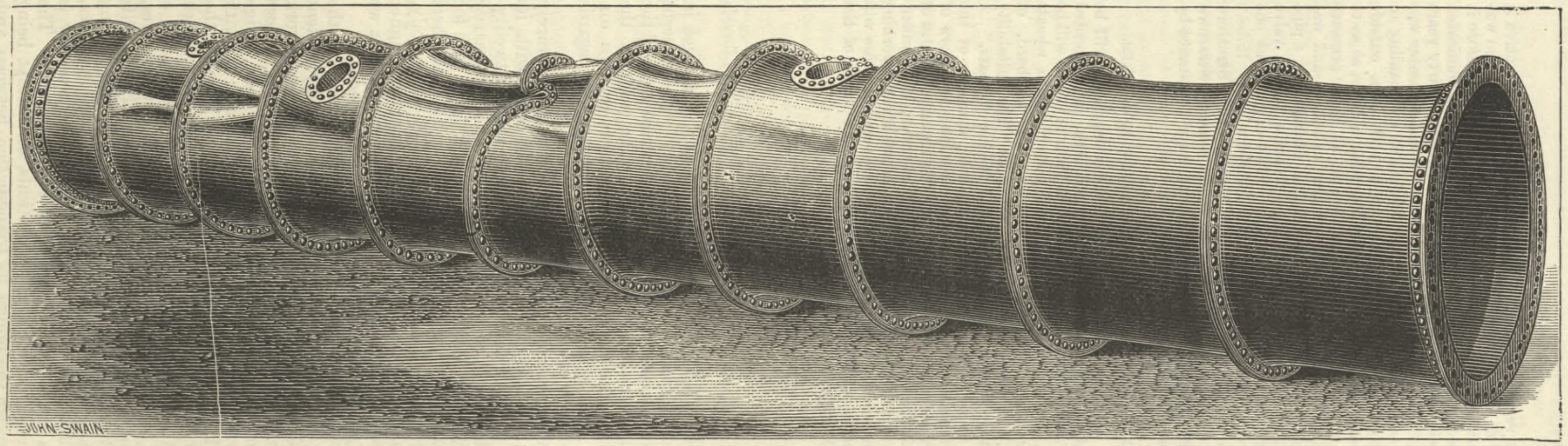
MESSRS. F. PEARN AND CO., MANCHESTER, ENGINEERS.



STEAM PUMP FOR HYDRAULIC MACHINERY.

THE accompanying engraving represents a powerful compound engine erected with other machinery by Messrs. F. Pearn and Co., West Gorton, Manchester, for and in the lead works of Messrs. Walkers, Parker, and Co., Lambeth. The plant consists of one pair of hydraulic pumping engines, one accumulator, and three hydraulic cranes, to be used in the manufacture of lead pipes. The engine and accumulator are arranged to work five pipe presses, each 20in. diameter, 22in. stroke, one 7-ton crane 14ft. radius, one 3-ton crane 16ft. radius, each provided with slewing gear, and one 30 cwt. crane; the water pressure being 3000 lb. per square inch delivered direct from accumulator and pumps. The old system of working the presses was such that they could only work one machine at a time by the same set of pumps, each having to work alternately, pumping through the presses when not required for a charge, and each press taking a considerable time to discharge. Now all the machines can work at the same time, and the charges be got out in two to three minutes.

The pumping engines are, as will be seen from the above engraving, of the horizontal compound tandem type, and of massive design. The high-pressure cylinders are 18in. diameter, and the low 28in. diameter, and the stroke of each 15in., working four 2¼in. rams direct, each 15in. stroke, and against 3000 lb. per square inch with 50 lb. steam pressure, at a maximum speed of fifty revolutions per minute. The exhaust steam is passed through one of Berryman's feed-water heaters made by Messrs. Joseph Wright and Co., of Tipton, Staffordshire. The terminal steam pressure in the low-pressure cylinder is about 3 lb. per square inch, and the feed-water after passing through the heater is 210 deg. It is passed through the heater by one of Messrs. Pearn's quadruple-acting pumps, which give constant flow, considered necessary when feeding through heaters, especially so where any solid matter is precipitated by the heat or is otherwise present in the water. The high-pressure pumps were cast solid, and the barrels and valve boxes bored out, the object for this being to have the castings as sound as possible, and after being finished they were tested to 10 tons per square inch without showing any sign of the slightest weep. The accumulator is 10in. diameter and has a lift of 10ft., and the ram is loaded with 110 tons of cast iron weights made in sections of 3 tons each, and is arranged to stop and start the engines by its rise or fall in the usual way. In connection with the accumulator there is a valve arrangement to prevent the weights being dropped suddenly on their bearings, and at the same time to prevent the load being taken off the engines suddenly. Should the accumulator from any cause be laid off, there is a second apparatus whereby the engine can be controlled almost as effectively as by the accumulator; it is in fact a miniature accumulator which has complete control over both the engines and pressure, even though all the work on presses and cranes be thrown off at one time. The engines and plant have now been running for about seven months, and are giving complete satisfaction.

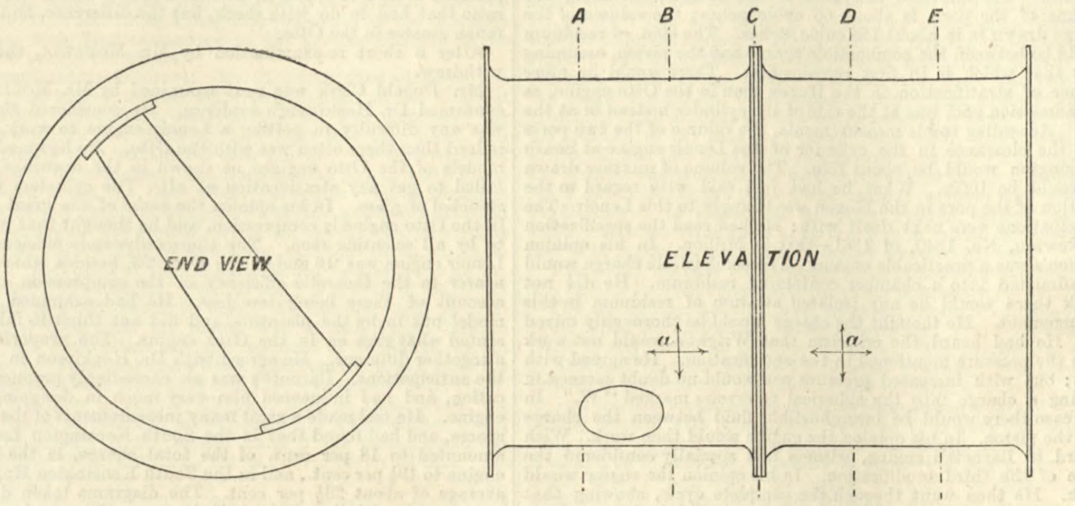


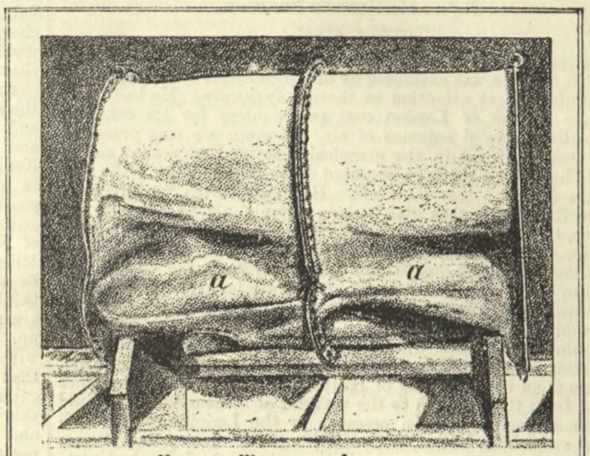
REMARKABLE CASE OF FLUE COLLAPSE WITHOUT DESTRUCTION

A REMARKABLE BOILER FLUE.

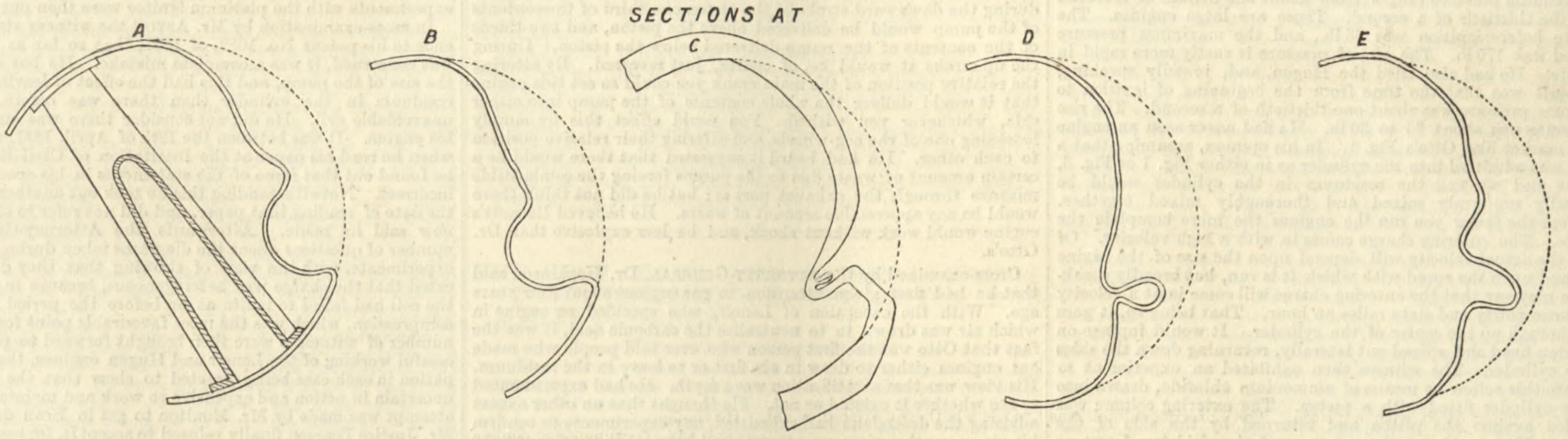
THE engravings, perspective and sectional, which are given herewith illustrate the collapse of what must have been a most remarkable furnace flue, and one which affords another illustration of the excellent character of good steel boiler-plates. The opinion generally expressed concerning the steel plates, to which we recently devoted some space, seems to have been to the effect that anomalous cases occur occasionally, though almost always explicable when trouble is taken to find out the history of any bad specimens, and that steel plates have now been in good behaviour in many hands for so

A REMARKABLE FLUE COLLAPSE.





From a Photograph



long a time that users will not easily have their faith shaken. The material used in the remarkable specimen of a collapsed tube, which we illustrate, will afford confirmation of this opinion, it is perhaps the most remarkable specimen of a collapsed tube anywhere to be found. Through the neglect of the fireman the water in the boiler was allowed to get low, and a fearful explosion would have been the result had the quality of the steel tube not been what it was. The steel plates were made at the West Cumberland Iron and Steel Works, and the boiler was working at a colliery in the Midland counties. The flue was, amongst other things, exhibited at the Calcutta Exhibition, and our smaller engravings we reproduce from the Government report on the exhibition, the large view being engraved from a photograph. Concerning the flue we may quote from the report:—

"A very superficial examination of the indented portion of the flue showed such smooth even curves, and such a limited extent of collapse as to demonstrate that the curves were produced by an evenly distributed fluid pressure, and that the collapsed portion must have been strongly heated when it gave way. Now these are just the conditions of a flue collapse, and in order to secure them, the ends must have been rivetted and enclosed steam-tight. This being so, all the objections raised on the score of lack of markings, &c., of rivet heads fall through. It may be remarked, however, that the object of caulking is to beat the rivet head up to the plate—not the plate to the rivet, and if properly done, the process should barely mark an iron plate, and should not mark a steel one at all; while as regards the cutting out of the rivets, we have no evidence as to the side on which or the manner in which this was done.

"The real difficulty under which most people laboured in this matter was that of realising the great difference in the behaviour of steel* and ordinary boiler-plate iron under such circumstances. One has got so used to speaking of the fibre of iron and judging its quality by the appearance of its fibrous fracture, &c., that its presence is looked upon as an essential accompaniment of the pure metal. This, however, no matter how extensively believed, is to a large extent an error. Much of what is called 'fibre' in iron is the result of intermixed impurity, slag or tap-cinder, locked up in the spongy, puddled ball from which it can never be entirely removed by the subsequent processes of rolling, hammering, &c. The more the iron is subjected to these processes the more slag is removed, and the more uniformly the remainder is disseminated through the mass, but its entire removal is impossible.

"Thus a bar or plate of iron resembles in a sense a mass of pure iron wires, cemented together by a matrix of slag. It is this which gives rise to much of the so-called 'fibre,' and renders iron so much weaker across the fibre than in the direction of its length that boiler-inspectors in England have often referred to the matter in their reports as having an important bearing on the construction of boilers. In steel, all this is changed, the product has been melted, and the slag entirely removed; it is uniform in strength in all directions, as was abundantly shown by numerous specimens in this exhibit, which were bent in every possible way, with regard to the direction of rolling, 'fibre' being practically absent. In applying these important properties of steel to an explanation of the collapse in question, the following brief remarks will suffice:—

"The flue, as will be seen from the annexed drawings, representing side and end-elevations of the original flue, sections at various positions of the collapsed part, and a photographic picture of the exhibit as it stood, was formed of flanged rings rivetted together, each ring consisting of one plate welded and being flanged to form one piece. These separate rings were then rivetted together by their flanges with an expansion ring between to form the flue, the flanges, together with the Galloway tubes, giving great strength to the whole. Two of these rings, apparently those immediately behind the fire bridge, were exhibited, the greatest concentration of heat having apparently been at the junction of the two rings, since the depression on both sides of this was about equal. The first parts to yield to the combined influences of heat and gradually increasing external pressure were those marked *a* and *a*. During their depression the flange was being heated, the level of the water lowered. The depressions increased, and thus brought into play the resistance offered by the tensile strength of the metal. These forces —shown by the arrows at *a a*—increased with the depression, and ultimately were so great, when assisted by the softening of the flange and the external pressure, as to pull it down, and by thus opening the joint to disclose the collapse. The amount of this tensile force may be imagined from the fact that the plate had elongated 6in. in 33in. by the bulging downwards. Had the material been iron of even the best quality, it is all but certain that before the depression had extended to the extent to which it reached in this case, the plate, owing to its comparative weakness across the fibre, still further weakened by heating, would have opened out in the direction of the fibre and have given rise to that phenomenon technically described as 'the steam splitting the iron open,' which was repeatedly impressed upon me as a necessary accompaniment of boiler collapses. This portion of the exhibit has been fully described not only on account of the great interest which it excited at the time, but because of the lesson it affords in the matter of construction of boilers, both as regards the material used in their construction and the forces brought into play in such a collapse, a disregard of which is shown by all recent reports to be the prime cause of nearly all explosions."

* The term "steel," as at present used, embraces all varieties of iron from that practically free from carbon to cast steel containing 1·8 per cent. to 2 per cent. of that element, the essential point being that it has been cast from the molten state in its present condition, and in this differs from wrought iron, which has been worked up from the puddled ball. The purer or softer varieties are known as mild steels and homogeneous iron. Some kinds of steel, however, such as spring steel, shear steel, &c., made by the older methods of manufacture, could not be thus defined, as they have not been formed in the molten condition. The term as frequently used is very ambiguous.

PALMER'S FRAME PULLEY.

"A FRAME pulley," says a contemporary, "is no new thing, but a pulley which has an artistic appearance when applied, and can be applied in about one-eighth the time of the ordinary pulley, is a novelty of interest. Such is the claim made by the manufacturers of the pulley illustrated below from an American contemporary. No chisel is needed in applying it, only a centre bit, the centres for which are made by the marker shown, under

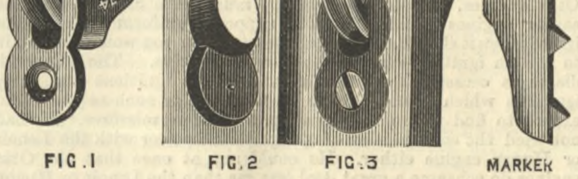


FIG. 1 FIG. 2 FIG. 3 MARKER

a slight tap of the hammer. Fig. 1 shows the pulley complete, showing the corrugated edges, which fit the openings made by the bit. Fig. 2 shows the appearance of the frame when the bit has been used, and is ready for the insertion of the pulley; and Fig. 3 shows the appearance of the frame after the pulley is applied. The marker is sent out with the pulleys for the convenience of the carpenter. It is claimed that the facility with which these pulleys can be put up is, by hand, eight to one over the old mortised pulley, and with a power boring machine twelve to one. The manufacturers are the Palmer Manufacturing Company, Troy, New York."

