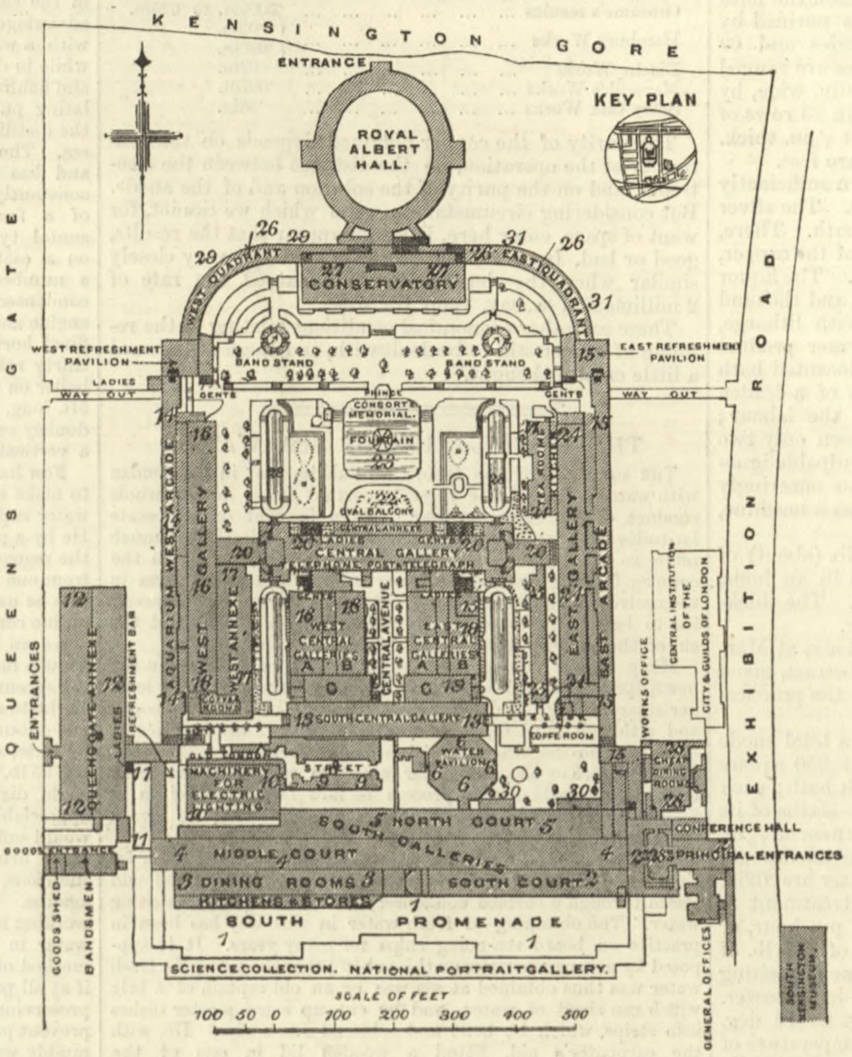
ELECTRICAL ENGINEERING AT THE INVENTIONS EXHIBITION.

No. I.

DURING the last few years the inventive genius of this and almost every other civilised country has been largely concerned with electrical science and its application to useful purposes. The result has been the development of a new branch of engineering, and we find that side by side with steam, hydraulic, railway, naval engineering, and other branches of the profession, that of electrical engineering has come into existence, engaging at the present time the attention, not only of scientific men, but also of practical men who are making a speciality of it. This development has been so rapid and the practical results obtained are so hopeful that one is inclined to listen to the advocates of electricity, and to consider it as something more than a figure of speech when they tell us that the world is now entering into the era of electricity; just as in the time of James Watt it entered into the era of steam. Whether these prophets be right, and what the outcome of this unprecedented and almost feverish activity in the world of electrical engineering may be, time alone can show, but meanwhile we find in the coming Exhibition a very favourable opportunity for obtaining a clear idea of the present state of the new industry. Within the last few years so many Exhibitions have succeeded each other that one wonders how there can be anything new to show, and yet there always is, especially in electrical matters. As far as the application of electricity for lighting purposes is concerned, the two preceding Exhibitions in South Kensington, and especially that of last year, although only remotely connected with electricity, have afforded an opportunity for display, and have been very instructive and eminently successful. The coming Exhibition will, however, not only outshine even that of last year by reason of a larger and more varied show of electric lighting plant in action, but other applications of electricity will be added, which may soon equal, and perhaps excel, that of electric lighting in practical importance.

We propose to describe in detail and, where possible, illustrate electrical exhibits of interest in the course of these articles as soon as the Exhibition has been opened. At present only very few exhibits are in their places, and with the exception of the electric lighting plant, the erection of which, under the able management of Mr. Gooch, is being rapidly pushed on, the interior of the buildings at South Kensington presents as yet an almost empty appearance. The shed containing the machinery for electric lighting has been considerably enlarged, and additional steam power, reaching 2160-I.H.P., has been provided. We hope to give plans and particulars of this in an early issue. For the present our space will only permit us to give a list of the firms who participate in the lighting of the buildings and grounds, and to add some information regarding the number, type, and position of lamps used. By the aid of the plan of the Exhibition buildings and grounds above, our readers will be able to see what parts have been allotted to the different exhibitors, the numbers inscribed on the plan corresponding to the numbers in the first column of our list, headed "Section." The lighting of an area like that occupied by the Exhibition buildings is no small matter. Here in England, where as yet the number of lights in installations are counted only by hundreds in the case of incandescent lamps, and by much smaller figures in the case of arc lamps, an installation like that now being erected at South Kensington must appear to be an undertaking of almost gigantic dimensions, as there will be over 6000 incandescent and over 400 arc lamps in use every night. But if we come to consider the complexity of the different systems which make up this grand total of lights supplied from one central station, it is evident that at these Exhibitions the electric light is produced under difficulties far greater than could ever exist under conditions of ordinary public supply. The list we publish contains, of course, only those exhibitors whose plant will be actually at work, and engaged in the lighting of the Exhibition. As will be seen, most of the names are well-known, and only a few new names will be found. Under the old names there will, however, be found many new exhibits. Thus Messrs. Crompton and Co. are going to show their new type of machine, and the Anglo-American Brush Company will show one of their improved Brush dynamos, with the new wrought iron armature. This is the old 60-light Brush, driving arcs of about 700 to 800 candles, converted into a 24-light machine driving arcs of 3000 candles. The new machine gives, therefore, about 50 per cent. more light than the old machine of equal size. Messrs. Goolden and Trotter are, as a firm, new in the field; although individually well known in the profession. They will show their new dynamos, driving incandescent and Hochhausen arc lamps. Messrs. W. H. Allen and Co., the well-known makers of high speed steam engines and centrifugal pumps, are also new comers at an electrical exhibition. They will show a combined twin engine and slow speed dynamo on one bed-plate. Messrs. Goulard and Gibbs are going to show their secondary generators for the conversion of currents of high electro-motive force into currents of low electro-motive force. What the efficiency of conversion really is has for a long time been a disputed point, as it was not easy to make measurements sufficiently accurate with the alternating currents employed by the inventors. We shall not be far wrong if we say that electricians having, up to a short time ago, very little troubled about the measurement of alternating currents, were, on the appearance of the Goulard and Gibbs secondary generator, suddenly confronted with an almost new and difficult problem, and could not all agree how it should be treated. Hence the differences of opinion as to the value of this invention. The matter seems, however, now fairly clear, and has, by the work of Professor Ferraris of Turin, been brought within the realm of rigorous mathematical investigation. Our contemporary, the *Electrician*, has lately published an abstract of Professor Ferraris' researches, and from these it would appear that the efficiency of conversion is in reality extremely high. The secondary generators to be shown in the forthcoming Exhibition will be employed for supplying the Varley lamps with current. Each lamp is to have its own small generator placed in a neatly designed stand under it. The lamps are supplied with Varley's patent flexible carbon, and are said to be extremely economical of power, a light of 200 candles being obtained with an expenditure of only 150 Watts electrical energy.

An interesting feature of novelty in this country will be the Thompson-Houston dynamo and lamp, although both have for a considerable time been in successful use in America. The system is one employing high tension currents, as many as forty arc lights being run in series off one of the dynamos to be exhibited. Our list does by no means exhaust the number of electric lights which will be in use nightly at the Exhibition. In addition to the illumination of the buildings, the grounds will be lighted by small incandescent lamps which are to take the place of the Chinese lanterns and night-lights in coloured glasses employed last year. This installation is also of considerable magnitude, but as the arrangements will not be completed until the 29th of this month, when there will be a private view previous to the opening of the Exhibition, we must defer our account until then. At present there is little electrical plant in the building, but a few days will suffice to advance matters.



PLAN SHOWING DISPOSITION OF ELECTRIC LIGHT SYSTEMS IN THE INVENTIONS EXHIBITION.

Electric Light Installations at the Inventions Exhibition.