BRITISH SHIPBUILDING IN 1885.

IN the nineteen or twenty districts devoted to this great British industry, something like a gross total of 540,000 tons of new shipping have been built during the year 1885. The total number of vessels represented in this figure is something like 615, a very large proportion of which—approaching 45 per cent. —have been sailing vessels. The Clyde, as was to be expected, takes first place amongst the shipbuilding centres as to quantitative output, the contribution of that river to the aggregate being 241 vessels, of a total tonnage of 193,458—the smallest output, it may be remarked, since 1879. It is noteworthy that this total is largely made up of small vessels, as many as sixty vessels being under 100 tons each, and sixty-five more being under 500 tons. On the Tyne there have been launched during the year 105 vessels, with a gross total of 102,990 tons—a decrease of 21,220 tons on the output of 1884. The Wear shows a declension, the amount produced this year being 61,770 tons, a result considerably behind that for any of the past seven years. The relative positions of the several shipbuilding districts will be gathered fully from the following table:—

	Name of district.	No. of vessels.	Total gross tons.	Average tonnage.
1	The Clyde	241	193,458	802¾
2	The Tyne..	105	102,998	981
3	The Wear..	46	61,771	1343
4	The Tees	57	34,338	602½
5	West Hartlepool	18	33,030	1835
6	Belfast	17	27,756	1632¾
7	The Mersey	40	27,596	690
8	Southampton	10	19,192	1919
9	Leith	28	8,666	309½
10	Aberdeen..	7	7,399	1057
11	Dundee	13	7,357	566
12	Hull	12	6,191	516
13	Barrow-in-Furness	4	4,058	1014½
14	Workington	1	1,860	1860
15	Maryport..	1	1,548	1548
16	Grangemouth..	7	1,500	214
17	Blyth..	3	1,215	405
18	Chepstow..	3	398	133
19	South Wales	3	90	30

Taking the four North-East Coast of England ports—Tyne, Wear, Tees, and Hartlepool—as a group, and comparing them, as is very often done with the Clyde, as regards aggregate output, it will be seen that they give a total of 231,737 tons, while the Clyde total is 193,458, or 38,279 tons short. Disregarding the Hartlepools, however, the Clyde total is only 5149 tons short of equalling the combined North-East Coast ports output. The number of vessels which go to make up the Clyde aggregate is as high as 241, while for the four ports named the number is only 226—giving in the case of each port, except the Tees, a much higher average than the Clyde.

As showing the relative position taken up by the various large firms throughout all the districts in the grand aggregate output of British shipping, the subjoined list will be found interesting:—

List of Firms whose Output is above 10,000 *Tons, arranged in the Order of their Individual Outputs.*

	Name of firm.	District.	No. of vessels.	Total tonnage.
1	Russell and Co...	Clyde	28	40,866
2	Palmer Company	Tyne	17	25,057
3	Harland and Wolff	Belfast	12	20,492
4	Gray and Co.	Hartlepool	12	20,386
5	Oswald Mordaunt and Co. ..	Southampton	10	19,193
6	Denny and Brothers	Clyde	11	16,423
7	J. L. Thompson and Sons ..	Wear	8	15,551
8	Armstrong, Mitchell, and Co.	Tyne	11	14,266
9	McMillan and Sons	Clyde	9	13,288
10	Swan and Hunter	Tyne	7	12,801
11	Richardson, Duck, and Co. ..	Tees	20	12,799
12	Withy and Co.	Hartlepool	6	12,644
13	Redhead and Co.	Tyne	9	12,241
14	Pearse and Co.	Tees	5	11,711
15	James Laing	Wear	7	11,616
16	Stephen and Sons	Clyde	8	11,549
17	Royden and Sons	Mersey	5	11,523
18	Wigham-Richardson and Co.	Tyne	9	11,388
19	Hawthorn, Leslie, and Co. ..	Tyne	4	11,385
20	Duncan and Co...	Clyde	7	10,626

THE total excavations for the Panama Canal during last month reached, it is reported, 1,100,000 cubic metres. Active preparations are being made to increase that figure. A French firm of contractors have commenced operations between kilometres 26 and 44, the amount of excavation which they have undertaken being 20,000,000 cubic metres.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE, CHANCERY DIVISION.

Before Mr. Justice Pearson.

OTTO *v.* STEEL.

The first witness called for the defence was Dr. John Hopkinson, F.R.S., who was examined by Mr. Moulton. He stated that he had given great attention to thermo-dynamics. He had found that one volume of London coal gas requires for its complete combustion 5½ to 6 volumes of air. If more air was present it would take no part in the chemical reaction, but would simply become heated by the heat liberated during combustion; the final pressure obtained would be less. He agreed with Sir Frederick Bramwell in saying that with a given mass of air, or inert gas and coal gas, the most gradual combustion would probably be a uniform mixture. The rise of pressure would be a little more rapid in the case where the same quantity of gas is concentrated to a certain degree in one part and the other portions are left free from gas, or comparatively free from gas. In the combustion of any mixture the whole of the heat would not be developed at the time the maximum pressure was attained. The pressure that comes upon the piston increases very rapidly after the moment of ignition, the time from the beginning of ignition till the maximum pressure varying from the thirtieth to the sixtieth of a second. He should put the average maximum pressure in the Lenoir, with a full load, at something like 45 lb., something like three atmospheres. In two nominal 12-horse power Otto engines which he had occasion to try some little time ago, he found that the time in attaining maximum pressure ranges from about one-fiftieth of a second up to the thirtieth of a second. Those are large engines. The pressure before ignition was 36 lb., and the maximum pressure attained was 170 lb. The rise of pressure is vastly more rapid in the Otto. He had also tried the Hugon, and, broadly speaking, the result was that the time from the beginning of ignition to maximum pressure was about one-thirtieth of a second. The rise of pressure was about 25 to 30 lb. He had never seen an engine in the market like Otto's Fig. 1. In his opinion, assuming that a charge was admitted into the cylinder as in either Fig. 1 or Fig. 3, the gas and air and the residuum in the cylinder would be practically uniformly mixed and thoroughly mixed together. Therefore the faster you run the engines the more complete the mixture. The entering charge comes in with a high velocity. Of course the actual velocity will depend upon the size of the engine itself and upon the speed with which it is run, but broadly speaking you may say that the entering charge will come in at a velocity of between thirty and sixty miles an hour. That being so, it goes right through up the centre of the cylinder. It would inpinge on the piston head and spread out laterally, returning down the sides of the cylinder. The witness then exhibited an experiment to illustrate this action by means of ammonium chloride, drawn into a glass cylinder fitted with a piston. The entering column was projected against the piston and returned by the side of the cylinder. He considered the existence of the residuum forms no barrier at all. The residuum as a thing separate in any sense disappears in an exceedingly small fraction of a second, and in his opinion, based upon these considerations, he did not believe there was any stratified condition of the charge in the Otto cylinder at the time of ignition. The experiments with the Otto engine with platinum coil for ignition were then gone into. There was a small coil of platinum wire in the middle of the piston, which was connected through the piston and solid portions to wires, conducting the current from a galvanic battery. The passage of the current from that galvanic battery heated that platinum wire to a greater or less extent by increasing or diminishing the power of the battery. The engine was run first of all with the ordinary ignition of an ordinary Otto engine. The ordinary ignition was then cut off and the battery applied. He found then that with a proper battery power he get precisely the same working of the engine, as far as he could detect by the means at his disposal, and the same indicator diagram as he got with the ignition by means of the flame; and he noticed this further, that as he increased the battery power so as to increase the temperature of the wire, and caused it to heat the gas more vigorously, he got an ignition before the compression of the mixture in the cylinder was complete, and when that was done, and it was heated considerably above the point at which he found working successful, the engine was actually pulled up. These results were not consistent with a stratum of incombustible fluid next the piston. He believed that the strongest mixture Otto can have is about 1 to 10 or 1 to 9. Residuum did not differ materially in its operation from other inert gases. It is at a higher temperature, which is undoubtedly a disadvantage. It reduces the efficiency of the engine, because the initial temperature of the complete charge is higher. Another thing is that if you leave the residuum in the cylinder you may have that residuum so hot that when the mixed gas and air enter the cylinder and the piston advances they may be ignited. He did not consider that Otto's specification shows any means of regulating, detaining, or making gradual what would otherwise be a sudden explosion. Even supposing for a moment that there were sufficient directions for keeping a stratum of incombustible gas between the combustible mixture and the piston, in his opinion that would not have any useful effect. A drawing of the Hugon engine at South Kensington was then put in. The main difference between the Hugon and Lenoir engines was that the former had a gas ignition and the latter an electric one. In the Hugon the ignition was at the entrance of the port, just as it is in the Otto. It was a double-acting engine, and the explosions took place at each end. He had seen this engine at work, and it worked without shock. The charge was not measured. He had taken diagrams both when the engine was running light and when it was doing work. He had seen three Lenoir engines at work during the last eight or nine months. The first was at Petworth, the second was in Westminster—the South Kensington engine was brought down there—and the third was at a place in Dorset-street, near Baker-street. He had found no difficulty in setting the Petworth engine to work. It went off at once, and there was no trouble whatever. He took indicator diagrams, but did not ascertain what horse-power it was actually doing effective. It was doing the ordinary work, as he understood, to which it was generally applied. The diagrams would enable the actual power developed in the cylinder to be ascertained. The engine worked very quietly indeed. He had seen the Lenoir engine at Dorset-street doing work, and working without shock. There was no difficulty in starting it. When he went there and had it started at first there was a certain amount of knocking at the middle of each stroke. By putting the hand upon the bearing of the crosshead and the bearing of the crank pin it was at once apparent that that was due to slackness of the brasses—that they were worn. He, therefore, had the engine stopped, and had the brasses tightened up so far as could be done on short notice, and started the engine again. That knocking then practically disappeared, and the engine ran in a satisfactory manner. From his observations on the working of Lenoir and Hugon engines, his opinion was that there was no more shock than in the ordinary high-pressure steam engine. The witness was then questioned as to the advantage in using compression. The primary and most obvious thermo-dynamic advantage was, that if you compress your gas before you ignite it you can carry the expansion of that gas to a very much higher point than you can without that compression before coming down to atmospheric pressure, and in all practical gas engines the lowest pressure to which you can work is the atmospheric pressure. It is not practical to go below that and obtain work. Another advantage was that with a given size of cylinder you can obtain a much larger amount of work, and as a large portion of the loss of work of the heated gases is due to the conduction of the heat through the walls of the cylinder, and as the conduction through the walls of the cylinder will be much the same whether you are working under pressure or without, it is clear that the percentage of waste will be less when working with compression than when working under the ordinary atmospheric pressure. In his opinion compression is the cause of the efficiency of the Otto engine. He had measured the clearance of the Hugon and Lenoir engines. The effective clearance of the Hugon, including the volume of the port, is about 60 cubic inches; the volume of the charge drawn in is about 188 cubic inches. The 60in. of residuum would be between the combustible charge and the piston, assuming that that which is in first remains first. There would be more chance of stratification in the Hugon than in the Otto engine, as the admission port was at the side of the cylinder instead of at the end. According to his measurements, the volume of the two ports and the clearance in the cylinder of the Lenoir engine at South Kensington would be about 15in. The volume of mixture drawn in would be 100in. What he had just said with regard to the position of the port in the Hugon would apply to this Lenoir. The anticipations were next dealt with: He had read the specification of Newton, No. 1840, of 1861—that is Million. In his opinion Million's was a practicable engine. The combustible charge would be admitted into a chamber containing residuum. He did not think there would be any isolated stratum of residuum in this arrangement. He thought the charge would be thoroughly mixed up. He had heard the criticism that Wright's would not work with the pressure mentioned in the specification. He agreed with that; but with increased pressure you would no doubt succeed in getting a charge into the spherical reservoirs marked "W." In this case there would be incombustible fluid between the charge and the piston. In his opinion the engine would then work. With regard to Barnett's engine, witness had specially considered the cycle of the third modification. In his opinion the engine would work. He then went through the complete cycle, showing that during the downward stroke of the piston one-third of the contents of the pump would be delivered above the piston, and two-thirds of the contents of the pump delivered below the piston. During the up stroke it would be, of course, just reversed. By altering the relative position of the main crank you could so set this engine that it would deliver the whole contents of the pump into either side, whichever you wished. You could effect this by simply loosening one of the cog-wheels, and altering their relative position to each other. He had heard it suggested that there would be a certain amount of waste due to the pumps forcing the combustible mixture through the exhaust port *m*; but he did not think there would be any appreciable amount of waste. He believed Barnett's engine would work without shock, and be less explosive than Dr. Otto's.

Cross-examined by the Attorney-General, Dr. Hopkinson said that he had first given attention to gas engines about four years ago. With the exception of Lenoir, who specified an engine in which air was drawn in to neutralise the carbonic acid, it was the fact that Otto was the first person who ever told people who made gas engines either to draw in air first or to leave in the residuum. His view was that stratification was a myth. He had experimented to see whether it existed or not. He thought that no other expert advising the defendant had submitted any experiments to confirm his views or otherwise; no attempt had been made to take out the actual gas from a cylinder, just before ignition, at one, two, or three points. It could be done. He knew that if dilution was carried to a certain point you can reach the limit of combustibility, but had never tried if there was any difference in this respect when gas was let in during the whole stroke to when the same quantity was let in during half the stroke. He thought if there was better ignition in the latter case it was due to the richer charge in the port. The experiment with the glass cylinder was devised about the time Sir Frederick Bramwell had finished his evidence. He had not tried that experiment with anything else except the chloride of ammonium, but he had in other matters in which he had had occasion to try somewhat similar experiments. He considered it would make no difference whether ammonium chloride or any other smoke was used. A model was then produced by the Attorney-General, in which a piston in a glass cylinder was pulled out by a connecting-rod worked from a crank, as in an ordinary engine. The smoke from a cigarette was then drawn in, the witness acknowledging that there was stratification. If he found from three samples of gas taken the moment before ignition that in the one there was 10·5 per cent. of gas—that is the one nearest the point of ignition—and that in the second there was 7·5 of gas, and in the third, close to the piston, 5·8 of gas, that in his opinion would show substantial stratification. What it really does show is this: that there is a difference in the composition of the gas at the points at which you draw it. Stratification means a little more than that; it refers to the position of the gas as well. He had not obtained analyses of the charge. Referring to the platinum wire experiment, he did not think it absolutely disproved stratification. What the experiment proves is simply this, that you have against the piston a readily ignitable mixture. He did not know what the temperature of the platinum wire would be. It could not have been lower than a red heat. He could not tell, without referring, at what temperature combustion of any given mixture would take place. A Hugon engine could probably work with a mixture as dilute as 22 to 1, but he could not say this for certain. If it be the fact that an Otto works regularly with 1 in 30, he could not account for it except by a rich condition of the mixture near to the lighting, and the compression and consequent heating of the mixture. Now, supposing you find with a uniform mixture of 1 in 20, or 1 in 22, you cannot by compression get ignition, and supposing in an Otto engine you took 1 in 30—that is to say, one-thirtieth of gas—but let it in at the last few inches of the out-stroke, and found regular ignition, he could not account for it scientifically, except on the suggestion that there was a richer mixture nearer to the point of ignition. Referring to indicated diagrams, witness said it was the fact that when you are working an Otto you get a much more gradual curve than when you are working a Lenoir with the same mixture. The Otto is actually nearer to the adiabatic than the Lenoir. The descent is not so rapid. He had never worked one engine on the two systems. He had never compared the Hugon way of working and the Otto on the same engine. He could not tell the mixture used in any of his experiments, either with the Hugon or Lenoir engines. He never measured the work that was being done. The Petworth indicator diagrams showed occasional missfires. This did not occur in the Otto engines, therefore something must have happened in the earlier engines which made the supposed uniform mixture not ignite when it should. After a missed ignition you would be certain to get an ignition—probably an early ignition. The Petworth diagrams occasionally show missfires, late ignitions and early ignitions which would be due to missfires, or such as you would expect to find where there had been previous missfires. He had not tried the consumption of gas per horse-power with the Lenoir or Hugon engine either. He could say at once that the Otto engines do consume a great deal less gas than the Lenoir or Hugon did seventeen years ago. The Hugon and Lenoir as they have been worked up to to-day consume respectively about 95 and 85 cubic feet per hour per indicated horse-power. He should imagine a 3-horse Otto would consume from 35 to 40. That is a saving of more than 50 per cent. It practically makes the Lenoir use over 100 per cent. the amount of gas in an Otto. He was aware that in large Otto engines the consumption was as low as 25 cubic feet. He had never compared the Lenoir and the Otto, or the Hugon and Otto, to see how often the missfires occurred in one as compared with the other. With regard to the Otto, if the flame is alight the missfires are extremely rare. Occasionally you find a premature ignition. They are not so frequent in the Hugon as in the Lenoir. This witness was then questioned in regard to the indicator diagrams taken during Mr. Imray's experiments with the modified engines at Manchester. Given that the engine was worked under the same conditions exactly, except that the point of ignition was half way up, or further up the cylinder in one case than in the other, he could not, as an experienced man of science, account for the different diagrams on any other theory except that it is quicker nearer the point of admission. He could not suggest any other cause than that at the point of ignition the gas was richer in the one case than in the other. The diagrams taken with a homogeneous mixture show that the ignition was equally effective in both cases. In the Lenoir engine the ratio of initial to maximum pressure is as 1 to 5, and in Otto as 1 to 3½; but it was not the ratio that had to do with shock, but the difference, and that was much greater in the Otto.

After a short re-examination by Mr. Moulton, the witness withdrew.

Mr. Dugald Clerk was next examined by Mr. Moulton. He confirmed Dr. Hopkinson's evidence. He considered there never was any difficulty in getting a Lenoir engine to work, and less indeed than there often was with the Otto. He had made full size models of the Otto engines, as shown in the drawings, and had failed to get any stratification at all. The cylinders were constructed of glass. In his opinion the cause of the great efficiency in the Otto engine is compression, and he thought that was agreed to by all scientific men. The thermo-dynamic efficiency of the Lenoir engine was ·16 and of the Otto ·33, besides which you get nearer to the theoretic efficiency in the compression engines on account of there being less loss. He had examined the glass model put in by the plaintiffs, and did not think it fairly represented what goes on in the Otto engine. The proportions were altogether different. He agreed with Dr. Hopkinson in regard to the anticipations. Barnett's was an exceedingly practical specification, and had influenced him very much in designing his own engine. He had made a great many measurements of the clearance spaces, and had found that in the South Kensington Lenoir they amounted to 18 per cent. of the total charge, in the Petworth engine to 19½ per cent., and in the South Kensington Hugon to an average of about 26½ per cent. The diagrams taken during the experiments with the platinum igniter were then put in.

In cross-examination by Mr. Aston the witness stated in reference to his patent No. 1089, of 1881, that so far as the displacer was concerned, it was a complete mistake. He has since reduced the size of the pump, and this had the effect of leaving more of the residuum in the cylinder than there was before. It was an unavoidable evil. He did not consider there was stratification in his engine. It was between the 12th of April, 1881, and the time when he read his paper at the Institution of Civil Engineers that he found out that some of the statements in his specification were incorrect. Notwithstanding this he took out another patent after the date of reading that paper, and did not refer to the mistake he now said he made. Afterwards the Attorney-General put a number of questions about the diagrams taken during the platinum experiments, with the view of showing that they distinctly indicated that the charge was heterogeneous, because in several cases the coil had failed to ignite at or before the period of maximum compression, which was the most favourable point for ignition. A number of witnesses were then brought forward to prove the successful working of the Lenoir and Hugon engines, the cross-examination in each case being directed to show that the engines were uncertain in action and expensive to work and maintain. Another attempt was made by Mr. Moulton to get in Beau de Rochas, but Mr. Justice Pearson finally refused to accept it, for reasons that will be clear to those who have followed the remarks already published by us on this head.

Mr. John Imray was then recalled and examined by the Attorney-General and Mr. Aston, and cross-examined by Mr. Moulton in reference to his Manchester experiments and the indicator diagrams he had produced.

The next witness was Professor Dewar, F.R.S., who was called for the plaintiffs: He said that the working of the Otto engine could not possibly be explained on the assumption of a uniform distribution. He had taken samples of the charge from the cylinder of the Clerk engine; that is to say, the one in which Mr. Clerk himself said that there was no stratification, and about which he had made a mistake in the year 1881. He took samples at three different places, A B and C. A, close to point of ignition; B, intermediate; and C, just behind the piston. The samples were taken immediately before ignition. The sample A, taken nearest the point of ignition, contained 10·5 per cent. of coal gas; nitrogen, 75·2; oxygen, 13·2; and carbonic acid, 1·1. B contained coal gas 7·5; nitrogen, 78·4; oxygen, 13·0; carbonic acid, 1·1. And C, coal gas, 5·8; nitrogen, 79·5; oxygen, 12·7; carbonic acid about 2 per cent. The C was not inflammable under ordinary conditions. B is just on the limit; and A is undoubtedly inflammable. He also took samples after ignition at the corresponding points, and found that practically the whole of the coal gas at A was burnt, about one-half at B, and none at C. The result obtained with the one set of experiments fully confirmed those of the other. He had also analysed the residual gases, and had found that unless the amount of gas was abnormally small, complete combustion takes place. Taking gas and air—1 of London gas to 13 of air does not burn; 1 to 12 gives a very slow combustion. With 1 to 11 you get a fair velocity of combustion. This is without compression. The analysis of the residuum coming from the Otto engine shows that the engine can work easily and do efficient work with one of gas to 23 of air. That is with compression. If you took 1 to 23 and made it homogeneous, you could not, by either pressure or heat, make it burn. With 1 of gas to 16 of air there is no combination at a pressure of 4½ atmospheres.

The following are the results of Professor Dewar's experiments with various mixtures of gas and air:—

Ordinary pressures and temperatures.

Gas.		Air.	
1	.. ..	13	Does not burn.
1	.. ..	12	Very slow combustion.
1	.. ..	11	Fair velocity.

Gas and air at higher pressures.—Ordinary temperatures.

Gas.		Air.	
1	.. ..	16	No explosion at 4½ atmospheres' pressure.
1	.. ..	13	Feeble combustion.

Gas and air mixtures, plus residuum in the proportion of 3 *of residuum to* 5 *of mixture, compressed to* 4 *atmospheres, and heated to* 150 *degrees C.*

Gas.		Air.	
1	.. ..	12	No combustion.
1	.. ..	11	Faint combustion, no explosion.
1	.. ..	11	No combustion, no explosion. (Manchester gas.)
1	.. ..	10	Slow flame.
1	.. ..	6	Explodes.

He had tried to imitate, in laboratory fashion, something that would be an approximation to the action in the cylinder of the gas engine. For this purpose he took a tube with electric wires inserted at one end, and with a manometer attached, into which it is possible to compress the gaseous mixtures and to heat them to any fixed temperature. That being done, he tried to imitate the sudden injection into the hot residuum of an explosive mixture. Therefore, he filled the explosive mixture into this, fired it, and then suddenly, by means of a force pump, injected into this heated residuum the explosive mixture, and then fired it. He had never seen a case in which the flame went uniformly through the whole mass; it always stopped in a well-defined curved surface at the end of the residuum. He could not account for that in any way, except by the residue being kept separate from the combustible mixture. He never reached a higher pressure, before firing, than four atmospheres, and never heated beyond 200 deg. Centigrade. The results of all his experiments show heterogeneity. It is absolutely impossible that the Otto engine could be worked with the small amount of gas per horse-power with which it was worked, and with regular ignition, unless the charge was richer at the ignition end of the cylinder.

Professor Dewar was cross-examined by Mr. Moulton, and explained how by estimating the amount of carbonic acid in the exhaust gases he could at any moment tell with certainty the richness of the charge.

Mr. Coombe, and Mr. Pinchbeck, formerly manager at the Reading Ironworks, where the Lenoir engines were manufactured, were called for the plaintiffs in reference to the working of the Lenoir engines. Sir Frederick Bramwell was then recalled and examined as to the Manchester experiments, and gave evidence in support of Mr. Imray's and Professor Dewar's conclusions. Mr. Clerk and Dr. Hopkinson were also recalled by Mr. MOULTON. The former had been down to Messrs. Crossley's works at Manchester to examine the experimental engine with side lighting arrangement, and gave it as his opinion that the results shown on Mr. Imray's diagrams were due to the side slide having too little lead instead of to the greater dilution of the charge just behind the piston.

This completed the evidence. Mr. MOULTON then addressed the Court at great length, dealing with the judgment in the Court of Appeal in the Linford case, and pointing out how materially the plaintiff's evidence now differed from what was then given, and how completely they had shifted their ground. He then criticised and compared the evidence. He did not think he had said a single unkind word about the Otto silent gas engine. He admitted it was an extremely practical compression engine, and that a practical compression engine was wanted, but he did say that justice requires that the first claim should be struck out, and that invention, independent of the lines of this engine, should be allowed to go on. Here we had Clerk's engine, which is really a growth of Barnett's engine, radically different in its idea. We had it brought up actually to trial here, until the matter was settled, simply because they do not even allege any infringement of any claim except Claim No. 1. They said there was a residuum there, and then the charge behind it, and then they said that was within Claim No. 1. It stops invention in entirely different lines to those which the plaintiff has so successfully prosecuted. The Steel engine would be an infringement of the second claim if the second claim was independent of the first claim. He had never contested that. He said this was a question with regard to the validity of the patent. This patent has once been supported, as he said, on insufficient evidence. Now, he put far richer materials before his lordship, and he thought he had proved that this patent does not do what it says it does, and that it has been anticipated. He was not going through the whole, but he said there was the same richness throughout, or the greater part of the gas being substantially diffused through the whole. It does not differ in its diagram from that of a homogeneous mixture; the only thing is that in Otto's there is such a proportion of residuum that it acts as a diluent and prevents too rapid combustion. If there was such a thing as the plaintiff thought he had got, namely, this graduated arrangement, it would not render it gradual, but it would render it more rapid. That is proved by all the evidence here, and by the plaintiff's own admissions; and then he said that if it simply means letting this into a chamber with residuum, and that that will accomplish the result, there are no precautions taken by the plaintiff—no precautions suggested as being necessary by the plaintiff—in order to make it produce this result. He treats it that the mere admission first is all that is wanted; and if that was so, it was abundantly clear that, both by the prior users of the two forms of Lenoir and Hugon, and by the prior publications of Million and Barnett, this has been anticipated. He was only claiming that there was merit in what other people did in their engines; and if he was not to answer for having made a mistake in what the merit was—which merit he admitted—and he admitted that he would not have to answer for it, if what he had done could be proved to have been an advantage and to be novel—he certainly could not, on the other hand, say that he was entitled to a patent, because he had said that there was merit in something which was done before. He especially pressed upon his lordship, in addition to all the other scientific evidence, the anticipations of Million and Barnett and the prior users by the Lenoir and the Hugon. He could not understand it if there was *de facto* an advantage or a great gain by residuum entering the chamber early, but all he could say was that if there was, they participated in it as much as the plaintiff did, and there would be this absurdity, that if this claim was supported the plaintiff could restrain the making of a machine exactly like Million's and exactly like Barnett's. He could actually restrain it because they do this very same thing. He attempted to restrain one made on the fundamental lines of Barnett, which, so far as it could be said to be an infringement of the No. 1 claim, was not more so than Barnett's. He attempted to restrain that, and the case actually came up, and would probably have been heard, had not it been settled. Under these circumstances he submitted that this first claim was bad, and that being bad, until the plaintiff has purged his patent with regard to that, his client was not liable for infringement.

The ATTORNEY-GENERAL then rose on behalf of the plaintiffs. While admitting the great ability displayed by Mr. Moulton in his address, he cautioned his lordship against acting on some of the very positive statements which he had made. He would show by the evidence of Sir Frederick Bramwell and Mr. Imray, which had not been contradicted, that Otto's invention as specified was a very great invention, and that for all legal purposes it was accurately specified. It was a little strange that while the infringer had bodily taken Otto No. 3, and had in the most barefaced manner copied that invention so that his own counsel cannot deny infringement—it was a little strange that while he had taken that very form which the patentee prefers, that is to say, the best form, according to the patentee, in which you are to have the particular kind of compression, and in which you are to have compression in the same cylinder, his counsel is allowed to get up and say there was nothing in the Otto engine except improvement of mechanical details, and it was absolutely untrue that he had discovered even the application of any new principle. He contended that every experiment that had been made showed that there was a stratification or gradual shading off in the strength of the Otto charge. At the same time it must not be assumed that anything in Dr. Otto's specification went so far as to say that the mixture at the moment of the time of firing was not homogeneous. He submitted humbly that when his learned friend, Mr. Moulton, although he spoke afterwards not very nicely of Dr. Otto's inventions, when he is driven to admit the results, and has wholly failed to suggest a single reason which has produced those results—when he is driven to admit results of cheapness which have made it one-third of the cost with three times the efficiency, then it was a little strong to say that Dr. Otto was all wrong, and that he knew nothing whatever of what he was talking about; and that Mr. Clerk and Dr. Hopkinson, who have not invented the thing, but only criticised it, knew a great deal more. In fact, Dr. Hopkinson said that Dr. Otto's idea was a myth, and did not exist at all. The indicator diagrams and the experiments were dealt with in detail, more especially those made with the same engine working on Lenoir's and Otto's systems, in which the latter showed a saving of 20 per cent. in gas consumption for a given power. No experiments of any kind whatever were brought forward on the other side to refute this, which was a most remarkable thing. With regard to the platinum experiments, Dr. Hopkinson had said there was no difference in the diagram whether the charge was ignited normally or abnormally. When the diagrams were produced, however, he said with confidence that such a contention could not be supported. He then came to the alleged anticipations, and he submitted that a workman having taken any one of these prior publications would be unable to construct an Otto machine or a machine working as Otto did. Some of them would absolutely lead people away from Otto. Wright's, everybody admitted, would not work at all. In Million, though there would be residuum, if such an engine was made, it would merely be a thin film. In conclusion, he submitted that he had demonstrated on the evidence that Dr. Otto's invention was an invention for sending into the cylinder a packed charge, and for sending it in packed in this way—that as it went in there was in front air or incombustible gas, which had previously been there. As described in modification No. 1, he primarily intended air, but it is possible that his lordship might take the view that incombustible gas left in or sent in would also have been within that—that in his compression engine he worked in the novel way which has been described. He submitted he had proved upon the evidence that to whichever of these modifications you apply the stratification you get results which are wholly unobtainable without that stratification, and that it was no good suggesting that the packing produced homogeneity in the end. The result was a saving of gas which had never been attained before, although compression was known, although a good many of the parts were known, and although in shape and form the Lenoir engine was not so very different from Dr. Otto's. The only point in which you could find a difference was the different system of engine and the system of working the engine; and so far from it being due to mechanical details, the principle being wrong, as Mr. Moulton said, there had not been one single mechanical detail pointed out which, apart from the principle, could account for this extraordinary change. He asked his lordship to say that that patent was valid, that it had been infringed, and had been infringed, as was practically admitted, in the grossest and most glaring manner, by taking bodily modification No. 3 out of Dr. Otto's patent, and using it without any attempt to disguise it or distinguish it. After reading several passages which had occurred in cases as to the way in which anticipations had to be regarded, the learned counsel resumed his seat.

This ended the case for the time. The judgment pronounced by Mr. Justice Pearson appeared in full in our impression for Dec. 25th.

The matter does not end here, however, for on Wednesday, the 17th, before Lord Justices Cotton, Bowen, and Fry, a motion was made to stay execution pending an appeal. The motion was made in the first instance before Mr. Justice Pearson. His Lordship refused to suspend the operation of the judgment, intimating that he had the less hesitation in doing so because the Court of Appeal having control over the appeal business if it were thought a fit case could advance the appeal. The defendant appealed. Mr. Graham, on Wednesday, appeared in support of the appeal. He asked that, if necessary, the appeal might be accelerated. He admitted that the appeal would probably take five days to hear. Sir R. Webster, Q.C., and Mr. Lawrie, for the plaintiff, were not called upon.