Section.	Exhibitor.	Type of lamp.	Actual candle-power.	E.M.F. of lamp.	Number of lamps.	Position and remarks.
1	Crompton and Co.	Crompton-Crabb DD arc lamps	3000	—	6	South Promenade. Lamps in pairs on three masts.
2	Edison-Swan...	Edison and Swan incandescent	{ 10 { 20	150 100	400 750	Entrance. South Court. }
3	Paterson and Cooper	Bernstein incandescent	50	—	270	Dining-rooms. } S. Gallery.
4	Siemens Brothers	Swan incandescent	20	46	1080	Middle Court. }
5	Anglo-American Brush Company	Victoria incandescent...	20	60	750	North Court. }
6	Goolden and Trotter	Woodhouse and Rawson incandescent	20	100	300	Austrian Court. Current supplied by new Goolden and Trotter dynamo.
7	Elwell-Parker	Swan incandescent	20	100	200	Royal Pavilion. Elwell-Parker dynamo and accumulator.
8	Mackie	Lea arc lamps	2700	—	5	Old London street. Three lamps fixed to houses, and two lamps hoisted on two masts.
9	Crompton and Co.	Woodhouse and Rawson incandescent	20	100	300	Old London houses. New Crompton dynamo and Willan's engine.
10	Andrews	Andrews arc lamps	1000	—	16	Shed containing machinery for Electric Lighting.
11	Clark, Chapman, and Co...	Swan incandescent	20	100	200	Refreshment bar.
12	Anglo-American Brush Company	Sellon Brush arc lamps	3000	—	24	Queen's-gate Annexe. All 24 lamps on one circuit, driven from Brush machine with new armature.
13	Jablochkoff Electric Light Company ...	Jablochkoff candles	—	—	—	South Central Gallery.
14	Gülcher Electric Light Company	Swan incandescent	20	45 and 50	750	Aquarium. (Gülcher dynamo.)
15	Goulard and Gibbs	Varley lamps and Maxim incandescent... ...	200	—	30	East Arcade and West Gallery, Concert Rooms. Lamps, &c., worked by secondary generators on one main circuit.
16	Pilsen-Joel	Pilsen arc lamps	780	—	42	West Gallery.
17	Paterson and Cooper	J. F. pattern arc lamps	650	—	24	West Annexe.
18	Cordner, Allen, and Co.	Thornton arc lamps	650	—	30	West Central Galleries. Arc and incandescent lamps in parallel.
19	Maxim-Weston Co.	Weston arc lamps	2000	50	20	East Central Galleries.
20	Gülcher Electric Light Company	Gülcher arc lamps	700	—	50	Central Gallery. All the arc lamps in parallel; fed by Gülcher dynamo.
21	Gülcher Electric Light Company	Swan incandescent	20	45	250	Chinese Restaurant, Tea-rooms. All lamps parallel; fed [by Gülcher dynamo.
22	Goolden and Trotter	Hochhausen arc lamps	3000	—	6	All the six lamps on one mast over Royal Balcony.
23	Siemens Brothers	Siemens arc lamps	—	—	12	For fountain display.
24	Thompson-Houston	Thompson-Houston arc lamps	{ 800 { 500	— —	40 } 18 }	East Gallery. Two Thompson-Houston machines.
25	—	—	—	—	—	East Annexe. (Three exhibitors; names not yet decided.)
26	Clark-Bowman	Arc lamps	700	—	12	East Quadrant and West Quadrant.
27	Siemens Brothers	Siemens arc lamps	5500	—	4	Conservatory. Same as last year.
28	Sun Lamp Company	Sun lamps	1100	—	24	Cheap dining-rooms.
29	Woodhouse and Rawson	Woodhouse and Rawson incandescent	20	100	300	West Quadrant.
30	W. H. Allen and Co....	Swan incandescent	20	100	200	Tea and coffee stalls adjoining North Court. Slow-speed dynamo, driven direct by twin engine.
31	Consolidated Electric Company	Consolidated incandescent	20	60	200	East Quadrant. Lamps arranged in groups on the B.T.K. system.

COMMERCIAL ELECTROLYSIS.

No. II.

By Paget Higgs, LL.D., D.Sc.

As has been said, the first step to the study of the practical laws of this subject is the collation of facts as to what has been really effected in practice; and to resume this, we will first refer to the works of Messrs. Œschger, Mesdach, and Co., established at Biache, near the English Channel. Here is employed a Gramme machine, duplicate to that used by Dr. Wohlwill at Hamburgh, and this supplies twenty baths, producing daily 880 lb. of copper.

The baths in these works are constructed of 2½in. planking, lined with lead. Each bath is 10ft. long, 2ft. 6in. wide, and 3ft. deep. They are coupled in series, and are filled with a solution of sulphate of copper maintained uniformly at a density of 19 deg. Baumé. When the bath becomes too strongly charged with iron, it is purified by crystallisation. Each bath contains 88 anodes and 69 cathodes of equal total surfaces. The anodes are ranged in 22 rows of four; they are 28in. long and 6in. wide, by about ½in. thick. The cathodes are ranged in 23 rows of three; they are 34in. long, 7in. wide, and about $\frac{1}{16}$in. thick. There is therefore in action about 10,800 square feet.

The copper is deposited on the cathodes in sufficiently thick layers to be taken directly to the rolls. The silver is found in the mud at the bottom of the bath. There, also, are to be found less profitable impurities of the copper, as well as broken bits of cathodes and anodes. The liquor of the bath is decanted through lead syphons, and the mud removed, washed, and subsequently fused with litharge, or with simply a reducing re-agent, the former product being treated as argentiferous lead. The decanted bath liquor is raised again to the baths by means of a leaden Giffard injector. Two men are sufficient for the labour; and during five years of work there have been only two important stoppages, both of them due to culpable ignorance. Those so-called practical men, who sneeringly impugn the lasting power of the dynamo as a machine, would do well to refer to these machines.

At these works, the production is 1540 lb. (about) of copper in a day of twenty-four hours, or 64 lb. an hour, upon a cathode surface of 13,000 square feet. The thickness of the deposit is about ·00012in. per hour.

The details of the works of M. Hilarion Roux, at Marseilles, may be summed up in the following abstract, given for reference subsequently when dealing with the practical cost of this process of refining.

The number of the baths is forty, having a total anode surface of about 10,000 square feet, or about 250 square feet per bath. There are 115 plates in each bath; each plate is 2ft. 3in. long, and is immersed to five-sixths of its length, by a width of nearly 6in., with a thickness of $\frac{1}{16}$in. The weight of a single plate is 26 lb. The anodes are distant from the cathodes 2in., and the latter are ·02in. thick. The total weight of copper under treatment is 54 tons. Twenty-three pounds are refined per hour, or about 550 lb. per day, with an expenditure of 530 lb. of coal per day, used in driving a No. 1 Gramme depositing machine at 850 revolutions, absorbing about 5-horse power. The density of the bath solution is 16 deg. to 18 deg. Baumé, and the bath is maintained at a temperature of about 25 deg. Cent. The deposit is at the rate of ·0002 lb. per square foot of cathode, or a thickness of $\frac{1}{100000}$in. per hour—a remarkable instance of the importance of small increments of matter.

In addition to the previous details, a description of the process and details of the work as carried on—as far as is known—at the Selby Oak Works, near Birmingham, by Elliott's Metal Company, will afford sufficient data on which to base conclusions as to the commercial character of the electrical processes of refining copper. These works produce ten tons of refined copper a week; the current is obtained from five Wilde's machines; the baths are in five series of 48, coupled one after the other in each series.

The baths are 2·9ft. long by the same width, and 4ft. depth; each contains 16 anodes, 2ft. long by 6in. wide by ½in. thickness, weighing each 26 lb. But there are only 10 cathodes in each bath, each cathode being 1·4ft. long, 22in. wide, and ·03in. thick, weighing 2·86 lb. The total weight of copper in each bath is about 450 lb., and in a battery of forty-eight baths about 10 tons. The distance between the electrodes is 3½in. The immersion of the anodes is only to 20in. of their length, so that the immersed surface, counting both sides of the anode, is only 1¾ square feet, and there are 30 square feet in each bath. The production for the forty-eight baths is nearly 30 lb. an hour, or about ·65 lb. per bath per hour, corresponding to a current of 235 ampères. The anodes are replaced every five weeks, and the work is consecutive for 156 hours a week. There are at Selby Oak Works five similar installations to that described.

It would be useless to multiply examples of the commercial importance of electrolysis; it remains to be seen whether these processes are conducted on sound commercial principles—that is, whether they pay and how they pay. Subsequently we may consider whether they are capable of extension.

That these processes pay we judge, *à priori*, from the length of time they have been in operation; but to form any opinion as to their value as commercial concerns it is necessary first to take into account several technical points. The first is the thickness of the deposit in a given time.