Lord JUSTICE COTTON said that the appeal would take a considerable time, and if it were advanced would certainly interfere with the hearing of other appeals. The suitors who had already presented their appeals would be aggrieved if the appeal were advanced. As to staying the operation of the injunction, that was not the practice. Here the plaintiff had established his patent in two actions; if the judgment was stayed in this case it ought to be in almost every case. The appeal must therefore be refused.

Lords JUSTICES BOWEN and FRY concurred.

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

(*From our own Correspondent.*)

NEITHER in the crude nor in the finished iron trade of South Staffordshire is there much improvement to note upon the week. Trade is so slowly recovering in America that an improvement which it had been thought by not a few ironmasters would begin to be seen at this period of the current year, has not yet loomed, and the intimation that certain changes favourable to this market in the American tariff reported to the House of Representatives by Mr. Morrison are, at the best, unlikely to come into operation during the current year—while the likelihood of any change whatever being practicable within a reasonable time is ridiculed by the American Protectionists—did not contribute to improve the tone either at the Wolverhampton market, or at that in Birmingham to-day—Thursday.

Stamping sheets were fairly firm, some makers quoting from £10 to £10 10s. Plates for girder work were to be had at from £7 upwards; but notable brands of boiler plates were obtainable at nothing under from £8 to £9.

There was a trifle less iron of the single gauge to be had for galvanising at under £6 10s. Galvanising doubles were a leading article offered. Prices were a shade stronger upon the minimum than a week ago; yet £6 12s. 6d. was difficult to obtain, while trebles were procurable at from £7 2s. 6d. to £7 5s. onwards to £7 10s.

Bars for working-up purposes are plentifully offered at under £5. From £5 10s. to £6 will buy a capital quality bar, while at from £6 10s. to £7 10s., and for Earl Dudley's brand—£8 2s. 6d. —a magnificent quality is procurable.

Strip iron was plentiful yesterday and to-day at under £5, and hoops were from about the same figure up to £5 2s. 6d.

Pigs were plentiful, but they were not pressed upon the market. Part mine pigs were easy to buy to-day at from 42s. 6d. to 45s., and all mines at from 55s. up to 60s. Derbyshire pigs were to be bought at 38s. 6d. Certain other Derbyshire brands were held by makers at 39s., agents being prohibited from selling below that figure.

Ironmasters who are engaged upon Government work were the most able to-day (Thursday) in Birmingham to report that the current business is yielding them profit; and longer working hours, or some equivalent ease in wages, was declared to be imperative alike at the pits and at the chief producing establishments.

The iron which is being rolled for Government use is at prices fixed under contracts entered into before the market suffered so serious a relapse.

Coal was upon plentiful offer at both markets. Mill coal is in slow demand at 7s., but a little more is doing in forge coal at 5s. 6d. boat weight, delivered. Thick coal pits, whence blast furnace proprietors usually obtain their supplies, are doing scarcely more than half work at from 8s. to 9s. per ton for large, and 4s. 6d. for slack.

The presidency of the South Staffordshire Board was announced at its meeting to be vacant. The formal resignation of Alderman Avery was received with expressions of regret, and a gentleman well known in the district was selected for election.

Messrs. Nettlefolds, Birmingham, announced yesterday that in future they will increase by 5 per cent. the discount from list prices of iron wood screws.

Makers of bicycles and tricycles are very active in preparing for the coming season, which has been opened with much promise of success by the London show.

Many of the edge tool manufacturers have some good orders in hand, consequently operatives engaged in this department are well employed. Considerable quantities are being made for export. Hollow-ware makers engaged in the tinned branch are receiving orders for increased quantities of best goods for exportation to Germany.

The twenty-second annual report of the Patent Nut and Bolt Company, which will be presented at the ordinary general meeting on the 24th inst., shows that the net profits, after writing off bad debts and providing for doubtful debts, amount to £35,588 11s. 11d., of which £30,000 is proposed to be spent in paying a dividend of 5 per cent. on the preference and 10 per cent. on the ordinary shares.

A decision materially affecting manufacturers and contractors of all classes, was on Tuesday arrived at in a case which came on for hearing in the Birmingham County Court. Mr. George Rathbone, an ironfounder, sought to recover from Messrs. Shirlaw and Co., engineers, £42 odd for iron castings sold and delivered. Defendants admitted their liability for £20, but objected to pay the balance on the ground that they had been put to great trouble and expense owing to the defective quality of the castings supplied, and they made a counter claim for £37 for time and labour wasted in preparing and testing the defective castings. His honour, Judge Chalmers, ruled that there was no precedent on which such a counter claim could be established. The purchaser might either return the goods or plead a breach of warranty in diminution of price or in justification of damages, but he could not, as in this case, both return the goods and counter claim for damages. He therefore gave judgment for the plaintiff on the claim and counter claim.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

MR. F. T. MAPPIN, M.P., speaking at the Sheffield Technical School last week, stated that the Sheffield steel manufacturers twelve months ago were not in a position to supply large forgings, and that these were not produced by hammers at all, but made by hydraulic pressure. The *Sheffield Daily Telegraph* takes Mr. Mappin to task on this point, and states that Sheffield has been in a position for several years to make these large forgings and castings, and that they have been made during that period by at least three houses in the town—the reference, no doubt, being to Messrs. Vickers, Sons, and Co., Messrs. Thos. Firth and Sons, and Messrs. Charles Cammell and Co. These included the forgings for the 100-ton and 110-ton guns, made three years ago, and hammers were employed in the manufacture of these very guns. No doubt Mr. Mappin was referring more particularly to the first-named firm, who were able to set their press at work last April. Messrs. Charles Cammell and Co., Messrs. John Brown and Co., and Messrs. Thomas Firth and Sons, are also making extensive additions to their works for this purpose. Messrs. Firth and Sons, I believe, are relying still upon hammers, while the others adopt hydraulic presses. Messrs Cammell and Co., as a matter of fact, put down a 2000-ton press as far back as 1864. Engineers were not in favour of this principle then, and the press was set aside for this purpose, and applied to bending armour-plates. Recently the experts have been all in favour of presses, and Messrs. Cammell are now erecting at their Grimesthorpe Steelworks a press of the enormous capacity of 5000 tons. It is stated that hammers are still exclusively employed on the Continent for large forgings and castings. Our local firms have always been able to supply whatever forging or casting has been ordered, and if the authorities say otherwise, they must be misinformed. As Mr. Mappin points out, the extensions now taking place will put Sheffield in a position to meet all possible requirements of the future.

German cutlery is again being discussed in certain circles. I have already informed you of the number of representatives of German houses who find their way to Sheffield and do a profitable business; but it is now freely stated that the Sheffield firms buy these goods and stamp "Sheffield" upon them, and re-export them as Sheffield wares. This statement has been made in most alarmist fashion; but the scare was soon over. It is said that one or two factors and perhaps two manufacturers have sometimes branded Sheffield on German goods of certain low grades, but that the practice is at all common in Sheffield is altogether untrue. There are no firms in the country who are more jealous for their good name than those of Sheffield. To my knowledge, one large cutlery establishment has expended over £40,000 in protecting its trade-mark against piracy in foreign markets, and they are still continually called upon to do so. The head of the largest house in Sheffield tells me that the remedy against selling German wares as Sheffield-made is twofold—(1) to impose a duty of 10 per cent. upon German wares, and (2) to arm the Cutlers' Company with more stringent powers, so as to enable them to seize dishonest wares and destroy them, if they think fit, as well as to punish the makers or vendors of deceitful wares. This was one of the objects of the Cutlers' Company, and they have still their "searchers;" but the term seems more one of courtesy than of practical meaning. Of the abundance of German wares in the Sheffield district there is no doubt; but a far greater number are sent from Germany direct to the different markets of the world without touching an English port at all, and these, to a large extent, are marked with names and trade mark so closely resembling those of Sheffield that the foreign purchaser can scarcely help being deceived.

I have in my possession a two-bladed, ivory-handled spring knife, branded "Rodgers, Sheffield," which was exposed in a Sheffield window for sale at sixpence. Messrs. Rodgers and Sons say that the knife is not of their make, that it must have been made in Germany, and branded "cold" in Sheffield; and, besides that, the ivory scales alone would cost 7d. How was it done?

The Steel Rail Manufacturers' Association, about which some information was recently given, is expected to enter upon a further lease of life. Certain difficulties which had arisen are in process of adjustment, and it is hoped by the members that it may still continue to exercise its influence in checking the downward tendency of prices. The present quotation is about £4 15s. per ton.

Several orders have been received since my last in railway material. The Lancashire and Yorkshire Railway Company has received tenders for 20,000 tons of steel rails. It is expected that the work will be divided between Messrs. Charles Cammell and Co. and the Barrow Company. Messrs. John Brown and Co., Atlas Steel and Ironworks, have a contract for steel channels—about 400 tons—for Indian States' wagons; also for 2000 spiral springs for the Great Indian Peninsular Railway. The Great Northern Railway has given the Leeds Wheel and Axle Company, Leeds, 1000 sets of wheels and axles; while the Queensland Government Railways have ordered 200 sets of wheels and axles from Messrs. Harrison and Camm, Rotherham.

The opening month of the year shows a slight improvement in Sheffield trade with the United States, the Sheffield exports having been £34,448 against £30,828 for January, 1885. Steel was exported to the value of £14,463 and cutlery £13,820, against £11,959 and £11,057 respectively for the corresponding month of 1885.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The continued absence of anything in prospect to indicate a relief to the long protracted depression throughout all branches of the iron trade in this district is disheartening in the extreme, and casts quite a gloom over the market. The persistent downward movement in prices reported from the large iron centres of Scotland and the North of England adds still further to the feeling of despondency with regard to the future, and it would seem as if the ruinous shrinkage of values could only be arrested by a further considerable reduction of the output. I have heard rumours that in Scotland the blowing out of a number of furnaces is really in contemplation. As regards local and district irons the process of curtailing the output has been going on gradually until it has been well nigh reduced almost to the minimum, the Wigan Coal and Iron Company, who has recently blown out another furnace, having now only one out of ten erected in blast on the production of pig iron, three having been put on to spiegel, whilst more than half of the plant lies completely idle. It has long since been abundantly proved that lowering prices in the present condition of the market has little or no effect in stimulating any actual increase of buying. Consumers and buyers have so little confidence in the future, that however low the price makers might be prepared to accept, it is questionable whether buying of any weight would be induced beyond actual ascertained requirements, and in some quarters a disposition is being shown to practically stand aside for the present rather than attempt to force business under conditions which only result in a constantly increasing loss on the actual cost of production.

The attendance on the Manchester Iron Exchange on Tuesday was about an average one, but business could not well have been quieter. For pig iron there was an almost complete absence of inquiries of any weight, and even when buyers have small orders to give out they are offered at such wretched prices that only the lowest cutting sellers in the market have any chance of securing them. Very little iron is actually wanted; in most cases the present requirements of consumers are pretty well covered by the iron coming in under old contracts, and the new work coming into the hands of consumers is so small that they have comparatively very little to cover so far as future wants are concerned. For local and district brands delivered into the Manchester district the minimum current rates remain at about 37s. 6d. to 38s., less $2\frac{1}{2}$ per cent., delivered equal to Manchester; but at these figures there is underselling, and the quotations of one or two makers that are about 1s. per ton above these figures are practically simply nominal, as they are only got occasionally on small special sales.

In the hematite trade the downward tendency of prices continues, and good foundry qualities are now to be got at about 51s. 6d., less $2\frac{1}{2}$ per cent., delivered into the Manchester district, but even at this figure there is very little disposition to buy.

The manufactured iron trade continues excessively dull, and manufacturers complain that it is in a far worse condition than ever during the depression of 1879. The average basis of prices is still about £5 2s. 6d. for bars delivered into the Manchester district, but for actual specifications there is very keen cutting on the part of needy makers, and there is not much difficulty in placing anything like good orders at above £5 per ton, with hoops to be got at £5 10s., and local made sheets at £6 10s. per ton, or even a little less.

Reports as to the engineering branches of industry show no improvement in the condition of trade. At some of the shops short time is being adopted, and the number of men coming out of work continues on the increase, the last returns of the Steam Engine Makers' Society showing about $5\frac{1}{2}$ per cent. of the members in actual receipt of out-of-work support. With the exception that in some shipbuilding centres it is reported that more work is being got, trade throughout continues very slack. Some of the special tool makers in this district are fairly employed, but in most cases they are in want of orders. Cotton machinists generally report a falling off in work, and the stationary engine building trade is depressed. The reduction in wages, which comes into force after the last pay-day in the present month, has created a very bitter feeling amongst the men. Although it must have been evident beyond question that, in the face of the determination of the employers to enforce the notices, the acceptance of the reduction was an absolute necessity, many of the men have strongly denounced their trades union leaders for not having supported them in opposing the reduction, and I understand that Mr. Burnett, the general secretary of the Amalgamated Society of Engineers, was actually hooted by the men in the streets of Manchester.

Messrs. Hetherington and Co., of Manchester, have just completed for the Crewe works a locomotive-frame slotting machine, which is the largest tool of the kind that has been made in this country. The bed is 36ft. long and 5ft. wide between the uprights, and the machine, which is constructed to deal with ten 1in. steel frame sides simultaneously, weighs complete between 50 and 60 tons. In its general construction it is much the same as existing machines, the principal feature being its exceptionally massive character. In the arrangements for driving some improvements are introduced which are worth noticing. The driving is effected by means of a three-speed cone pulley, carrying a 6in. belt, and a 5in. steel shaft the entire length of the bed, from which three vertical shafts, geared by means of bevels, give motion to the cutting heads. The stopping and starting is effected by one of Mather and Platt's patent friction couplings applied to each head, and controlled by a handle on the front side of the machine, by which arrangement the attendant can start or stop each cutting head independently without going to the back of the machine. Each cutting ram is provided with a quick return motion by means of a disc and slotted link, which is balanced, to take out all backlash of the tool. The feed motions are all effected by means of steel screws both for the longitudinal and cross traverse, each worked by ratchet wheels from one slotted disc wheel, and an arrangement is made by which the two screws may be coupled by means of change wheels after the manner of a screw-cutting lathe. In order to meet the requirements for shaping out the horn blocks and inclined ends of the frame plate where the cylinders are placed on, the front of each ram is fitted with a special tool box for radiusing out the corners, which is also provided with self-acting motion. Messrs. Hetherington have also in hand a very powerfully geared planing machine for one of the Government dockyards. This machine is to plane 13ft. long by 8ft. 3in. wide and 5ft. high. It is geared by means of a 5in. steel screw, the driving pulleys being at right angles with the centre line of the machine, and all parts of the machine are of a massive character throughout. The firm have in hand another planing machine to plane 40ft. long and 3ft. 6in. wide. The bed of this machine will be 66ft. long, and it is specially constructed for planing bridge plates and similar class of work. It is a rack planing machine of the ordinary type, the only speciality being its exceptional length of bed.

In the coal trade a fairly good demand for house fire consumption still moves off steadily the better qualities of round coal, and keeps collieries generally going pretty near full time. Other classes of fuel continue slow of sale, and steam and forge coals and engine classes of fuel are plentiful in the market. There is no quotable alteration in prices, but the tendency is in favour of buyers. At the pit mouth best coal averages 8s. 6d. to 9s.; seconds, 7s. to 7s. 6d.; common coal, 5s. up to 6s.; burgy, 4s. to 4s. 6d.; and slack, 2s. 6d. to 3s. 6d. per ton, according to quality.

House fire coals are in tolerably good demand for shipment, but steam coals are dull, and delivered at the high level, Liverpool, or the Garston Docks, can be bought at 7s. to 7s. 3d. per ton.