Amongst the earliest investigators in this important field was Mr. John T. Sprague, who employed as a generating source of electricity a Daniell's cell, varying the current by varying the resistances, so that a given thickness—·0035in.—was obtained in 30 hours, as the slowest, and in 45 minutes, as the quickest, rate. Between a thickness of ·00012in.—measured, of course, by weighings—and of ·00144in. deposit per hour—that is, between rates of deposit as 1 to 12 up to the limit of the last—the deposit was good; beyond this all quicker rates gave defective deposits. From these trials Mr. Sprague concluded that the limit of current of 1 ampère to 33 square centimetres, or to, say, 5 square inches, should not be exceeded. This corresponds to 300 ampères per square metre, or to nearly 30 ampères per square foot of anode. But in practice this limit can never be attained. Even in the most careful manipulation of typographic clichés, when depositing from anodes of pure copper, one-third this rate is rarely exceeded with safety. Indeed, there is scarcely a safe, hard-and-fast rule, for the impurities of the anode really control the speed of the operation. M. Gramme has recommended in some cases as slow a deposit as at one-tenth of this given rate; and has obtained hard, fine, and tenacious deposits at even 1 ampère per square metre. We have previously referred to the rate of deposits as obtained at Hamburg, at Biache, and at Marseilles, and we may now tabulate these results; but in order to give the deposits appreciable thickness, the total of a week's work of 156 hours is taken.

Maximum deposit chemically pure anodes.	·067in.
Sprague's results; good deposits	·02in. to ·24in.
Gramme's results	·0006in. to ·025in.
Hamburg Works	·02in. / ·006in.
Biache Works	·02in.
Marseilles Works	·007in.
Selby Oak Works	·06in.

The purity of the copper obtained depends on the continuity of the operation, on the distance between the electrodes, and on the purity of the solution and of the anode. But considering circumstances upon which we cannot, for want of space, enter here, it would appear that the results, good or bad, from all the works quoted are very closely similar when the deposit does not exceed the rate of 2 millimetres, or, say, ·08in. per week.

There are other economical conditions relating to the refining of copper still to be dealt with, and these will reward a little careful thought.

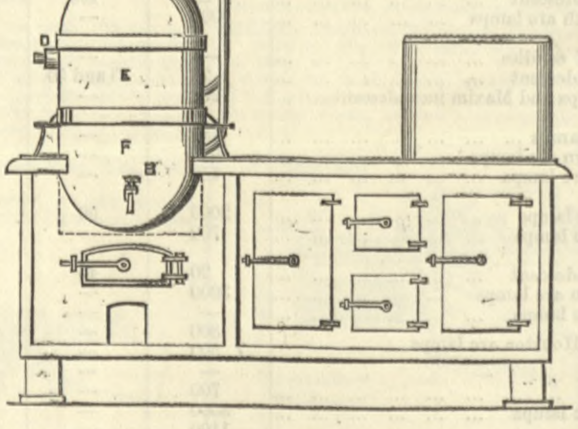
THE DISTILLATION OF SEA WATER.

The supplying of the troops at Suakim and in the Soudan with water is one of the most important items in the whole conduct of the Egyptian war. Even in cold or temperate latitudes fresh water is a first necessity for animal life; much more is this the case in the desert; and the wells in the country forming the scene of our military operations form in themselves valuable strategical points. Their supply, however, has to be supplemented, and to do so artificial means and the aid of the engineer have to be enlisted into this service.

Many of our readers see notices from time to time in the newspapers about this or that ship being employed, or at least her steam fittings, in distilling water for the use of the troops; and although most of, if not all our readers are engineers, still it is no disparagement to some of them to assume that they are more or less unfamiliar with sea water distillation on the scale on which the process is now being carried on at Suakim; and as the subject is of general interest, we give a short description of the process.

In a general sense fresh water is obtained from sea water by simply generating steam from the sea water, passing the said steam through a surface condenser, and filtering the resulting water. The obtaining of fresh water in this way has been in practice on board sea-going ships for many years. It is supposed by some authorities on this subject that the first time fresh water was thus obtained at sea was by an old captain of a brig which ran short of water, and he cut up some pewter dishes into strips, which he bent and soldered into a pipe. He, with the carpenter's aid, fitted a wooden lid in one of the cooking boilers, and fixed one end of his pipe in it. He next sawed a water cask in half, bored a hole in the bottom of one half, and took his pipe through it, filling the space round the pipe with sea water. Thus he extemporised a worm and still or condenser. The distilled water, however, was scarcely drinkable. Not to be beaten, however, the captain got some pieces of charred wood which he put in the water, which so far improved it as to render it at all events fit to sustain life, and our skipper brought his brig and her crew safe to port. What suggested the use of charcoal to his mind history does not tell. For many years past scarce any sea-going vessel leaves port that is not fitted with a properly constructed distiller; and one conspicuous advantage attending this practice is that each ship thus fitted to the satisfaction of the Board of Trade inspector is allowed to sail with only half the quantity of fresh water on board which she should have if not provided with a distiller. The distiller and filter occupy very much less space than that which would be occupied by the casks or tanks of water otherwise required to be carried.

Coming now a little to detail, sea water distillers are usually fitted in connection with the winch and its boiler, which latter supplies the steam both for distillation and to drive the engine working its circulating pump. Smaller distillers are worked without a pump, the cooling water merely passing through by gravitation. These smaller affairs again are of two kinds, the one being mounted at one end of the cooking hearth, as in outline sketch, which shows a two oven hearth with distiller at one end. A is the supply pipe to admit air to aërate the water;



B is the cock where fresh water is drawn off; C is a pipe conveying cooling water to the condenser E, placed on three little feet on top of the boiler F, whose steam rises up a central pipe to the dome top, where it expands out and returns downwards through a number of tubes about 1in. diameter, in which it is condensed, collected in a bottom chamber, and drawn off through the cock B. A distiller of this size would make about thirty gallons of fresh water per day. Very frequently a distiller, such as is shown in the sketch, is mounted separately, and placed near the winch or donkey boiler, which supplies it with steam, the lower part F being then used as a filter. The diameter of E is from 15in. to 18in., the outer casing being either iron or copper. Another form of distiller is one like the above, but larger, and having a small donkey engine and circulating pump attached thereto. As a rule these distillers are vertical, but larger apparatus are arranged horizontally. To give our readers some general idea of size, weight, and produce of water, we may say that a plain cylindrical distiller, mounted on a square filter case, measuring 3ft. 9in. high, weighing 4½ cwt., will distil twelve gallons per hour. A larger size, measuring 6ft. 2in. high, and weighing about 23 cwt., will give 85 gallons; whilst a still larger one, measuring 7ft. high and weighing 32 cwt., yields 150 gallons. These have no pumps. When an engine and pump are fitted the weight is increased from about 80 per cent. in the smaller to 50 per cent. in the larger sizes. An immense advantage attends the use of those distillers that are combined with a winch boiler. Of course, the chief use of the winch is while in dock; some use is made of it at sea to do heavy pulling and hauling, to wash decks, and in case of emergency the circulating pump is used as a fire engine. Were it not, however, for the distiller, the winch boiler would simply be idle lumber at sea. The distiller, however, finds useful employment for it, and has also this excellent effect, that as steam is pretty constantly kept up for the distiller, in the evil event of a fire the boiler is ready to work at once. In horizontal types of distiller an engine and pump are mounted on a cast iron casing as a bed, and in this casing is placed a number of tubes through which the steam passes to be condensed, the whole being simply a surface condenser with engine and pump above. Another type is that of a small single-flued horizontal boiler with combustion chamber and twenty or thirty return tubes—in fact, the present high-pressure marine boiler on a small scale. A boiler of this sort, measuring 4ft. to 5ft. long, 3ft. 9in. to 4ft. 6in. diameter, would have a horizontal donkey engine on a bed at its side, and at the end of the engine a vertical cylindrical condenser.

Few have done more, perhaps none so much, as Dr. Normandy to make sea water distillation not only a success as a source of water supply, but also to supply it at a minimum cost for fuel. He by a peculiar arrangement of pipes embodied something of the regenerative system in his apparatus, using the heat taken from one lot of steam to generate more, and again the heat from this he used over again. The defect of his older arrangements was undue complexity and consequent trouble to keep in order.

As can be well imagined, the distillers in use at Suakim are on a much more colossal scale, and owing to the now almost universal use of surface condensers in ocean steamers, no great difficulty ought to attend the adaptation of the boilers and condensers of one of our transports. One of these full-powered steamers will indicate, say, 5000-horse power, and assuming her engines to use 25 lb. of steam per indicated horse-power, or 2½ gallons, she could distil some 12,000 gallons of water per hour. As no appreciable pressure of steam need be maintained, the boilers would suffer little from deposit, especially if regularly blown out. Hard firing need not be resorted to; indeed, it would be injudicious, as, of course, priming must be carefully guarded against. Of course, the salt water distilled will affect the working not exactly of the distillers, but of the boilers. If the water in the harbour, as is not improbable, is muddy, some method of filtering it before pumping it into the boilers ought, if at all practicable, to be resorted to, for the twofold reason of preserving the boiler plates from muddy deposit, and also to prevent priming, which would certainly ensue from the use of muddy water. No doubt the medical staff take care that the distilled water is alike thoroughly aërated and efficiently filtered. The most successful method of aërating is, we believe, to cause the current of steam as it enters the condenser to suck in air by induced current along with it. The filtering ought not to present any difficulty, as at all events sand enough can be had. Charcoal, however, is another affair, and all distilled water ought to be brought into contact with this substance.