Barrow.—There are not many new features to note in connection with the hematite pig iron trade of this district. Makers have, however, secured several new orders, and the work in their hands is comparatively large, and certainly a considerable improvement on the position occupied a few months ago. The chief request, however, is for Bessemer qualities of iron, which are more largely used than of late by steel makers, and others who have secured good contracts for delivery during this and the ensuing season. The inquiry is not only on home, but on continental and foreign account; but, of course, the home trade represents by far the largest tonnage of sales. The demand on foreign account is very poor; but it is expected there will be a revival from this quarter so soon as prices are such as will enable makers to meet foreign markets. Stocks of iron remain very large, but a large bulk of the metal now in stock is held in warrants by speculators, while other parcels are stocked pending delivery at times which have been agreed upon. Prices are still firm for all qualities of pig iron, and mixed Bessemer descriptions are still offered at 45s. 6d. to 46s. per ton net at works, with No. 3 forge and foundry iron at 43s. 6d. to 44s. per ton. Steel makers are busily employed in the heavy rail department, and one of the features of recent transactions has been the acceptance of an order for 10,000 tons of steel rails for the Lancashire and Yorkshire Railway Company, to be delivered during the following year at a price which is stated to be about £4 15s. per ton net at works. Other orders, but not of equal importance or weight, have been placed. Shipbuilders are indifferently employed, and have not succeeded in getting any of the large Government orders which have been lately on offer. It is understood that a good proportion of them have gone to the Tyne. Iron ore is in fair request comparatively speaking, but prices show no improvement, and stocks remain very large. Coal and coke are in steady consumption, but the demand is very much restricted. Shipping remains very quiet in all departments.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

BUYING and selling were almost at a standstill at the iron market held at Middlesbrough on Tuesday last. Few sales were effected, though prices were lower by 3d. per ton than on the previous Tuesday. Makers did not seem disposed to do business at minimum prices, and consequently they sold very little. Some merchants also refused to sell at the prices now alone obtainable; but others were willing to accept as low a price as 30s. 6d. per ton for No. 3 g.m.b. in small quantities.

The demand for forge iron has not improved, and the price remains at 30s. 3d. per ton.

Warrants continue in poor demand, and they have again fallen in value. It is reported that Middlesbrough warrants have been sold at Glasgow at as low a figure as 30s. $1\frac{1}{2}$d. per ton. The usual quotation, however, is still 30s. 6d. to 30s. 9d.

Messrs. Connal and Co.'s stocks of pig iron amounted on Monday last to 165,129 tons at Middlesbrough, and 688,323 tons at Glasgow. The increase during the week at Middlesbrough was 4789 tons, and at Glasgow 3125 tons.

Shipments of pig iron from Tees-side wharves have been steadily improving since February 1st. The quantity which had left the port up to Monday night was 29,701 tons, as compared with 21,827 tons in the first fifteen days of January.

The manufactured iron trade continues in a dull and unsatisfactory condition, and orders and inquiries are as scarce as ever. Ship-plates are offered at £4 10s. to £4 12s. 6d. per ton on trucks at makers' works, according to quality; angles at £4 7s. 6d., and common bars at £4 12s. 6d., all less $2\frac{1}{2}$ per cent. discount. Common puddled bars are £2 17s. 6d. per ton net at works.

Messrs. Allhusen and Co., of the Newcastle-on-Tyne Chemical Works, and the Haverton-hill Salt Works, have issued their annual report. It shows a net profit for the year 1885 of £15,223. No dividend will be paid on the ordinary shares, as the directors recommend that the amount named should be applied towards defraying the cost of erection of the new salt works. Three brine wells are now in operation, producing 500 tons of salt per week, and in a month's time this output will probably be increased to 900 tons, or all at present required at the alkali works belonging to the company.

A meeting of the Tyne and Wear shipbuilders was held at Newcastle on Thursday, the 11th inst., to receive a deputation from the Boiler Makers and Iron Shipbuilders' Society. The delegates informed the employers that the men had again decided against submitting to any reduction whatever, and had not empowered them to negotiate for a settlement. The deputation then withdrew, and the employers, after discussion, passed the following resolution, viz: "That having regard to the terms of the resolution handed to the delegates of the Boilermakers' Society at the termination of the last meeting, and recognising the desirability of coming to a settlement at a period when such deep distress prevails, the employers have, after a protracted discussion, adopted the following resolution, viz.: That the terms of the reductions originally asked for be modified to 10 per cent. from piece rates, and 2s. off time wages." The above resolution was handed to the deputation, and the meeting adjourned to Thursday, the 18th inst.

Since the above meeting the operatives have met at their various local lodges throughout the district to consider their position. The decisions, so far as they have yet been made known, are generally in favour of making no concession whatever. An amendment proposing to agree to a $2\frac{1}{2}$ per cent. reduction on certain piecework rates was lost by an overwhelming majority. Much was made of the unconciliatory tone supposed to be evinced by the employers towards the delegates at the joint meeting; and generally the speeches of the operatives indicated that their minds were still far from being in a calm judicial condition. Notwithstanding their resolute attitude, however, it is believed by those who have experience in such matters that most of them are already sick of the dispute, and would be only too glad to be at work again even on the employers' terms.

The distress occasioned by the depression of trade is still the leading topic of conversation in the North. It has been computed that from the Tyne to the Tees 33,300 men and boys are now idle. Of these, 15,000, or nearly one-half, are at Sunderland, 13,300 at Newcastle and the Tyneside towns, 1000 at the Hartlepools, 3500 at Stockton and Middlesbrough, and 500 at Darlington. Supposing such a gigantic work as the Manchester Ship Canal had had time to become fully organised from end to end, it is conceivable that it might employ 10,000 hands. More than three Manchester Ship Canals would therefore be necessary to absorb the surplus labour of a district such as that under consideration, which is only about fifty miles long by twenty miles broad. But what is to be done to employ all the other idle hands in all the other parts of the country where riots have occurred, and where they have not occurred; where peaceable, but earnest and anxious meetings have alone been held; and in the still more numerous towns and places where large numbers of the industrial class, and, perhaps, of other classes too, are slowly and silently starving? The problem becomes more and more appalling every day.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron market has been subject to somewhat violent fluctuations this week. On Tuesday warrants were depressed by large sales as much as $8\frac{1}{2}$d. a ton, the official figures touching 38s. $4\frac{1}{2}$d., while some transactions are even said to have occurred at less money. The shipments reported for the past week were 7852 tons, as compared with 5621 tons in the preceding week, and 8315 tons in the corresponding week of 1885. The current inquiry for shipping iron is reported poor. During the week between 2000 tons and 3000 tons of pigs were added to the stock in Messrs. Connal and Co.'s Glasgow stores, and makers' stocks are understood to be likewise on the increase. One furnace has been put out at Glengarnock and another at Eglinton, leaving ninety-six in blast, which is the same number as was blowing at this date last year.

Business was done in the warrant market on Friday last at 39s. cash. On Monday a large number of transactions took place at 38s. $11\frac{1}{2}$d. to 39s. $2\frac{1}{2}$d. and 39s. $1\frac{1}{2}$d. cash. On Tuesday forenoon heavy sales of warrants were made at 38s. $8\frac{1}{2}$d. cash, and in the afternoon the quotations further declined to 38s. $4\frac{1}{2}$d., recovering to 38s. 6d. at the close. On Wednesday transactions took place from 39s. 1d. to 39s. 9d. cash, closing with buyers at 38s. 6d. Business took place to-day—Thursday—from 38s. 10d. down to 38s. 2d. cash.

Owing to the depressed condition of the warrant market, and the indifferent foreign demand, there has been a further decline in the values of makers' iron. Gartsherrie, No. 1, f.o.b. at Glasgow, is quoted at 43s.; No. 3, 42s.; Coltness, 47s. and 43s. 6d.; Langloan, 45s. and 43s.; Summerlee, 47s. 6d. and 43s.; Calder, 46s. 6d. and 42s.; Carnbroe, 43s. 6d. and 41s.; Clyde, 44s. and 40s. 6d.; Monkland, 40s. and 37s.; Quarter, 39s. and 36s. 6d.; Govan, at Broomielaw, 39s. 6d. and 37s.; Shotts, at Leith, 46s. and 45s. 6d.; Carron, at Grangemouth, 48s. 6d. and 45s. 6d.; Kinneil, at Bo'ness, 43s. and 42s. 6d.; Glengarnock, at Ardrossan, 43s. 6d. and 41s.; Eglinton, 39s. 6d. and 37s.; Dalmellington, 42s. and 39s.

The shipments of iron and steel goods from Glasgow in the past week embraced one locomotive, valued at £550, for Brisbane; machinery, worth £4300; sewing machines, £1273; steel goods, £2640; and general iron manufactures, £34,000.

In the malleable iron and steel trades there is a fair business, but no new orders of any consequence are reported.

There has been rather more business in the coal trade since the disappearance of the snow, but the season is as yet, on the whole, very dull. From Glasgow the past week's coal shipments were 25,177 tons against 21,568 in the corresponding period of 1885; Greenock, 1943 against 803; Ayr, 9200 against 8540; Irvine, 2993 against 2425; Troon, 7003 against 4586; Grangemouth, 4720 against 7859; and Bo'ness, 2758 against 1100 tons. Main coal sells, f.o.b. at Glasgow, at 5s. 9d. to 6s. 3d.; ell, 6s. 6d. to 8s.; splint, 6s. to 6s 9d.; and steam, 7s. to 8s. The prices at the collieries are 1s. 6d. to 1s. 9d. lower. On the east coast the trade has been very quiet, and few new orders are coming to hand. Although the miners are in many cases only obtaining about four days' work a week, stocks continue to accumulate at the pits.

Notices were posted at nearly all the collieries in the Hamilton district on Saturday that on Monday the 6d. advance given on the 1st December last was to be withdrawn. When the increase was conceded the masters expected that they would be able to obtain an advance in the price of coals. In this they were completely mistaken, but they nevertheless allowed the increased wages to be paid to the men during the severest part of the season until now. How their generosity is rewarded appears from the proceedings of about 1500 men who met in an adjoining district on Saturday, where the advance had been withdrawn a week earlier. The following resolutions were carried:—(1) "That we desire to record our feelings of indignation and contempt at the withdrawal of the 6d. per day as an action unreasonable and unwarranted in the present circumstances of the trade, as no reduction in coal is announced." (2) "That the miners of Glasgow district pledge themselves to promote union in order to prepare for future action, work five days a week, observe Thursday as a holiday, and would urge workmen in every district to adopt similar measures for restriction and self-preservation." (3) "That the miners of Lanarkshire would desire to draw the attention of her Majesty's Government to the long-continued and increasing depressed condition of the Scottish mines labour, arising, they aver, from landlords and capitalists placing illegal burdens upon labour, and would call upon the Government to put into operation the provisions of the Scottish statute law, and reappoint the Master of Metals—an officer of the Crown whose functions were to secure justice to the miner in the prosecution of his labour."

The miners were all idle in the Hamilton district in the early part of the week, and the action of the coalmasters was much condemned, although the men must see that protracted resistance in the present condition of the market is altogether out of the question.

The coalmasters of Fife and Clackmannan have intimated a reduction of 10 per cent., and the men have petitioned for a conference on the subject.

Messrs. Lees, Anderson, and Co., engineers, Glasgow, have booked orders for three pairs of compound blowing engines in connection with the ventilating of the North German Lloyd steamers now building on the Clyde, and one set of the same kind of engines for the steamer Alcides of Messrs. Donaldson Brothers. The Fairfield Shipbuilding Company has contracted to build a new steamer of 6000 tons, 400ft. in length, and 8000-horse power, for the Orient Line.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

COAL prospects are by no means good. January totals for the three principal ports show a decided falling off in shipments to foreign ports.

At a meeting of the Sliding Scale Committee an ingenious arrangement for coal-getting by machinery on the screw principle was shown, and I hear that it will be practically tried at the Glamorgan and Dowlais collieries.

Another subject before the Welsh coal world is also being keenly discussed—an adaptation of a lamp station to a place of retreat on the occasion of a pit accident, fall, or otherwise, and consequent interference with the ventilation. The project is by Mr. Herbert Kirkhouse, a well-known mining engineer of great experience, and in a few words it may be described as formed of compartments, or in the solid rock, air-tight doors, and supplied with fresh air from the surface. Seeing that so many men succumb to the carbonic acid gas which follows the explosion of the carburetted hydrogen, the idea is a good one, and is well received.

The iron trade continues deplorably dull; exports foreign are more and more insignificant, and home trade is slack. One connected with engineering work in the district states that when anything is wanted it is sent for to Germany or North of England, and home industry is only thought good enough of for the humblest products. The conclusion is wrong. But I must say the steel rails are equal to any, and cheap to a fault. While on the topic of engineering work I must note a singular accident at Cyfarthfa in the fall of one of the converters. At present one only is in use. The fall occurred when there was no one close at hand. I am told that it was a close shave for the energetic manager, Mr. Evans.

The Cardiff Waterworks were begun in the Taff Vaur Valley, near Merthyr, on Tuesday. This is one of the greatest projects in Wales. There will be three great lakes and thirty miles of pipes. Mr. Jones, Neath, is the contractor.

In tin-plate there is not much to record. A black-plate works near Pontypool is in the market, and the well-known works, the Gadlys, Aberdare, are stopped. Swansea works are fairly busy, and prices are kept up tolerably well.

The Royal Commission on Mines having submitted a series of questions, it was decided this week at a committee meeting of coalowners that the chairman of the Coalowners' Association, together with Sir W. T. Lewis, and Mr. A. Hood, of the Glamorgan Collieries, should attend and give verbal replies.

The Neath Harbour tunnelling works have been wound up by petition to the Master of the Rolls. The petitioner was Mr. Stevens, publisher of the *Family Herald*.

Seeing the urgent necessity of a hospital at Merthyr, in the centre of huge works and collieries, the Marquis of Bute has given £1000, and in notifying this his chief agent, Sir W. T. Lewis, offers £100.

LAUNCHES AND TRIAL TRIPS.

ON Friday, the 5th inst., the s.s. Skirbeck, built and engined by Earles' Shipbuilding and Engineering Company, to the order of the Boston Deep Sea Fishing and Ice Company, was taken on her trial trip. The following are the particulars of the vessel:—Length between perpendiculars 85ft. by 19ft. 9in. beam by 10ft. depth of hold, with flush deck aft and small raised forecastle forward. She is built to class 90 A1 at Lloyd's, and has accommodation for captain and officers aft, and for crew in the forecastle; the whole of the remaining space clear of engines and boilers being fitted for the storage of ice and fish. She is ketch rigged with pole masts, and is fitted with a steam winch of Earles' special design and make for working the trawl gear. Her engines are inverted direct-acting, with cylinders 12in. and 22in. diameter by 20in. stroke, and are supplied with steam of 90 lb. pressure from a steel boiler fitted with one of Fox's corrugated furnaces.

On February 6th, Messrs. Oswald, Mordaunt, and Co. launched the Andrina, at Southampton—an iron sailing ship of about 2700 tons net register, and of the following dimensions: Length, about 315ft.; breadth, about 42ft. 6in.; depth of hold, about 24ft. 6in. The vessel has been built for Mr. G. W. Roberts, of Liverpool. She has four masts, being full rigged on fore, main, and mizen, and fore and aft on jigger, and is built to class 100A. The vessel has full poop for the accommodation of captain and officers; large deck-house for crew; topgallant forecastle, with lighthouses on same for bow lights; Emerson and Walker's patent windlass for working anchors. During construction the vessel has been under the superintendence of Captain Charles Semple, nautical assessor, of Liverpool.

On Saturday last the steel steamer Kaisow, built for the China Shippers' Mutual Steam Navigation Company, of London, left the works of Messrs. Joseph L. Thompson and Sons, Sunderland, for the official trial trip. The Kaisow is of the following dimensions, viz.: Length, 362ft.; breadth, 41ft. 6in.; depth of hold, 25ft. 6in.; constructed on the longitudinal cellular bottom system, having a capacity of 191,000 cubic feet for tea cargoes, for which this vessel has been designed and constructed. The Kaisow is fitted by Messrs. Thomas Richardson and Sons, of Hartlepool, with their triple expansion engines, which during the trial were working throughout at eighty revolutions per minute, the speed obtained during the day being, we are informed, 13·43 knots. The engines and boilers have been under the supervision of Mr. D. Meiklereid, consulting engineer, London, on behalf of the company. The trial of the vessel being successfully completed, and the compasses adjusted, she proceeded, under the command of Captain William Sinclair Thomson, to take the berth in the South-West India Docks for the Straits and China, having in view her arrival in Hankow early in May to take in a cargo of the coming season's teas.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, February 6th.