Simple, however, as such an arrangement as this appears to be, practical difficulties, which it is *said* are insurmountable, stand in the way of its adoption, and the distilled water produced for Egypt is made in special apparatus, and various forms of condenser are employed, made under various patents. The principle involved is, however, in all cases the same. Steam is generated in one of the ships' boilers, and condensed, filtered, and aërated in a special apparatus. The great objection to the use of the ordinary surface condenser is that the main engines would, in the majority of cases, have to be kept going, in order to pump the distilled water out of the condenser, and to supply circulating water. But it is easy to see that if engineers thought proper, this difficulty could be readily got over. Separate circulating pumps, usually centrifugal, are now freely used, and the addition of a special pump for lifting the condensed water presents no difficulty whatever. While the main engines are running the withdrawal of much condensed water would no doubt risk the safety of the boiler; but in the case of so-called "distilling" ships, there need be no trouble incurred on this score.

ENGINES OF THE MONA.

The following additional particulars of the engines of the Mona—illustrations of which appeared in our last impression—may be of interest:—The dimensions of the engines are as follows: Cylinders, 20in. and 40in. by 24in. stroke; crank shaft of steel, 7½in. diameter; main bearings, 11in. long; centre bearings, 14in. long; piston-rods of steel, 4in. diameter; diameter of air pump, 15in. by 15in. stroke; feed and bilge pumps, 3⅜in. diameter and 15in. stroke, all driven by beams from high-pressure cylinder; circulating pump, independent, 9¼in. diameter and 12in. stroke, double-acting, driven by a Pearn direct-acting engine, exhausting into condenser, driving also an auxiliary feed pump, sucking from bottom of condenser, and acting as an air pump when engines are standing, and steam is being blown through into the condenser; condenser tube surface, 750 square feet; thrust bearing with single collar connected to engine bed by stays. Donkey engine, double-acting; steam cylinder, 7in. diameter by 9in. stroke; pump, 4in. diameter by 9in. stroke, with brass bucket, liner, and valve, arranged to draw from sea and engine-room bilges, and to pump into the boiler, overboard and on deck, and exhaust led to this, to waste pipe, or condenser. A 4in. double-acting brass-lined hand pump is fitted, to pump on deck and into the boiler, and draw water from the sea and bilges, with a cock for testing the condenser. Boiler, 11ft. 6in. diameter by 10ft. long, of steel, stayed for a working pressure of 100 lb., and tested by hydraulic pressure to 200 lb.; three furnaces, each 2ft. 9in. diameter and 7ft. 6in. long; total heating surface, 1050 square feet; grate area, 45 square feet; weight of engines and shafting, without propeller and pipes, 26 tons; weight of boiler, with water, 28 tons.

RAILWAY MATTERS.

MR. C. L. TATE has been appointed general manager of the Mersey Tunnel Railway.

THE eastern system of Cape railways, passing through the colonial coal fields, was completed and opened for traffic to Burghersdorp on the 19th ult.

ON the 10th inst. the Wigan Tramways Company sold the whole of its remaining stock of horses. These lines have for the last three years been worked jointly by steam and horse-power, and it is through the undeniable economy shown by the past three years' working by steam as against horses that the above resolution was passed. The engines exclusively used on the system are the Wilkinson type.

A COMPANY is being formed for the purpose of constructing a railway, to be known as the Sutton and Willoughby Railway. The line will run from Willoughby to Sutton, where it is proposed to construct a North Sea Fisheries Harbour and Dock. It is proposed to construct the line and dock and harbour in response to the wishes of the smack owners, fishermen, and merchants of Grimsby, the fish dock there not meeting the requirements of the trade.

THE published accounts of the railway companies for the past few half years generally show that working expenses are growing less in relation to the amount of work done, and in fact, companies in this way have been able to make dividends that would otherwise have been small; and this is notwithstanding a considerably increased mileage of line to work, and a largely increased train mileage. Much depends on careful and judicious enterprise of locomotive, carriage, and wagon superintendents.

MESSRS. CRAVEN BROTHERS, Darnall Carriage Works, Sheffield, have just delivered to the Cheshire Lines Committee forty composite carriages of a very comfortable and substantial type, which are intended mainly for the through traffic to Liverpool. The same firm are now building two large dining saloons for the Great Northern Railway Company, to be used in their express service from London to Scotland. They will be somewhat similar to the new dining saloon recently constructed at Gorton for one of their special fast expresses between Manchester and London.

SPEAKING of the Suakim-Berber line, a *Times* correspondent says:—"The construction of the railway is a curious and interesting sight. In advance is a picket of cavalry, while far off on either side the vedettes scout in the bush. At the immediate head of the line is a battalion of infantry—at present the Grenadier Guards—echeloned, and advancing as the rails are laid. Streams of coolies carry the sleepers from the trucks, and teams of four artillery horses drag up the rails, two at a time, to the navvies, who lay them in a twinkling, and drive the spikes. In the rear are gangs who complete the line, and further back the ballasting parties."

MR. HOLT S. HALLETT, who had charge of the Colquhoun exploration, delivered an address on Monday before the London Chamber of Commerce on "Railway Extension to South-West China and Siam." He sketched out the route of a proposed railway, setting down the cost of the line at six millions. There were no extraordinary difficulties in the matter of construction. The main line from Bangkok to Kiang Hsen should not cost more than four millions, and it ought to pay as well, or better, than the Irrawaddy Valley State Railway, connecting the British Burmah seaport town of Rangoon with Prome, which yielded 6 per cent., and passed through a less thickly populated and fertile country.

THE *Railroad Gazette* record of train accidents in February contains brief accounts of 61 collisions, 136 derailments, and 19 other accidents; 216 accidents in all, in which 44 persons were killed and 259 injured. Fourteen collisions, 9 derailments, and 2 other accidents caused the death of one or more persons; 8 collisions and 29 derailments caused injury, but not death. In all, 25 accidents caused death and 37 injury, leaving 154, or 71 per cent. of the whole number, in which no injury to persons is noted. In the 61 collisions there were 23 persons killed and 57 injured. In the 136 derailments, 18 persons were killed and 202 injured; while the 19 other accidents caused 3 deaths, but injured no one.

WHEN the projected new line, 600 miles long, from Winnipeg to Hudson's Bay is opened, the distance to Liverpool from Manitoba, *viâ* Hudson's Bay, will be lessened by more than 800 miles of railway and 64 of sea. The distance to Liverpool from Port Churchill, on Hudson's Bay, is 2926 miles, or 64 miles nearer than Montreal, which is 2990 miles; and 114 miles nearer than from New York to Liverpool, which is 3040 miles. It is therefore anticipated that within three or four years a further reduction will be made in the cost of Manitoba wheat at Liverpool equal to the saving on 800 miles of railway carriage, or about 3s. per quarter on wheat and £3 per head on cattle, without taking into account the saving in time, which is estimated at more than three days.

ACCIDENTS on American railways in February last are classed as to their number and causes as follows by the *Railroad Gazette*:—Collisions: Rear, 38; butting, 21; crossing, 2; total, 61. Derailments: Broken rail, 34; broken frog, 6; broken switch-rod, 3; broken bridge, 3; spreading of rails, 9; broken wheel, 15; broken axle, 5; broken truck, 2; broken draw-head, 1; dropped brake beam, 1; accidental obstruction, 3; land slide, 1; wash out, 1; snow or ice, 20; wind, 1; misplaced switch, 6; purposely misplaced switch, 2; rail purposely removed, 2; malicious obstruction, 1; unexplained, 20; total, 136. Other accidents: Boiler explosion, 2; flues collapsed, 1; broken parallel rod, 10; broken wheel, not causing derailment, 4; broken truck, not causing derailment, 1; car burned while running, 1; total, 19. Total number of accidents, 216. A general classification of these accidents may be made as follows:—

	Collisions.	Derailments.	Other.	Total.
Defects of road	—	55	—	55
Defects of equipment	3	24	18	45
Negligence in operating ..	48	6	—	54
Unforeseen obstructions ..	10	26	1	37
Maliciously caused	—	5	—	5
Unexplained	—	20	—	20
Total	61	136	19	216

As usual, unexplained derailments form a large proportion of the whole.