THE business of the past week has been interrupted by the heaviest snowfall and the coldest weather of the season. Railroad traffic has been interrupted, and but little business has been transacted throughout the country off the lines of railroad. The iron and steel mills are all running a full capacity, having orders that will keep them engaged for some time to come. Prices have not materially changed within a week, and the strength which was imparted to the market some months ago still continues, and inquiries are coming to hand, showing that there are abundant market requirements yet to be filled. Quotations for steel rails to-day are 34 dols. 50c., with only a moderate demand. There are inquiries on the market for large lots, which may be placed at any time, but for some reason railroad builders are withholding requirements, most probably with a view of ascertaining the strength of the market. Light section rails are being ordered for mining and lumbering regions in the North-west and South. Railway traffic is not increasing, and the latest railway returns show no particular change. The Reading foreclosure seems to be nearer at hand, although the new president is making a very energetic, though quiet, effort to secure the capital necessary to lift it out of trouble. Several important railway combinations are projected, but have not progressed far enough to be deserving of more than sensational notices, which they are receiving in the daily papers. All kinds of old material are very scarce, particularly old iron and steel rails. Quotations for iron are 23 dols.; steel rails, 20 dols.; No. 1 scrap, 19 dols. to 20 dols.; Bessemer pig, 19 dols. to 20 dols.; 20 per cent. spiegeleisen is quoted at 27 dols. 50c. to 28 dols. The bar mills throughout the country are nearly all working full time, and the car works are still receiving orders from railroad companies. The coal situation has not materially changed. Up to present writing no combination has been formed, and prices are still being cut to the advantage of the consuming interests. A large amount of construction iron and steel will be wanted for elevated railways and bridge work besides store building. The development of natural gas is still the exciting topic, and a great deal of capital is being developed in probable gas-producing territory.

NEW COMPANIES.

THE following companies have just been registered:—

Aquilas Smelting Company, Limited.

This company was registered on the 9th inst. with a capital of £50,000, in £1 shares, to carry on in all branches the business of a milling, smelting, and mining company. An unregistered agreement of the 30th ult. between Alexandre Marin, Bruno Marin, and Henry Ryan Lewis, of one part, and C. F. Roseby, as trustee for the company, of the other part, is adopted. The subscribers are:—

	Shares.
J. F. H. Betts, 23, Leadenhall-street, cigar merchant	1
S. Miller, 4, Pavilion-buildings, Brighton, insurance agent	1
John Oakley, 11, Milton-road, Herne-hill	1
John Lovell Dening, jun., 7, Ceres-road, Kingston, secretary to a company	1
G. Miller, White House, Telegraph-street, stockbroker	1
John Minet, 185, Avenell-road, Highbury, agent	1
H. H. Raward, 3, Woodbine Cottages, South Hackney, clerk	1

The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first and are to act *ad interim*; qualification for subsequent directors, 300 fully-paid shares; remuneration, £500 per annum.

Gas and General Works Company, Limited.

This company was registered on the 8th inst. with a capital of £10,000, in £1 shares, to construct and maintain in any part of the world, railways, tramways, harbours, docks, waterworks, gasworks, telegraph, and electric works, or works for the supply, use, and application of electricity or electric light and power. The subscribers are:—

	Shares.
James Clegg, Accrington, clerk	1
William Harwood, Accrington, manager	1
William Hoyle, Accrington, manufacturer	1
A. Clegg, Church, Accrington, Italian warehouseman	1
A. S. Marshall, Accrington, clerk	1
J. H. Hoyle, Cheetham, Manchester, ironmonger	1
P. Clegg, Church	1

The number of directors is not to be less than two nor more than nine; qualification, £100 of capital; the subscribers are to appoint the first and act *ad interim*; the company in general meeting will determine remuneration.

Standard Time and Telephone Syndicate, Limited.

This syndicate proposes to acquire and work inventions for the regulation of time, time-keepers, or clocks, by electricity or otherwise; also for the transmission, accumulation, or dispersion of electric currents or force, and for the utilisation of electricity. Power is taken to manufacture telephones, and to establish exchanges, and to manufacture all electric, magnetic, and pneumatic appliances. It was registered on the 6th inst. with a capital of £20,000, in £1 shares. The subscribers are:—

	Shares.
C. E. Haefling, 143, Sandringham-road, Dalston, superintendent of a company	1
J. Negus, 38, Roseberry-place, Dalston, clerk	1
J. A. Hilliard, 75, Cornhill, solicitor	1
E. Shirley Parker, 75, Cornhill, clerk	1
G. H. Newman, 7, St. Quintin's-avenue, North Kensington, solicitor	1
J. Wallis, East-end, Finchley, clerk	1
S. Norman, 20, The Greenway, Uxbridge, accountant	1

The business will be conducted by managers to be appointed at a general meeting; the direction of the company to be vested in the subscribers until such appointment. The remuneration of the managers will be determined at the annual general meeting.

George Bayliff and Son, Limited.

This company proposes to trade as iron and steel founders, boiler makers and repairers, shipbuilders, mechanical engineers, machine and engineering tool-makers and repairers, brass-founders, millwrights, metal workers, steel converters, and hardware manufacturers. It was registered on the 4th inst. with a capital of £20,000, in £5 shares, with the following as first subscribers:—

	Shares.
*Wm. Bayliff, Liscard, Cheshire, ironfounder	1
T. D. Bayliff, Liscard, Cheshire, engineer	1
George Bayliff, Liscard, Cheshire, wine merchant	1
Herbert Bayliff, Liscard, Cheshire, cabinet-maker	1
*Ann Bayliff, Liscard, Cheshire, widow	1
Bessie G. Bayliff, Liscard, Cheshire	1
G. Banner, 4, Cook-street, Liverpool, chartered accountant	1

The number of directors is not to be less than two nor more than four; qualification, fifty shares; the subscribers denoted by an asterisk are the first. Mr. Wm. Bayliff is appointed managing director.

Westward Ho and District Gas Company, Limited.

Upon terms of an agreement of the 11th November, 1885 (unregistered), this company proposes to acquire the plant and business of Captain Molesworth, R.N., now possessed and carried on by him at Westward Ho, for making gas. The company was incorporated on the 8th inst. with a capital of £20,000, in £5 shares, with the following as first subscribers:—

	Shares.
William White, 29, De Crespigny Park, Denmark-hill	50
John Coates, C.E., 106, Cannon-street	50
H. W. Wimshurst, 16, Thicket-road, Anerley	50
E. Wilds, 26, Anerley Park, Staff Commander, R.N.	60
Durand G. Clarke, 31, Brooke-street, Holborn	50
W. C. Clarke, 226, The Grove, Hammersmith	20
A. Helps, 9, Cornhill, stockbroker	5

Directors' qualification, fifty shares. Most of the regulations of Table A of the Companies' Act, 1862, are adopted.

Rudge and Co., Limited.

This company was registered on the 6th inst. with a capital of £150,000, in £20 shares, to carry on business as manufacturers of cycles, bicycles, tricycles, velocipedes, carriages, and other machines of every description. The subscribers are:—

	Shares.
*G. Woodcock, Coventry, solicitor	1
*J. R. C. Taunton, 245, Bristol-road, Birmingham, metallic bedstead manufacturer	1
*J. Padmore, Wake-green, Birmingham, gold refiner	1
*Wm. Martin, 106, Colmore-row, Birmingham, architect	1
J. W. Lea, 38, Bennett's-hill, Birmingham, stock and share broker	1
*J. Taunton, Knowle, Warwick, metallic bedstead manufacturer	1
C. Wallis, Edgbaston, Birmingham, anvil manufacturer	1

The number of directors is not to be less than three nor more than five; qualification, 100 shares; the first are the subscribers denoted by an asterisk. The remuneration of the board (if any) will be determined by the company in general meeting.

Parrett Bath Brick Company, Limited.

This company proposes to acquire necessary land and property for carrying on the business of manufacturers of bath or scouring bricks, and other bricks, tiles, cement, and pottery. It was registered on the 8th inst. with a capital of £10,000, in £5 shares. The subscribers are:—

	Shares.
W. J. Poole, Bridgwater, solicitor	1
Wm. Maidment, Bridgwater, accountant	1
*Hy. Maidment, Bridgwater, grocer	1
*J. H. Brough, 32, Redcross-street, Liverpool, salt and brick merchant	1
*G. F. Torick, 45, Belmont-road, Liverpool	1
H. L. Brough, 53, St. Domingo-grove, Liverpool, bookkeeper	1
H. J. Maidment, 324, King's-road, Chelsea, accountant	1

The number of directors is not to be less than three nor more than seven; qualification, five shares; the first are the subscribers denoted by an asterisk. Mr. Wm. Maidment is appointed managing director at such remuneration as the company in general meeting may from time to time determine.

Raffety, Thornton, and Co., Limited.

This is the conversion to a company of the business of timber and wood merchants carried on by Messrs. W. J. Raffety, C. J. Thornton, and Albert V. Raffety, trading as Raffety, Thornton, and Co. It was registered on the 4th inst. with a capital of £100,000, in £1 shares. The subscribers are:—

	Shares.
W. J. Raffety, 42, Old Broad-street, timber merchant	1
*C. J. Thornton, 42, Old Broad-street, timber merchant	1
*A. B. Raffety, 42, Old Broad-street, timber merchant	1
*Horace E. Billing, 9, Great St. Helen's, merchant	1
*Ernest H. Burnett, 160, Cromwell-road, timber merchant	1
William Henry Fox, 22, Austinfriars, chartered accountant	1
L. Pearson, 42, Old Broad-street, clerk	1
F. W. Gowen, 4, Longfellow-road, Walthamstow, clerk	1

The number of directors is not to be less than three nor more than five; qualification, 250 shares. The first are the first four subscribers. Remuneration, 150 guineas per annum.

PRODUCTION OF BUILDING STONE IN THE UNITED STATES.—It is estimated that the value of the building stone quarried in 1884 was 19,000,000 dols., as against 20,000,000 dols. in 1883.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

8th February, 1886.

1834. KNITTING MACHINES, H. B. Payne and W. Campion, London.
1835. FASTENINGS for GLOVES, R. Werfel, London.
1836. PORTLAND CEMENT, J. B. White, jun., London.
1837. STRAINERS for TEAPOTS, &c., S. Worrall and J. Kendal, London.
1838. COMPRESSING PUMPS for REFRIGERATING MACHINES, E. Fixary, London.
1839. SUGAR CANE MILLS, T. Rousselot, London.

9th February, 1886.

1840. TREATING SEWAGE, W. Davis, Plaistow.
1841. BALL BEARINGS for VELOCIPEDES, G. A. Wright and J. de L. Watson, London.
1842. VENT PEGS for CASKS, &c., T. D. T. Sparrow, London.
1843. SPINNING COTTON, J. W. Makant and P. Parkinson, London.
1844. COUPLING RAILWAY WAGONS, &c., W. Quayle and T. Edmondson, Barrow-in-Furness.
1845. EYELETTING MACHINES, C. H. Guest, Birmingham.
1846. FITTING HAMMER, &c., for SHOEMAKERS, T. Wright, Northampton.
1847. LADIES' BUST IMPROVER, A. Harris, Burton-on-Trent.
1848. MOULDINGS, J. H. Bell and W. Rockcliffe, Sunderland.
1849. CARDING MACHINES, J. Bullough, Halifax.
1850. COUPLING RAILWAY WAGONS, &c., J., W., M., and T. B. Whitehead, Halifax.
1851. FLOWER-POTS, E. J. Collis, London.
1852. SECURE LOCKING CASEMENT STAY, H. T. Owens, Birmingham.
1853. BUTTON, N. F. Palmer, C. S. Goodwin, and H. R. Heath, London.
1854. DIVIDED CAR AXLES, G. W. Bedbury, London.
1855. CUTTING the FIBRES of WOOD before EMBOSSING its SURFACE, W. A. Compton, London.
1856. FRAMES for PICTURES, &c., T. Markham, Manchester.
1857. SAFETY CATCHES for BROOCHES, &c., W. T. Braham, Manchester.
1858. AERATING BEER in BREWING, &c., W. Palethorpe, Newcastle-upon-Tyne.
1859. BOTTLES and STOPPERS, D. Parish, Upper Tooting.
1860. VOLTAIC BELTS, TRUSSES, &c., A. T. Sherwood, London.
1861. SULPHURIC ACID TOWER, G. H. and W. H. Nichols, and J. B. F. Herreshoff, London.
1862. KITCHEN RANGES, R. Hunter and J. Turnbull, Glasgow.
1863. BATTING SHIELDS for CRICKETERS, P. Surridge, London.
1864. TEA-POT, J. A. Kelman, London.
1865. CANDLESTICKS, F. J. Bird, London.
1866. SCREW HOOKS, E. Barker, Birmingham.
1867. SAFETY CHECKS, A. W. Lake.—(*T. Hyatt, United States.*)
1868. DUMPING WAGONS, A. J. Boult.—(*G. E. Blaine, United States.*)
1869. STEAM BOILERS, J. Hartley, Liverpool.
1870. WRENCHES, F. Armstrong and N. W. Vandegrift, London.
1871. ORDNANCE, A. J. Boult.—(*D. M. Mefford, United States.*)
1872. REDUCING STEEL RAILS to PLATE METAL, A. J. Boult.—(*L. W. Sinsabaugh, United States.*)
1873. GAS PRESSURE REGULATORS, J. Fleischer, H. W. Müller, and J. G. Arnold, London.
1874. METALLIC BOXES for STEEL PENS, &c., H. Hewitt, London.
1875. SIMULTANEOUSLY LOCKING and UNLOCKING RAILWAY CARRIAGE DOORS, G. Epstein, Walworth.
1876. WARPING and ANCHOR CAPSTANS, W. Clarke, London.
1877. ELECTRIC LAMPS, N. Tesla, London.
1878. DETACHABLE HUBS and SPINDLES, &c., J. Finch, London.
1879. TOBACCO PIPES, H. C. Hiller, Manchester.
1880. CHECKING CASH, A. Steer and A. E. Kennard, London.
1881. ALUMINIUM COMPOUNDS, J. J. Hood and A. G. Salamon, London.
1882. LATHE CHUCKS, H. J. Haddan.—(*E. Pement, United States.*)
1883. SELF-ADJUSTING JOINTS, T. Summers, London.
1884. WEB PRINTING MACHINES, A. Paton and W. Oppenheimer, London.
1885. WASHING COAL, &c., M. Evrard, London.
1886. SALE and DELIVERY of ARTICLES, W. H. Davis, London.
1887. ELECTRO-STATIC GAS-LIGHTER, C. A. Teske, London.
1888. FILTERS, W. R. Lake.—(*F. O. Matthiessen, United States.*)
1889. DISCHARGES to FILTERING APPARATUS, W. R. Lake.—(*F. O. Matthiessen, United States.*)
1890. FILTERING APPARATUS, W. R. Lake.—(*E. E. Quimby, United States.*)
1891. FILTERING APPARATUS, W. R. Lake.—(*R. C. Howes, United States.*)
1892. EXTRACTION of METALS, L. Grabau, London.
1893. PURIFYING SPIRITUOUS LIQUORS, J. Mercer.—(*C. C. Beers, United States.*)
1894. REGULATING the TEMPERATURE of ROOMS, J. W. Brewster, Manchester.
1895. NAILS for BOOTS, W. R. Lake.—(*O. R. Chaplin, United States.*)
1896. SILK COCOONS, W. R. Lake.—(*H. R. Randall, United States.*)
1897. KNITTING MACHINES, W. R. Lake.—(*T. S. Nowell, United States.*)
1898. ANCHORS, W. R. Lake.—(*C. O. Burbank, United States.*)
1899. ART of TELEGRAPHY, G. A. Cardwell and W. P. Arnold, London.
1900. TYPE WRITERS, W. R. Lake.—(*W. H. Slocum, United States.*)
1901. MAKING INFUSIONS of TEA, &c., F. E. V. Beanes, London.
1902. OPENING and CLOSING FARM GATES, E. H. Penfield, London.
1903. MECHANISM for RE-STARTING TRAM-CARS, J. B. Carter, London.
1904. DARK BACKS for PHOTOGRAPHIC CAMERAS, F. Parsons, London.
1905. SHIP for CARRYING PETROLEUM, &c., F. Lane, London.
1906. SECURING SPOKES in WHEELS, W. R. Lake.—(*W. P. Bettendorf, United States.*)
1907. LAWN-TENNIS RACKETS, P. M. Justice.—(*F. W. Taylor, United States.*)
1908. LAMP BURNERS, P. M. Justice.—(*S. W. Wilcox, United States.*)
1909. CARRYING WATCHES on CYCLES, &c., A. Pellant, London.
1910. LAMPS for TRICYCLES, &c., J. A. White, London.

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1911. SWIMMING SHOE or SANDAL, C. P. Chaussier, Manchester.
1912. TILES, G. Wooliscroft and T. Freeman, Longton.
1913. CHIMNEY and VENTILATING COWLS, E. H. Shorland, Manchester.
1914. DRIVING the ROLLERS of WRINGING MACHINES, G. Whalley, Keighley.
1915. OBTAINING CHLORIDES of BARIUM, J. Mactear.—(*J. Kolb, France.*)
1916. ELECTRIC WIGS, &c., G. Epstein, London.
1917. SAW or KNIFE GUIDE, R. E. Quinn, Belfast.
9 . PICK-HOLDER and TOOL-HOLDER, W. H. and G. Barker, London.
1919. COUPLING, &c., RAILWAY WAGONS, H. Watson, Steeton.
1920. EXPLOSIVES for FIRE-ARMS, T. G. Hart, Bath.
1921. EXPLOSIVES for FIRE-ARMS, T. G. Hart, Bath.
1922. BABY'S COMFORTER, T. E. Marriott, Hastings.
1923. REVOLVING FIRE-ARMS, W. J. Whiting, Sutton Coldfield.
1924. AUTOMATIC CANDLE EXTINGUISHER, G. H. Brown hill, Wolverhampton.
1925. LINEN COLLAR BUTTON, J. W. H. Barwell, Birmingham.
1926. MAKING WHEATEN FLOUR in STONE MILLS, R. S. MacAdam and J. Byrne, Limerick
1927. WOOL-WASHING MACHINES, T. Lund, London.
1928. CLOTH, J. Burn, Bradford.
1929. BUTTONS, F. Stubbs, Doncaster.
1930. TREATMENT of FATTY MATTERS, A. C. Henderson —(*Madame Baudot, France.*)
1931. MOP HANDLE, H. Taylor, Blackburn.
1932. HOLDER for GAS-BURNERS, F. Loftin, London.
1933. TAPS and VALVES, T. Haigh and H. H. Leach Halifax.
1934. PURIFICATION of MIDDLINGS, J. Clayton, London.
1935. COLLECTING TICKETS, C. H. Crowther, London.
1936. PIPE TONGS and PIPE CUTTERS, W. A. Scarlett, London.
1937. STEAM TRAPS, J. Kirkman, London.
1938. HYDROMETERS and SACCHAROMETERS, T. Derham, London.
1939. SEPARATING GREASE from COTTON WASTE, &c., J J. Whittle, London.
1940. SPRINGS for CARRIAGES, A. T. Boon and A. Ries, London.
1941. TWO-WHEELER CABS, A. T. Boon and A. Ries, London.
1942. FUNNELS for FILLING VESSELS, J. Barnett, London.
1943. CANS, &c., for CONTAINING OIL, &c., J. Barnett, London.
1944. TRIPLE EFFECT EVAPORATING APPARATUS, J. McC. C. Paton, London.
1945. CONSUMING SMOKE, W. P. Thompson.—(*C. Moyrenc, P. Boyer, and A. and P. Vincent, France.*)
1946. TELEPHONE, &c., DIAPHRAGMS, G. C. Taylor, Liverpool.
1947. PHONOGRAPHIC IMPLEMENTS, G. C. Taylor, Liverpool.
1948. HIGH-PRESSURE SCREW-DOWN WATER TAPS, W. A. Gill, London.
1949. SHOVEL for SEPARATING COAL, &c., from DUST, C. E. Challis, London.
1950. POCKET for PACKING TOBACCO, &c., W. H. Dufton, South Wimbledon.
1951. FOOTSTEPS for SPINDLES, J. L. Bottomley, London.
1952. FOLDING STRIPS of WOOLLEN or SILK FABRICS, S. Nottelle, London.
1953. DIPPING SHEEP, T. Blake, London.
1954. ATTACHMENTS of SLIDE VALVES, V. Nepos and J. Edwards, London.
1955. EXPLOSIVE COMPOUND, F. Bolton, London.
1956. MEAT-CHOPPING, &c., MACHINES, R. Morton, Glasgow.
1957. MECHANICAL MUSICAL INSTRUMENTS, E. Wellner and E. Prager, London.
1958. GAS MOTORS, H. J. Haddan.—(*P. Jonasen, Denmark.*)
1959. WAXING TEXTILE FABRICS, &c., H. H. Doty, London.
1960. CHARGING, &c., GAS RETORTS, A. G. Holbrook, London.
1961. BRONZE, E. P. and E. C. F. Verschave, and A. F. V. M. Baron, London.
1962. PRODUCING PICTURES, E. Haseler and N. Macfarlane, London.
1963. COIN, TICKET, &c., RECEPTACLES, J. S. Wallace, London.
1964. COMBINED CANDLESTICK and MATCH-BOX HOLDER, J. P. Heaton, London.
1965. TYPE, J. S. Wallace, London.
1966. TRANSMITTING MOTION to SHAFTS, W. A. Barlow. —(*H. Petersen, Germany.*)
1967. FIGURED CLOTH, D. Boocock, Leeds.
1968. OPENING DOORS of THEATRES, &c., J. Freeman, London.
1969. ELASTIC TIRES, J. H. Nunn and N. Salamon, London.
1970. BREECH-LOADING FIRE-ARMS, F. V. Oppen.—(*The Colts' Patent Fire-arms Manufacturing Company (Incorporated), America.*)
1971. MECHANICAL MUSICAL INSTRUMENTS, G. F. Redfern.—(*E. G. Sturm, Germany.*)
1972. FRICTION GEARING, J. Blackburn, Dudley.
1973. RIBBED, &c., HOSIERY, J. M. Thornton and T. Mawby, Leicester.
1974. NECKTIE ADJUSTERS, A. Clarke, Stevenage.
1975. CORKSCREW, E. Smith, Hunslet.
1976. MATCH STRIKER, A. Hart, Wolverhampton.
1977. DECORATING METALLIC BOXES, W. H. and B. Jones, Wolverhampton.
1978. HORSE-COLLARS, &c., J. Dumbar and J. McGlashan, Greenock.
1979. CONSTRUCTING CANT RAIL HINGES, W. R. Allen, Liverpool.
1980. OPTICAL APPARATUS, &c., J. Bruster and J. M. Gibbs, Cheshire.
1981. DROP SHUTTLE BOXES, E. Knowles and J. Houghton, Halifax.
1982. DRAW-BAR CONNECTIONS for RAILWAY CARRIAGES, &c., F. Craven, Halifax.
1983. CHAIN SLIDES, &c., of TENTERING, &c., MACHINES, F. Craven, Halifax.
1984. VALVES, J. Hawthorn and S. Moorhouse, Manchester.
1985. TRIPODS and TRIPOD HEADS for SUSTAINING CAMERAS, C. Tomlinson, Manchester.
1986. SCISSORS, C. R. Voos, London.
1987. SELF-ACTING POINTS for RAILWAYS, &c., W. Marshall, Sheffield.
1988. DISCHARGE and other CONNECTIONS for BATHS, &c., J. Shanks, Glasgow.
1989. PREPARING SODA, J. Mactear, Glasgow.
1990. RAISING LIQUIDS, J. Mactear, Glasgow.—(*J. Kolb, France.*)
1991. SLUICE VALVES, H. H. Sporton, London.
1992. NAVE and CAP, A. Cockman, London.
1993. DRESS STANDS, J. Watson and T. Rowe, London.
1994. STRETCHING ARTISTS' CANVASSES, A. J. Boult.—(*W. Cutts, Canada.*)
1995. ORNAMENTATION of PICTURE FRAMES, &c., W. J. Baker.—(*A. Werkmeister, jun., Germany.*)
1996. MACHINE for MITREING PICTURE FRAMES, W. Haigh, Bradford.
1997. VELOCIPEDES, J. H. Dearlove and H. Thresher, London.
1998. BALM for the CURE of SORE NIPPLES, J. Saunders, London.
1999. ELECTRIC LAMPS for LIGHTING MINES, &c., J. W Swan, London.
2000. VALVE GEAR for MOTIVE-POWER ENGINES, D. Joy, London.
2001. CARRIAGE STEPS, G. Wearing, London.
2002. APPLYING ELECTRICITY to the SCALP, G. Lichten field, London.
2003. DRILLING MACHINES, J. Neilson, Glasgow.
2004. TURBINES, J. Gamgee, London.
2005. VEHICLES, W. J. Brewer, London.
2006. METALLIC WHEELS for CARRIAGES, J. K. Starley,
2007. RAILWAY CARRIAGE ROOF LAMPS, J. Thomas, London.
2008. FLORAL CLASPS, E. M. Saunders, London.
2009. RACK PULLEY for WINDOW BLINDS, B. Higgins and G. R. Cane, London.
2010. BEDRIDDEN INVALIDS' BED, R. Richardson, Carlisle.
2011. TESTING the ACCURACY of GAS METER INDICES, G. Joslin, London.
2012. REGULATING APPARATUS for ARC ELECTRIC LAMPS, J. D. F. Andrews, London.
2013. ELECTRIC LAMPS, J. D. F. Andrews, London.
2014. LOCKS and LATCHES, J. Armstrong, London.
2015. THRASHING MACHINES, J. Marshall, London.

2016. Apparatus for Stopping Steam Engines, T. Schiller and P. Brennicke, London.
2017. Frames for Window-sashes, J. and J. Mason, London.
2018. Railway Carriage Lamps, J. W. Sutton and F. Le Rossignol, London.

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2019. Steam Engine Indicators, W. W. Hooper and W. J. Box, London.
2020. Grain Elevators, W. G. Herbert, Liverpool.
2021. Portable Drilling Machines, J. W. Hartley, Longport.
2022. Copying Multiplicators for Writings, &c., E. Behrens, London.
2023. Sluice Valve, C. Billington and J. Newton, Longport.
2024. Combined Railway Chairs and Sleepers, P. Kirk, Manchester.
2 25. Rolled Sleepers P. Kirk, Manchester.
2026. Portable Photographic Camera, F. Dresser, Liverpool.
2027. Fire-brasses, H. Sheldon and F. W. Green, Birmingham.
20 8. Tobacco Pipes, R. A. Benson, Birmingham.
2029. Railway Wheels, S. Alley, Glasgow.
2030. Floating Docks, R. H. Twigg, L. P. Gallwey, and S. Alley, Glasgow.
2031. Pickers for Looms, O. Ingham, London.
2032. Guards for Forks, W. Cooper, London.
2033. Portable Lamps, J. Wingfield, jun., London.
2034. Hoists or Lifts, W. Lumb and R. H. Holt, Rochdale.
2035. Balanced Slide Valves, H. W. Pendred, Streatham.
2036. Bicycles, &c., J. Hudson, Birmingham.
2037. Opening and Closing Taps, J. Malpass, Manchester.
2038. Stop-motion for Twisting Machines, &c., T. Unsworth and E. Whalley, Manchester.
2039. Photographic Cameras and Stands, H. Lucas, Birmingham.
2040. Oil-cans, H. Lindley, Salford.
2041. Trap for Vermin and Rabbits, W. Burgess, Malvern Wells.
2042. Alarm and Signal Guns, W. Burgess, Malvern Wells.
2043. Double Sockets for Metal Ropes, W. C. Blackett, Kimblesworth.
2044. Stair Rod, &c., T. Dobbs, Wolverhampton.
2045. Lighting and Illuminating, P. Smith and R. Wild, Fallowfield.
2046. Convertible School Desks and Seats, T. May, Sheffield.
2047. Valve Taps, H. S. Moore, Sheffield.
2048. Opening the Swell Shutters of Organs, J. R. Cafferata, Liverpool.
2049. Pumping Sea-water, Liquids, &c., R. J. Meek, London.
2050. Mincing Meat, Mixing Flour, &c., J. Hunt, London.
2051. Bleaching Fabrics, R. H. Ainsworth and E. B. Manby, London.
2052. Leather, W. R. Earp, Liverpool.
2053. Separating Particles of Iron from other Substances, W. P. Thompson.—(*F. E. Fisher, U.S.*)
2054. Corrugating Metal Rolls, &c., B. C. Tilghman, London.
2055. Boiler Furnaces, W. Noble and A. Mackie, Sutton.
2056. Cooling Liquids by Compressed Air, W. F. Bower, London.
2057. Outhaul for Yachts and Small Craft, A. Burgoine, London.
2058. Automatically Steering Bicycles, &c., E. C. Clarke, Derby.
2059. Collecting and Checking Money, A. Page, London.
2060. Asphaltic Covering for Ships' Decks, E. F. Wailes, London.
2061. Piston Packing Rings, J. Turnbull, jun., Glasgow.
2062. Dies, &c., G. F. Symonds, London.
2063. Window Fastening, H. J. Morris, London.
2064. Money-checking Till, A. B. Johnston, Glasgow.
2065. Stop Cocks and Bib Cocks, J. H. Diers, London.
2066. Winning Coals in Mines, C. Burnett, London.
2067. Circuit Switches, C. A. Gisborne.—(*F. N. Gisborne and D. H. Keeley, Canada.*)
2068. Photographic Apparatus, L. Geofroy and W. F. B. Massey-Mainwaring, London.
2069. Luggage Bags for Bicycles, &c., J. A. Lamplugh, Birmingham.
2070. Cowls or Caps for Ventilating Shafts, J. Watson, London.
2071. Malt Kilns, J. Smolik, London.
2072. Gully Traps, E. J. Heward and J. T. Martin, London.
2073. Kilns, G. Lazenby, London.
2074. Securing Axle Bushes, A. E. and H. M. Butler, London.
2075. Water-heating Apparatus, A. Sweet, London.
2076. Ships' or other Berths, E. Lawson and E. W. De Rusett, London.
2077. Compressed Air Cartridges, P. Giffard, London.
2078. Buckles, C. Nockler, London.
2079. Gas-pressure Regulators, A. Sonnenschein, London.
2080. Electric Switches, A. Bernstein, London.
2081. Telephonic Apparatus, L. de Combettes, London.
2082. Hydraulic Machinery, J. Leeming, London.
2083. Bluing for Laundry Purposes, W. R. Lake.—(*A. E. Spencer, United States.*)
2084. Velocipedes, W. Phillips, London.
2085. Velocipedes, H. Osborne, London.
2086. Softening, &c., Liquids, P. Maignen, London.
2087. Trusses, M. Mendoza, London.
2088. Explosive Compound, S. H. Emmens and J. O. Byrne, London.
2089. Target Screens, R. Morris, London.
2090. Cases for Sporting Cartridges, G. Kynoch, London.
2091. Figured Weaving, A. G. Dawson and J. and F. E. Adams, London.
2092. Seed Drills, T. H. Chandler, London.
2093. Lifting Potatoes, T. C. Fichtner.—(*R. Fichtner, Germany.*)
2094. Centrifugal Apparatus, C. G. P. de Laval, London.