AT the end of 1883 the capital of the six leading French railways, including the subventions, was 10,671,716,000f., of which 10,069,671,000f. had been expended on the lines of the old and new network, comprising about 25,647 kilos, authorised, of which 23,201 kilos. were in work. The cost per kilometre worked was about 434,000f., whilst the total charge for rolling stock was 1,468,128,000f., or equal to 63,300f. per kilometre. The total traffic receipts of 21,163 kilos. brought into these accounts were 1,040,572,902f., or an increase of 3,370,954f. over 1882, whilst the expenses rose from 513,682,321f. in 1882, to 537,522,442f., or 23,840,121f. increase, leaving 503,050,460f. against 523,519,627f. as net receipts, or a decrease of 20,469,167f. The proportion of expenses to receipts was 51·66 as compared with 49·53 per cent., or 2·13 per cent. increase. In 1883 the companies carried 6,566,448,000 passengers one kilometre at an average fare of 0·0484f. For the same year, the tonnage carried by the *petite vitesse* one kilometre was 10,766,532,000 tons, at a cost of 0·0571f. To secure this traffic the trains ran 198,912,000 kilos., the locomotives 228,891,000 kilos., and the carriages and wagons of all sorts 4,128,558,000 kilos. Looking at these results from a financial point of view, the results of the working of a group of lines having a capital of 8,305,500,000f., a revenue of 522,287,000f. was carried, giving 6·29 per cent. on the capital. From the statistics it appears that the working of the lines, which in 1882 left a balance of 7,163,881f. towards the repayment of advances made by the State, left in 1883 a deficit of 11,783,822f.

NOTES AND MEMORANDA.

THE pig iron production of Austria in 1883 was 522,400 tons, against 445,478 tons in 1882. Of this quantity 474,754 tons were forge, and 47,646 tons were foundry iron.

THE total production of iron ore in Austria in 1883 was 882,313 tons, against 905,510 tons in the preceding year. The average output of each of the hands employed was 180 tons. Bohemia, 209 tons; Carinthia, 149 tons; and in Salzburg, 111 tons. The largest output was obtained in Styria, where 544,243 tons were worked.

PROFESSOR RIATTI has constructed a thermo-electric cell, based upon the principle that the production of electricity is due to the difference of the temperature of two parts of a single fluid. The cell consists of a receptacle of wood or porcelain, traversed by two tubes of copper, with wires at a certain distance between them. By the principal tube a jet of steam is passed, and by the other cold water. The outer jar contains a solution of sulphate of copper. When the circuit is made, the copper of one of the tubes is dissolved, and is deposited in the other. This cell is said to be constant, and not liable to polarisation.

HERE, says the *Carriage Monthly*, is a brief description of the process of steel-converting axle spindles. The threaded portion is incased in a ball of fire-clay. The axles are next stood—points down—in metal boxes; the space between the axles is then filled with animal carbon, usually calcined "bone dust," to a point 1in. or more above the collar. A fire is then made about the metal boxes, and kept up until the carbon ignites and penetrates the iron, the whole being at a red heat. When thoroughly charged with the carbon, and while red hot, the axles are removed and placed in the cooling vat, the water of which is most usually charged with salt, and sometimes with prussiate of potash.

WRITING to the *Times* on the fracture of the South Foreland Lighthouse lenses, Professor Tyndall says: "I have already shown that different kinds of glasses act differently on radiant heat. We have now to add that different kinds of radiant heat act differently on the same glass. Take an example. A plate of transparent glass will transmit 40 per cent. of heat from a brightly burning lamp, while the selfsame plate will transmit only 6 per cent. of the heat radiating from a plate of metal with a temperature of 700 deg. Fah. This small transmission implies a correspondingly large absorption. Now it so happens that precisely where the fractures begin at the South Foreland a source of heat over and above the flames comes suddenly into play. This second source is the flue into which the products of combustion, and indeed a portion of the flame of the large burners, are discharged. I think I am safe in stating that the heat radiated from this flue is wholly lodged in the glass. Thus, from the second lens upwards, we have the combined action of two sources of heat, and to this union of forces I attribute the partial destruction of the upper three lenses."

GAUS has computed—taking as a unit of his measure a magnet 14in. long, 1in. wide, 0·25in. thick, weighing 1 lb. made of the hardest steel and of the strongest magnetic force possible—the earth's magnetic force as equal to 8,464,000,000,000,000,000,000 such magnets. The attracting or lifting power of such a magnet is about 10 lb. which would make the attractive power of the earth 42,310,000,000,000,000 tons. This calculation may be rather curious, a multiplication of a quantity by 10 reducing it by a good many millions. The *Horological News*, which published the figures, probably thought that when all is guess work it is not wise to waste time on minute accuracy or give it a second thought. It adds, if this magnetism were equally distributed throughout the mass of the earth, the magnetic intensity of each cubic yard would be equal to six of these magnets, or about 60 lb. attractive force. Professor Mayer has shown that this magnetic influence, this invisible force, is a power filling space to an unknown distance and radiating in the lines of magnetic force very much as the rays of the sunlight, the lines of the earth's magnetic force being from south to north, as indicated by the compass needle.

SOME interesting facts are published concerning what are known as "the greyhounds" of the Atlantic. The steamship Etruria, the latest addition to the Cunard Line, has made 805 knots in forty-six hours with three-quarters steam. From the Fastnets to Ballycotton Light she steamed at the rate of 19·6 knots per hour, with sixty-three revolutions of the screw per minute. On a six hours' run in the Clyde, with Scotch coal, she reached 67·5 revolutions of the screw, and made 20·233 knots, going and returning between the Pladda and Sanda. This gives a speed of 24 statute miles per hour. The Etruria is a sister ship of the Umbria. She is entirely of steel, 520ft. long by 57ft. 3in. broad, and 41ft. deep. The following figures relate to nine vessels of the fastest class, all constructed within the last eight years:—

Name.	Builder.	Length. ft.	in.	Breadth. ft.	in.	Depth. ft.	in.
Arizona	Elder ..	452	2	45	4	35	7
Alaska..	Elder ..	500	0	50	0	38	0
Servia	Thomson ..	515	0	52	1	37	0
City of Rome	Barrow ..	560	2	52	3	37	0
Oregon	Elder ..	500	0	54	0	39	9
Aurania	Thomson ..	470	0	57	2	37	2
America	Thomson ..	441	8	51	2	36	0
Umbria	Elder ..	520	0	57	3	41	0
Etruria	Elder ..	520	0	57	3	41	0

Five of these, the Servia, Oregon, Aurania, Umbria, and Etruria, are owned by the Cunard Line, and it will be observed that these five have a greater breadth of beam and greater depth than their competitors—an important element in the calculation of comfort and safety. During the seven voyages from May last to January, the Oregon never steamed less than 400 knots per day coming east, nor did she vary more than four hours in the trip. Her quickest passage out and home—the quickest passage on record—was done in 12 days 21 hours 9 minutes, or an average of 18¼ knots, or 21·40 statute miles per hour.

THE employment of the telephone increases very rapidly in Europe. In Italy ten cities possessed telephone lines at the end of 1884, the same number in 1883; but the number of subscribers increased from 3710 in 1883 to 5301 in 1884, an increase of 30 per cent. In France eleven cities had telephonic communication both in 1883 and 1884; the number of subscribers increased from 4739 in the former year to 5535 in 1884, an increase of 15 per cent. In Belgium, in five cities, the increase has been from 2051 subscribers in 1883 to 2443 in 1884, or 19 per cent. In Great Britain, London had 3350 subscribers in 1884, against 2565 in 1883, an increase of 25 per cent. Liverpool, Manchester, Southport, and Blackburn had together 2359 subscribers in 1883, augmented to 2734 in 1884, or an increase of 17 per cent. For Sweden the figures for 1882 and 1884 are available; they show the largest increase for any country. In 1882 only five cities, with 1554 subscribers, had the telephone; in 1884, fifty-one cities, with 7737 subscribers, an increase of 398 per cent. in two years. In Holland, in eight cities, we find 1972 subscribers in 1883, and in 1884, in nine cities, 2250 subscribers; an increase of 14 per cent. In Switzerland, in ten cities, in 1883 there were 1778 subscribers, which figures rose in 1884 to twenty-seven cities, with 3771 subscribers; increase, 112 per cent. In Russia there were in 1883, in six cities, 1485 subscribers, rising to seven cities with 2230 subscribers in 1884; increase 60 per cent. The statistics for the German Empire for 1883 and 1884 are not yet published. There were 1500 subscribers in Berlin in June, 1884. In Austria at the end of 1883 eight cities only had telephone lines; there were 708 subscribers at Vienna in December, 1884. In Norway on June 30th, 1883, two cities—Christiania and Drammen—had 755 and 150 subscribers respectively. In Denmark, Copenhagen had 516 subscribers in June, 1883. In Portugal there were at the end of 1883 telephone lines in Lisbon, with 343 subscribers, and in Oporto with 183 subscribers. Spain is the only country which has no telephonic communications as yet, and a law was recently passed by the Cortes reserving to the Government the telephonic monopoly.