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2095. Automatic Sale, &c., of Goods, J. G. Lorrain, London.
2096. System of Saturating Liquids, J. Mangnall and W. Bratby, Blackley.
2097. Spring Penholder, F. H. Harrison, Bradford.
2098. Metal Mountings for Whipple, &c., Trees, W. Rounsfell, Glasgow.
2099. Beer Taps, E. Reynolds, Sheffield.
2100. Bicycle Hub Lamps, F. Powell and F. Hanmer, Birmingham.
2101. Securing together the Ends of Tapes, E. W. Hirst and J. Wood, Halifax.
2102. Baling Cramps, J. Trayes and J. Anderson, Belfast.
2103. Tripods, W. Middlemiss, Bradford.
2104. Facing Nut Seats, J. Oldfield and A. Anderson, Glasgow.
2105. Spinning Machinery, W. Mair, Glasgow.
2106. Tapping Casks and Drawing off Contents, G. Howard, London.
2107. Controlling Circulation of Vesicles of Vapour in Boiling Wort, &c., F. Faulkner and W. Adlam, London.
2108. Hop Extract, F. Faulkner and W. Adlam, London.
2109. Gloves, Mitts, &c., S. Davis and F. Moore, London.
2110. Printing Machines, F. C. Barker and R. F. Sproule, Liverpool.
2111. Checking Collectors of Fares, J. Owen, Liverpool.
2112. Preserving, &c., Beer, J. Walton and W. Humphreys, Liverpool.
2113. Punching and Eyeletting Machines, M. H. Pearson, London.
2114. Fork Guards, W. Cooper and J. H. Rawson, London.
2115. Beer and other Pumps, J. Hobson, London.
2 16. Oars, Sculls, &c., L. Young, London.
2117. Steering Bicycles, &c., C. J. Hart and B. C. Barton, Birmingham.
2118. Velocipedes, C. J. Hart and B. C. Barton, Birmingham.
2119. Ships' or other Berths, E. Lawson and E. W. de Rusett, London.
2120. Automatic Ventilation, B. Boothroyd, London.
2121. Applying Spring Packing Rings to Pistons, N. Evans and H. C. Ashlin, Liverpool.
2122. Hot-air Engines, W. Eimecke and Co., London.
2123. Lamp for Mines, J. Heath and W. Frost, London.
2124. Turning Plough, &c., J. E. Brown, Saxilby.
2125. Cyclometers, C. V. Boys and M. D. Rucker, London.
2126. Permanent Cattle Stall for Ships, C. H. Caton, London.
2127. Generation of Steam, A. Reis, London.
2128. Main Shoes, &c., of Mowing Machines, W. McI. Cranston.—(*The W. A. Wood Mowing and Reaping Machine Company, U.S.*)
2129. Medicinal Preparation of Mixture for Curative Purposes, E. E. Burnett, London.
2130. Levelling Shafting, A. E. and H. M. Butler, London.
2131. Sash Fasteners, R. Greenwood and J. Webb, London.
2132. Mid-cylinder Exhaust Steam Engines, L. J. Todd, London.
2133. Velocipedes, D. Wiggins, London.
2134. Valves for Pumps, &c., A. Riedler, London.
2135. Woven Loops, &c., with Inscription, T. G. Lomas, Manchester.
2136. Stringed Musical Instruments, F. E. P. Ehrlich, London.
2137. Separation of Liquid from Solid Matter, J. Marx, London.
2138. Administration of Anæsthetics, G. E. Johnson, London.
2139. Photographic Printing, H. Van der Weyde, London.
2140. Oil, &c., Motors, E. Capitaine and F. Brünler, Berlin.
2141. Bakers' Ovens, L. T. Baudu, London.
2142. Soot-boxes, H. Seale, London.
2143. Water-raising Apparatus, W. Anderson, London.
2144. Extracting Butter from Milk, B. M. Plumb and T. I. Richman, London.
2145. Urinals, J. Doulton, London.

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2146. Hanging Lamps, B. R. Phillipson, Dublin.
2147. Buttons, H. Allcock, Birmingham.
2148. Stopper for Bottles, E. O. Parry and T. Davies, Liverpool.
2149. Fittings for Gas Brackets, &c., S. Brigden, Birmingham.
2150. Chandeliers, B. Twigg, Rotherham.
2151. Artificial Bait for Fishing, R. A. Ray, Great Grimsby.
2152. Spring Fork for Velocipede, &c., Wheels, J. M. Starley, Coventry.
2153. Wheels for Bicycles, &c., G. T. Neville, Birmingham.
2154. Carrying away the Fumes of Gas, &c., W. H. Bodin, Wednesbury.
2155. Mouse, &c., Traps, E. Sherring, Manchester.
2156. Change-box Motion Attachments of Fancy Looms, C. E., F. P., and A. T. Middleton, Manchester.
2157. Morticing Machines, E. Kirchner, Germany.
2158. Perforation of Paraffine Lamp Bodies, &c., J. Morton, Aston.
2159. Bicycles, &c., D. Christie, jun., Redhill.
2160. Rotary Brushes, F. Richardson, London.
2161. Mules for Spinning, W. Hurst, London.
2162. Steam Engines with Injectors, W. Schmidt, London.
2163. Steam Boiler Furnaces, E. Albin, London.
2164. Cleaning Knives, W. Aytoun, London.
2165. Cooking Ranges, W. Telfer and J. McI. Shaw, Glasgow.
2166. Railway Sleepers, E. Schmidt, London.
2167. Fire-arms, H. Pieper, London.
2168. Filtering, G. Behrns, London.
2169. Army Electric Signalling Lamp, A. Lovell, London.
2170. Safety Lamps, J. G. Hawkins, G. E. Scarborough, and T. H. Eaude, London.
2171. Comforter, A. T. H. Trevor, London.
2172. Bead Festoons, E. Hoegger, London.
2173. Alarm Lock, U. V. Jaeggi, South Australia.
2174. Gas Engines, R. Skene, London.
2175. Filtering, &c., Water, A. M. Clark.—(*L. E. Robert, France.*)
2176. Duplex Water Gauges for Boilers, J. Dewrance, London.
2177. Locomotive Regulators, J. Dewrance, London.
2178. Lubricants for Steam Cylinders, J. Dewrance, London.
2179. Blower for Locomotive Fires, J. Dewrance, London.
2180. Steam Traps, C. Watson and A. Gaukroger, London.
2181. Kettles and Saucepans, G. A. Goodwin, London.
2182. Filters, F. Grosvenor, Glasgow.
2183. Railway Signalling, B. J. B. Mills.—(*J. Guetton, France.*)
2184. Type-writers, F. Mitchell, London.
2185. Expressing Notation for the Piano, &c., C. J. Jones, London.
2186. Transmitting Motive Power, G. F. Redfern.—(*H. E. Godé, France.*)
2187. Explosive Compound, G. F. Redfern.—(*O. Biernaux, Belgium.*)
2188. Automatic Flour Mills, G. F. Redfern.—(*E. Massin-Nanta, France.*)
2189. Safety Cock, G. F. Redfern.—(*J. B. Charlier, G. Clément, C. M. Eilersgaard, France.*)
2190. Generating Steam, G. F. Redfern.—(*E. Nourry, France.*)
2191. Preserving Alimentary Substances, W. McDonnell, London.
2192. Locking by the Lock Buckle, I. D. E. L. Lloyd-Jones, London.
2193. Fittings of Mechanical Telephones, W. J. Burnside, London.
2194. Rotary Engine, W. H. Murch, London.
2195. Raising Ships' Boats, A. C. Hattatt, Isle of Wight.
2196. Children's Bedsteads, H. H. A. Schwarz, Millbrook.
2197. Reeds for Looms, T. Dean and T. E. Dean, Liverpool.
2198. Bolt and Rivet-making Machines, W. H. Beck.—(*F. Neveu and I. Jacquet, France.*)
2199. Closet Basin Joints, W. H. Tylor and W. B. H. Drayson, London.
2200. Ships' Tanks, S. J. E. Jörgensen, Norway.
2201. Expanding, &c., Apparatus, W. Tully, London.
2202. Locking Devices for Screw Nuts, H. H. Lake.—(*L. C. Learned, United States.*)
2203. Bottle Stoppers, J. C. Schultz, London.
2204. Metallic Cloth, A. H. Thorn, London.
2205. Numbering Apparatus for Rotary Printing Machines, J. M. Black, London.
2206. Drying Wood, H. H. Lake.—(*F. G. and A. C. Sargent, United States.*)
2207. Concentration of Sulphuric Acid, H. J. Leslie.—(*R. Finch, Germany.*)
2208. Effecting Locomotion on Steep Inclines, R. H. Lapage, London.
2209. Bogie Trucks for Locomotives, &c., T. English, London.
2210. Wire Rope for Cable Tramways, J. Lang, London.
2211. Artificial Silk-like Filaments, Comte H. de Chardonnet, London.
2212. Lighting Safety Lamps, W. Thomas and Sir W. T. Lewis, London.
2213. Production of Mixed Azo-colours, C. A. Martius, Germany.

SELECTED AMERICAN PATENTS.

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

333,449. Universal Shaft Coupling, *Hilen C. Crowell, Erie, Pa.—Filed August 10th*, 1885.

Claim.—(1) The combination, in a universal shaft coupling, of socket pieces, substantially as shown, adapted to be secured to shaft sections, with a connecting central section provided with rotary discs, substantially as shown, and trunnion pins connecting said rotary discs with the socket portion of the couplings, substantially as set forth. (2) The combination, in a universal shaft coupling, of socket pieces, adapted to be secured to shaft sections, with a connecting central section provided with rotary discs in the ends thereof, and having oil reservoirs on either side of said discs, and trunnion in said discs for connecting the same with the sockets, substantially as and for the purpose set forth. (3) In a universal shaft coupling, the combination of the central section L thereof, having oil chambers F F and oil plugs H H in each end thereof, substantially as shown, with rotary discs

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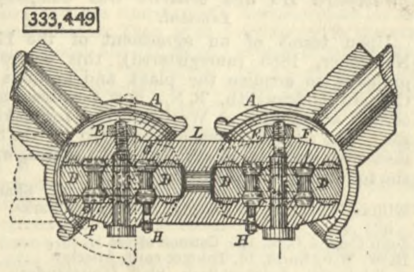

D, having oil chambers G and openings g therein, and journal bolts E, substantially as and for the purpose set forth. (4) The combination, in a universal shaft coupling, of the socket pieces A A, provided with trunnion pin openings C C, with the central section L, provided with rotary discs D D, having oil chambers F G on either side thereof, the journal bolts E, and trunnion J J, all constructed and operating together substantially as and for the purpose set forth.

333,392. Hood or Cap for Piles, *William T. Casgrain, Milwaukee, Wis.—Filed September 10th*, 1885.

Claim.—(1) A hood or cap for piles, consisting of a metallic casting having a recessed lower portion and end grooves bevelled at their tops, substantially as and for the purpose set forth. (2) A hood or cap for piles, consisting of a metallic casting having recessed upper and lower portions and end grooves bevelled at their tops, substantially as and for the purpose specified. (3) A hood or cap for piles, consisting of a metallic casting

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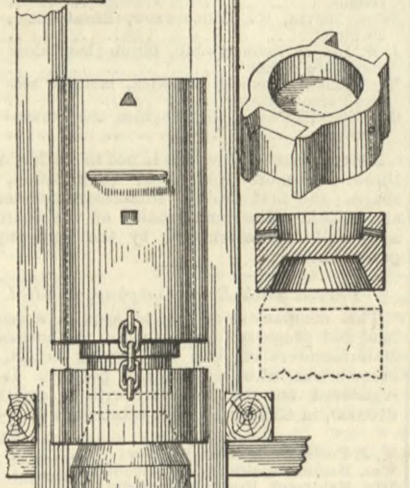

having bevelled recesses in its upper and lower portions and bevelled grooves at its ends, substantially as set forth. (4) A hood or cap for piles, consisting of a metallic casting having bevelled recesses in its upper and lower portions, bevelled grooves at its ends, and perforations in its sides at an angle to its horizontal plane, substantially as set forth. (5) A hood or cap for piles, consisting of a metallic casting having recesses in its upper and lower portions, grooves at its ends, and perforations in its sides, in combination with a short timber or cushion designed to fit the upper recessed portion of said hood or cap, and means, substantially as described, for connecting the latter with the monkey or rammer of a pile driver, substantially as set forth.

333,324. Key-seat and Gear Cutting Machine, *Matthew Morton, Romeo, Mich.—Filed August 2nd*, 1884.

Claim.—(1) The combination, with a cutter bar constructed with an orifice e, and cut away as at e^2, of the cutter E^1 and set screw e^1, the construction being such

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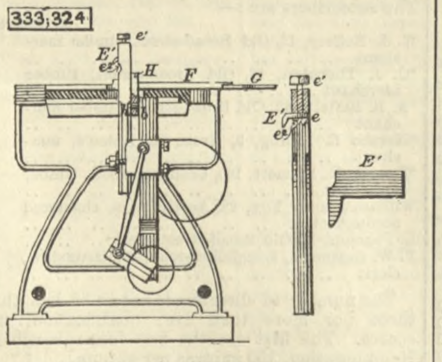

that various sizes of cutters may be located in said bar and held in place by said screw, substantially as described. (2) A cutter bar provided with a removable cutter, said bar cut away adjacent to the cutter, substantially as described. (3) The combination of a supporting frame, a top or table, a horizontally sliding bar on the table, and the cutter bar carrying a cutter, with an extended bearing interposed between the inner end of the sliding bar and the cutter bar, and against which bearing the sliding bar abuts to press the cutter forward to its work, substantially as described. (4) The combination, with the oscillating guide provided with a sliding head and a slide b, of a cutter and an extended bearing H, located in rear of said cutter, and having an orifice h, within which the slide b works to reciprocate the bearing by the action of the oscillating guide, substantially as described. (5) In a gear or keyway cutter, the combination, with the oscillating guide provided with a sliding head, of a cutter engaged with said head, an extended bearing in the rear of the cutter, a sliding bar F, and lever G, arranged to operate substantially as and in the manner described. (6) In a gear or keyway cutter, the combination, with the oscillating guide provided with a sliding head, of a cutter and extended bearing located in the rear of the cutter, and mechanism operating upon said bearing to crowd the cutter to its work, substantially as described. (7) In a keyway or gear cutter, a screw and thumb-nut and sliding bar J, engaged at one end with said thumb-nut to limit the movement of the cutter in a forward direction, substantially as described.

333,431. Rolling Mill, *Francis H. Treat, Joliet, Ill.—Filed September 19th*, 1883.

Claim.—(1) The combination, substantially as before set forth, with the rolls of a rolling mill, of a billet-turner composed of a trumpet-mouthed sleeve, the eye of which is angular in cross-section, and a stand or bearing on which said sleeve is journalled. (2) The combination, substantially as before set forth, of the

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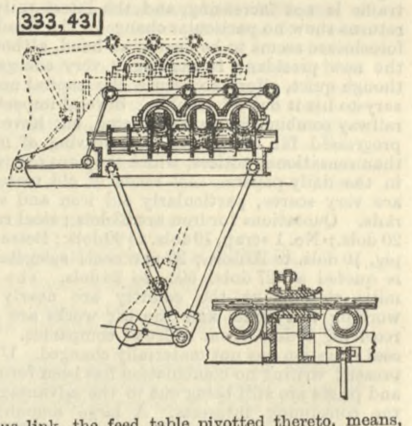

radius link, the feed table pivotted thereto, means, substantially such as described, for supporting and lifting and depressing said feed-table, the billet-turner, which is mounted on the feed-table, and the journalled sleeve of which is provided with an arm, and a rod connecting the said arm with the radius link.

333,570. Feed Regulator for Roller Mills, *Eli Strong, Kalamazoo, Mich.—Filed April 14th*, 1885.

Claim.—(1) The combination of the feed gate, the operating levers fulcrumed in the casing, the inner ends of the levers bearing a bridge, the outer ends having the perforated concave pockets, the feed gate, the rods having the rounded heads in said pockets, an upwardly-extending rod bearing a spring forming a resistance against the rise of the feed gate, said rod centrally connecting the gate, and an adjustable stop secured to the casing in position to limit the upward

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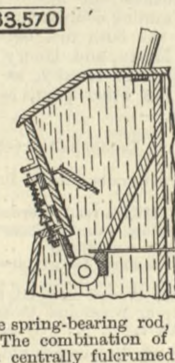

movement of the spring-bearing rod, substantially as set forth. (2) The combination of the feed gate, operating levers centrally fulcrumed in the casing, rods connecting the ends of the gate with the outer ends of the levers, an upwardly-extending rod centrally connecting the gate and bearing a spring, forming a resistance against the rise of the feed gate, an adjustable stop secured to the casing in position to contact with the spring-bearing rod in its upward movement, and a vertically-tilting bridge connecting the inner ends of the operating levers and disconnected from the hopper casing, substantially as set forth.

333,619. Lathe Centre, *William H. Fairless, Portsmouth, Va.—Filed October 2nd*, 1885.

Claim.—(1) In a lathe centre, the combination of a cone, a centre pin, and means, substantially as described, for adjusting the cone longitudinally on the pin, as set forth. (2) In a lathe centre, the combination of a cone having a central bore funnel-shaped at

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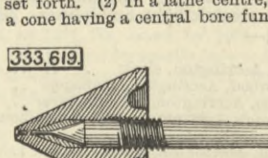

one end and recessed at the other, as at a, and in part screw-threaded, and a central pin having an enlarged screw-threaded part and a cone-shaped point adapted to fit the bore in the cone, substantially as described. (3) In a lathe centre, the combination of a cone having a central bore, a pin adapted to fit said bore, and a washer adapted to fit in the funnel-shaped end of the bore in the cone and over the end of the pin, whereby the cone may be longitudinally adjusted on the pin and still preserve its true central line, substantially as described, for the purposes set forth. (4) An adjustable lathe centre consisting of a cone having a central bore funnel-shaped at one end and in part screw-threaded, a central pin having an enlarged screw-threaded part and a cone-shaped point adapted to fit the bore in the funnel-shaped end, and a socket end, substantially as described.