MISCELLANEA.

AFTER a year's effort to obtain and refine oil from wells in Burmah, recent Government reports state that, "So far, attempts to obtain oil in paying quantities in British Burmah have proved a failure."

AT the meeting of the Iron and Steel Institute on the 6th, 7th, and 8th May, ten papers will be presented, several of which are of more than usual interest. The meeting takes place at the Institution of Civil Engineers.

A BILL now before the New York Legislature provides that the portion of any telegraph, telephone, or electric light lines in any town in this State shall be assessed in the manner provided by law for the assessment of lands.

A USEFUL table, showing the horse-power transmitted by shafts and leather belting, compiled for the publishers by C. L. Hett, A.M.I.C.E., has been published by Messrs. S. and E. Norris and Co., the well-known leather belt manufacturers.

AT the entrances to the Inventions Exhibition fifteen of the registering turnstiles of Messrs. Isler and Co. will be employed. The new subway from the station to the Exhibition will reduce the crush of people at the Exhibition road entrance stiles.

THE Board appointed to investigate the charges preferred by Mr. J. H. Howe, M.P., in Parliament—South Australia—against Mr. R. C. Patterson, the Deputy Engineer-in-Chief, have brought up their report, and they unanimously clear him on every point.

THE Brussels Municipal Gas Company has decided to reduce the price of gas consumed during the day to 10 centimes per cubic metre, and proposes to use a meter with two indices—one for registering consumption at high pressure and the other for that at low pressure or day consumption.

THE Engineering News Publishing Company, New York, has published the first series of a set of drawings on "Engineering Drawings and Data," illustrative of the New Croton Aqueduct from Croton Dam to Harlem River. There are sixteen plates, which are of considerable interest to engineers concerned on water supply works.

DURING 1884 the imports of frozen meat amounted to the enormous quantity of 619,324 sheep and 115,377 quarters of beef. Most of these supplies arrived in "magnificent condition," but in some instances great deterioration had taken place during the voyage, involving heavy loss to the importers, and showing the great value of trustworthy refrigerating machinery.

THE keenness of the competition in the bridge building trade is causing some manufacturers to agitate the question of the advisability of taking steps to cause, if possible, the insertion in the public press of the results of the tendering for large Government work which is from time to time given out, in the same manner as the applications for tenders are now published.

THE Government have entered into a further contract with Messrs. Yarrow and Co., of Poplar, for the immediate construction of three more stern-wheel steamers for the Nile. The new boats will be shipped in large sections, which can be bolted together afloat, thereby avoiding the delays and difficulties of rivetting up and launching. They will also be provided with powerful armament, and may be considered as the advance or fighting boats for the expedition.

THE French authorities in Cochin China have erected overhead wires across the river Mekong, posts 165ft. high having been put up on each side of the river, at a spot where the width is 2560ft., and from these silicious bronze wires—one ·04in., and the other ·055in. in diameter—are suspended across the stream. Over a tributary of the river another similar connection has been made, 1670ft. span and more than 114ft. above flood water. The former of these is a span of 0·46 of a mile.

FROM the annual report of the Manchester Steam Users' Association it appears that, during the year, the occurrence of 36 steam boiler explosions, resulting in the loss of 23 lives and in injury to 44 other persons, came to the knowledge of the committee, while 13 "miscellaneous" explosions, killing 8 persons and injuring 21 others, also took place. This brings the total for the year up to 49 explosions, 31 deaths, and 65 cases of personal injury. At Bilston, three boilers blew up simultaneously, and three men were killed.

IN their report on the water supplied to London during March, Mr. William Crookes, F.R.S., Dr. William Odling, and Dr. C. Meymott Tidy say: Of the 188 samples examined, the whole were found to be perfectly clear, bright, and well filtered. The mean amount of organic carbon in the Thames-derived waters for March was practically identical with that for February, viz., 0·18 in 100,000 parts of the water. Considering the condition of the river during the month, and the additional care needful to effect good filtration, it is noteworthy that not one of the 188 samples examined by us contained so much as a trace of suspended matter.

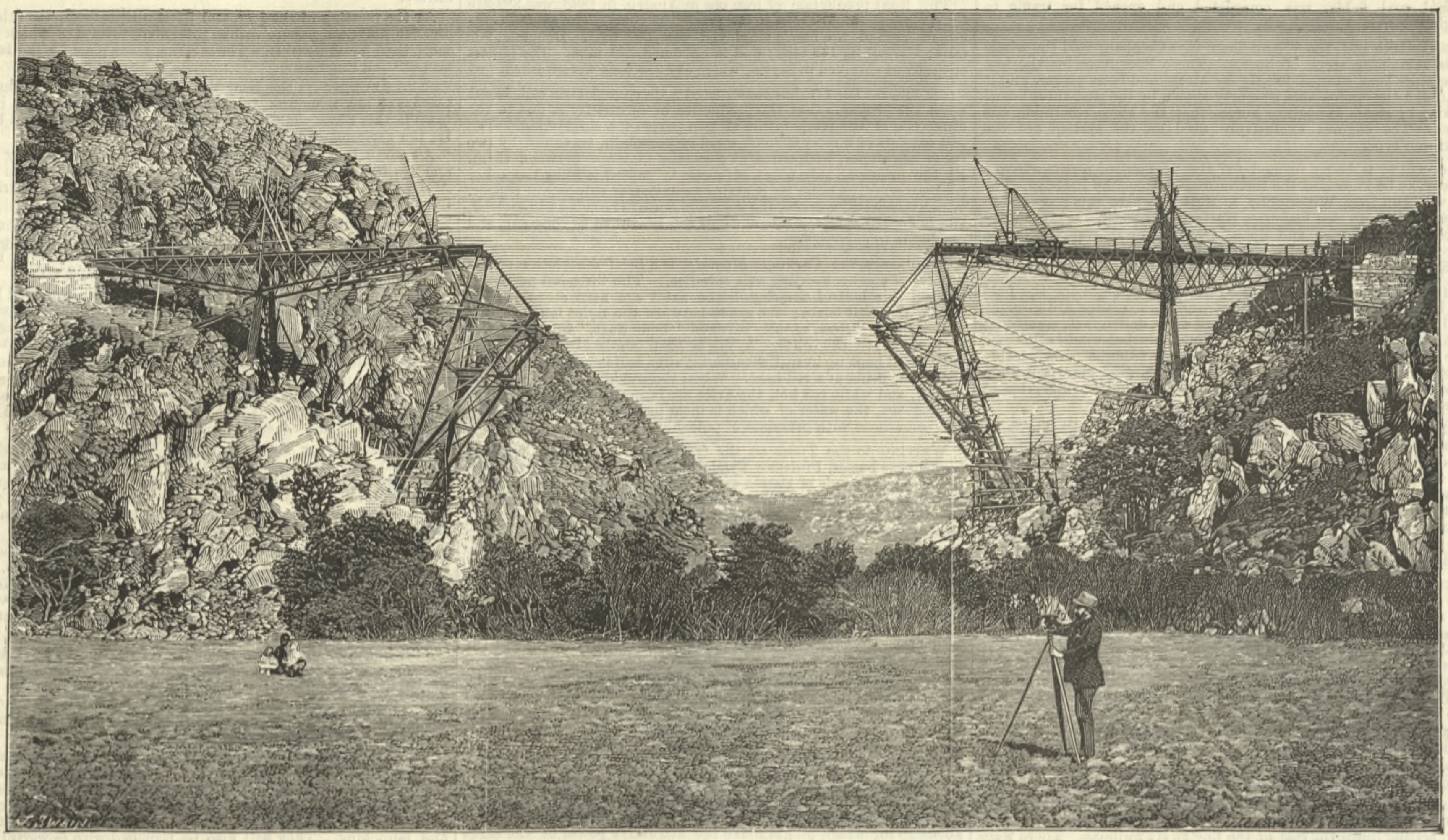
A NEW Telegraphic and Electrical School has recently been opened at the Lecture Hall, Royal Hill, Greenwich, by Messrs. A. P. Chattock and S. T. Dalton, for the purpose of affording instruction in electrical science and in telegraphy, both practical and theoretical. During the summer months the theoretical instruction will be confined to laboratory work, but early in October it is intended to supplement this by a series of lectures. In the classrooms there is a good collection of apparatus, including most kinds of telegraph instruments at present in use, and this will give a good opportunity for those wishing to prepare for the expected development of telegraphy when the new rates come into force.

A NEW pumping engine, of considerable power, built by Messrs. Hathorn, Davey, and Co., of Leeds, has been put down at the Moat Colliery, near Princes End, by the South Staffordshire Mines Drainage Commissioners. It will be publicly inaugurated on Saturday, when a luncheon will be given by the members of the Tipton District Committee. The boilers have been supplied by Messrs. Hawksley, Wild, and Co., of Sheffield. The engine is of the horizontal compound differential type. It has a 44in. high-pressure, and 76in. low-pressure cylinder, and a 10ft. stroke, with air pump and surface condenser. The pumps consist of two 19in. plungers, with 10ft. stroke, placed at a depth of 464ft. At each stroke of the plunger, 245 gallons of water are forced to the surface. The engine is capable of raising over two million gallons in twenty-four hours. An extensive system of levels is under completion, and when the levels are finished, it is expected that the one new engine will be pumping an area that has hitherto required the services of half-a-dozen steam pumps.

IN a letter on "River Conservancy," Mr. J. Bailey Denton says he does not believe that an observer of water economy exists who does not believe that the year 1885 will be signalised in the east and south of England by the lowering of the subterranean water supply and the reduction of the springs supporting our rivers, in which case the evils of pollution will be much aggravated. While the total amount of rainfall in 1884 was not more than two-thirds of the average annual fall of fifty years, the depth due to the winter months, from October to March inclusive, the period upon which the rivers depend for maintenance of flow, was, both in 1883-4 and 1884-5, considerably below the average fall of the period, while in 1884-5 the proportion of the rain evaporated was remarkably great. "The result of these coincidences manifested itself in a well of which he had had the depth of water taken weekly for twelve years by a declension of depth between the 1st of April, 1882, and the 1st of April, 1885, of 8ft. 10in. He felt that such a fact as this is worthy the attention of all who take an interest in the *régimes* of the rivers upon which we depend so much, for it shows how desirable it would be to replenish the natural reservoirs we possess in the water-bearing strata under our feet by sinking shafts or sumps into them from the surface of our valleys, so as to turn to useful account the flood and excess waters which are injurious to agriculture."

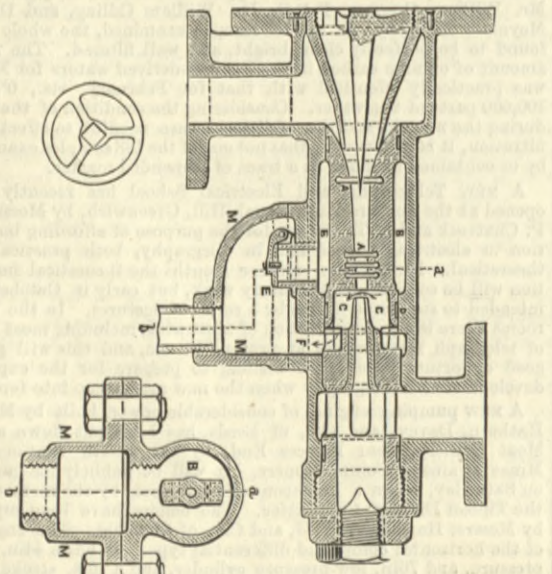
THE BLAAUW KRANTZ BRIDGE, CAPE COLONY.

MESSRS. HANDYSIDE AND CO., DERBY, CONSTRUCTORS.

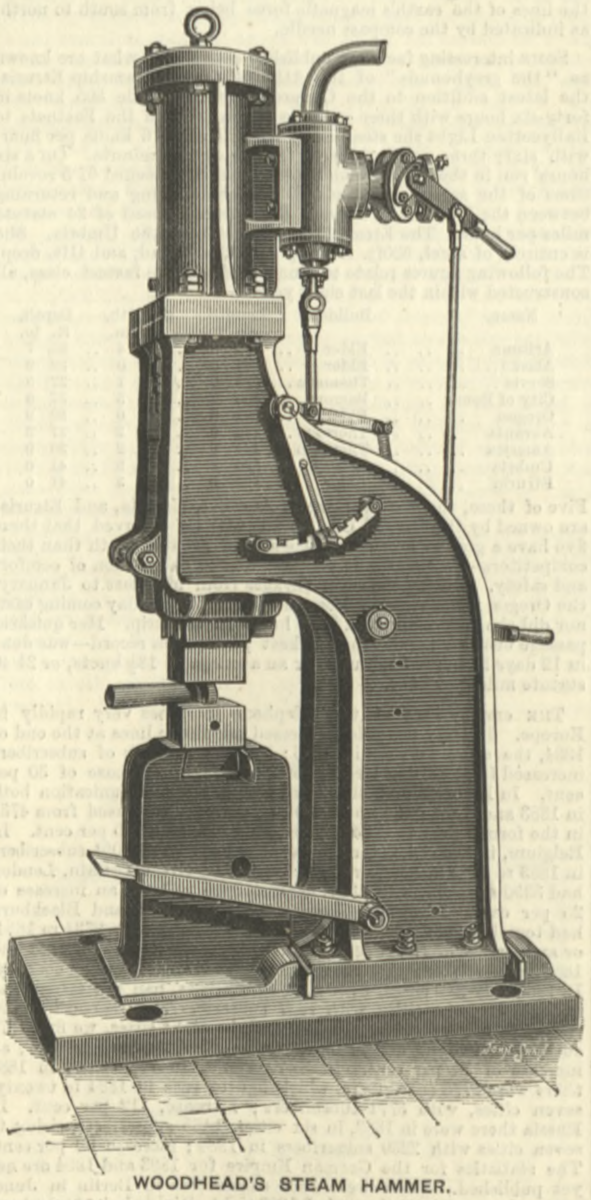


THE "IMPROVED" EXHAUST STEAM INJECTOR.

Messrs. Holden and Brooke, of Manchester, have introduced a further development of the comparatively recent type of exhaust steam injectors, the chief features of which are pretty clearly shown in the accompanying illustration. This they have termed their patent "improved"—rigid nozzle—exhaust steam injector, and the leading feature is that it dispenses with the flap or split nozzle of the ordinary exhaust injector, which is replaced by a small valve. The large surface—which of necessity must be accurately scraped up—of the split nozzle, with its hinge, is obviously an objection if the work can be done equally well with a much less surface, and this objection Messrs. Holden and Brooke have overcome in a very simple and at the same time very successful manner. In an exhaust injector of any kind it is essential for its efficient operation that the feed-water shall be able to get freely away until the jet can acquire a sufficient velocity to pass through the delivery or receiving



cone, and it is also necessary that when the injector is at work there shall be no access of air or vapour to the combining cone. These are points to which special attention has been paid in the improved injector of Messrs. Holden and Brooke. The combining nozzle is rigid and continuous, the water escaping by fixed gaps or openings, whilst the small surface of the valve presents the minimum risk of getting out of order. The construction of this injector, as shown in our illustration, may be described as follows:—A A are the gaps discharging into the chamber B, which chamber B is isolated from the vapour given off at the ordinary overflow C, by the packed bearing D, and from the outer air by the valve E. The action of the jet in the combining nozzle forms a powerful vacuum in the chamber B, and so holds the valve E firmly on its seat; at other times the valve E readily opens to allow the free escape of water, falling to its seat again by its own weight as soon as the flow of water ceases. The valve turns freely and independently of the arm which carries it, so that by removing the cap M it can be readily cleaned and reground on its seat. The cap M carries the overflow pipe as shown, and serves also for the ordinary overflow passing out at F. The arrangement of the slits, whereby the nozzle is kept continuous, is shown in the section *a b*. The large nut at the bottom serves for withdrawing the whole nozzle for examination, and also for regulating the water supply entering round the end of the steam nozzle. A number of these new injectors have now been at work for a sufficient length of time to afford an adequate test of their efficiency, which has been fully proved, and we have had an opportunity of inspecting several of them in operation—in one case working against 80 lb. boiler pressure. In their action they are perfectly automatic, and if the engine is stopped, as in the case of winding engines, they will re-start with the re-starting of the engines, and we have seen them start straight off without any loss of water whatever at the overflow. Messrs. Holden and Brooke have unquestionably introduced a very excellent and efficient exhaust



WOODHEAD'S STEAM HAMMER.

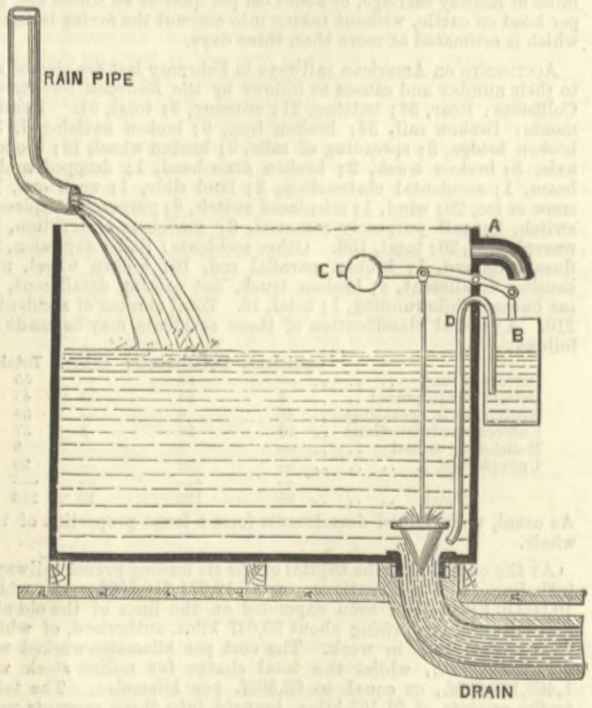
steam injector, and the fact that under conditions where other injectors had been found unworkable it has fulfilled efficiently all the conditions required, certainly gives it a claim to consideration.

WOODHEAD'S STEAM HAMMER.

The accompanying engraving illustrates a type of steam hammer made by Messrs. R. Woodhead, Steam Hammer Works, Whitehall-road, Leeds. This hammer is specially designed for studs, bolts, and other forgings made out of solid iron, and is suitable for ironmongers, machinists, and other special forgers. The special features are, that it is arranged for the smith either to work it by his foot, or it can be used as a hand motion hammer, or self-acting, with variable strokes, light or heavy blows, or with any number of dead stamps, as desired by the operator. It is self-contained, and requires very little extra foundation, thus is readily fixed, making it suitable for foreign markets, and has already been supplied to the West Indies, Australia, South Africa, and continental markets. It is a handy tool of simple construction.

FLUSH TANK.

The annexed sketch illustrates a novel automatic flushing apparatus. To whom to give credit for it we do not know, but the American *Sanitary Engineer* is of the opinion it was exhibited at the International Health Exhibition, and we will be glad to give the name of the inventor should we be informed of it. The diagram needs little explanations. Water enters through the rain pipe until it overflows through the pipe A into the bucket B. The weight of water in the bucket overcomes the weight of the lever and valve, opening the same and allowing



the discharge of water into the drain. The inductive action of the water as it passes the valve starts the small syphon D, which empties the bucket of weight, allowing the valve to close. Regulation is secured by the ball C on the balanced lever.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—George H. Weeks, chief engineer, to the Bacchante; Peter Eckford, chief engineer, to the Hercules; William Vincent, chief engineer, to the Euphrates; Robert Burridge, chief engineer, to the Tamar; Thomas Whebly, engineer, to the Penelope, additional; William Hines, engineer, to the Bacchante; John G. Jenkins and Frederick W. Austin, assistant engineers, to the Bacchante; George J. Fraser, chief engineer, to the Ruby; Alfred Rayner, engineer, to the Ruby; Isaac E. Hurst, engineer, to the Pembroke, additional; Edward G. Guyatt, assistant engineer, to the Ruby; and William C. Beal, chief engineer, to the Iron Duke.

THE BLAAUW KRANTZ BRIDGE, CAPE COLONY.

MESSRS. HANDYSIDE AND CO. DERBY, CONSTRUCTORS.

BRIDGE IN PROCESS OF ERECTION

THE BLAAUW KRANTZ BRIDGE IN CAPE COLONY.

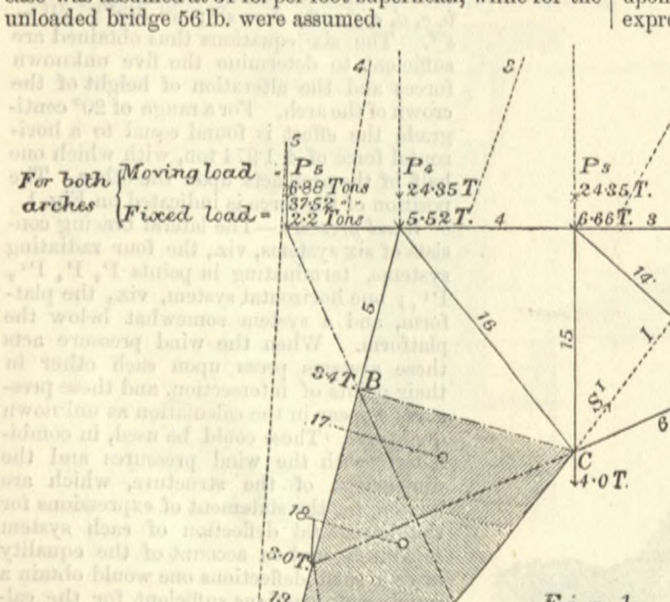
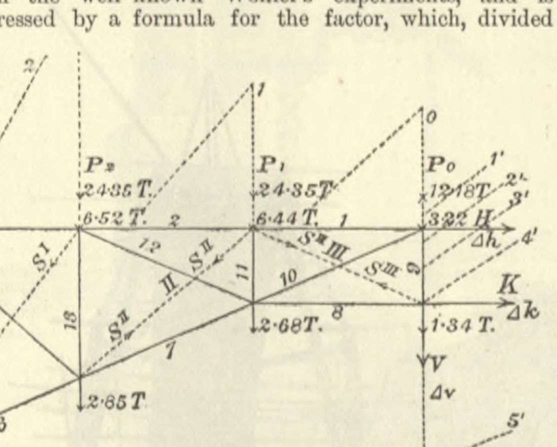
No. III.

Moving load.—The numerical values for the reactions of one half of the arch upon the other, and for the strains in the six supernumerary bars, were stated on page 202. By reference to Table I., the strains in the twenty-five bars or laminæ of the left half were then easily found by first adding the products of the values σ^{I}, σ^{II}, σ^{III}, σ^{H}, σ^{K}, σ^{V}, S^{P_0} into the values: s^{I}, s^{II}, s^{III}, H, K, V, P_0, out of Table III., together; then progressing to P_1, &c., in the same manner; and, further, to the loads on the other half of the arch, by putting in Table I. σ^{VI}, σ^{V}, σ^{IV}, for σ^{I}, σ^{II}, σ^{III}, and using the values for s^{VI}, s^{V}, s^{IV} out of Table III. In this way another table was constructed, which contains the strain or moment in each of the sixteen bars and nine laminæ from each of the eleven loads P=1. Then multiplying with such values in tons, as each P has in Fig. 1, and adding, on the one hand, the positive values, and on the other the negative values together, the maximum and minimum values for each bar for the moving load are finally arrived at. If it were desired to find the abutment reaction for any load P, it would only be necessary to construct the resultant of the corresponding forces H, K, and V in order to obtain the reaction upon the unloaded half, and the resultant of H, K, V, and P in order to obtain the reaction upon the loaded half. These reactions are indicated in Fig. 1 by dotted lines.

Fixed load.—The calculation of the strains from the fixed load which have to be added to the results, so far obtained, is much shorter, as the arch rested during the erection on three hinges, which were well oiled, and whose friction could therefore be disregarded. The three supernumerary diagonals of the left half have the same strains as those of the right half, and the calculation consequently presents only three unknown quantities instead of nine.

Temperature.—The effect of the change of temperature is calculated by putting in equations (1) to (12) $\Delta h = \Delta k$ equal to the positive or negative extension of an iron bar of the length of half the span, V = 0; a, b, c, d, e, f = 0; $s^{I} = s^{VI}$; $s^{II} = s^{V}$; $s^{III} = s^{IV}$. The six equations thus obtained are sufficient to determine the five unknown forces and the alteration of height of the crown of the arch. For a range of 20° centigrade the effect is found equal to a horizontal force of ± 1·974 ton, with which one half of the arch acts upon the other. The position of the force is indicated on Fig. 1.

Wind pressure.—The lateral bracing consists of six systems, viz., the four radiating systems, terminating in points P_2 P_4 P'_2 P'_4; one horizontal system, viz., the platform, and a system somewhat below the platform. When the wind pressure acts these systems press upon each other in their points of intersection, and these pressures appear in the calculation as unknown quantities. These could be used, in combination with the wind pressures and the dimensions of the structure, which are known, for the statement of expressions for the horizontal deflection of each system separately, and on account of the equality of two such deflections one would obtain a number of equations sufficient for the calculation of those pressures. It would be, however, almost impossible to make this calculation with an accuracy equal to that for the vertical loads on the arch, as in addition to the direct loads there also appear their turning moments. These act as loads upon the two arch systems, and thus have an influence upon the above-mentioned deflections. In the attempt to deal with the question from this point of view, the calculation assumed very soon unmanageable dimensions, and it was found necessary to imagine the six lateral systems as acting upon each other independently of the triangulated arches. In other words, looking upon the whole arch structure as a statically undetermined system in space, it has so large a number of supernumerary bars—*i.e.*, unknown quantities—that many of them must be altogether ignored before the calculation can be made. These complications are not peculiar to the structure here spoken of, but exist in most structures excepting straight girders. If the six systems act independently upon each other, as indicated above, the reactions in the points P_4 and P_2, and the two other intersections below these points, B and C, are found to be about + 206·6; +1126·6; − 623·0; +936·12 superficial feet of wind pressure surface on the assumption that a railway train covers the whole bridge uniformly. The wind pressure for this case was assumed at 31 lb. per foot superficial, while for the unloaded bridge 56 lb. were assumed.

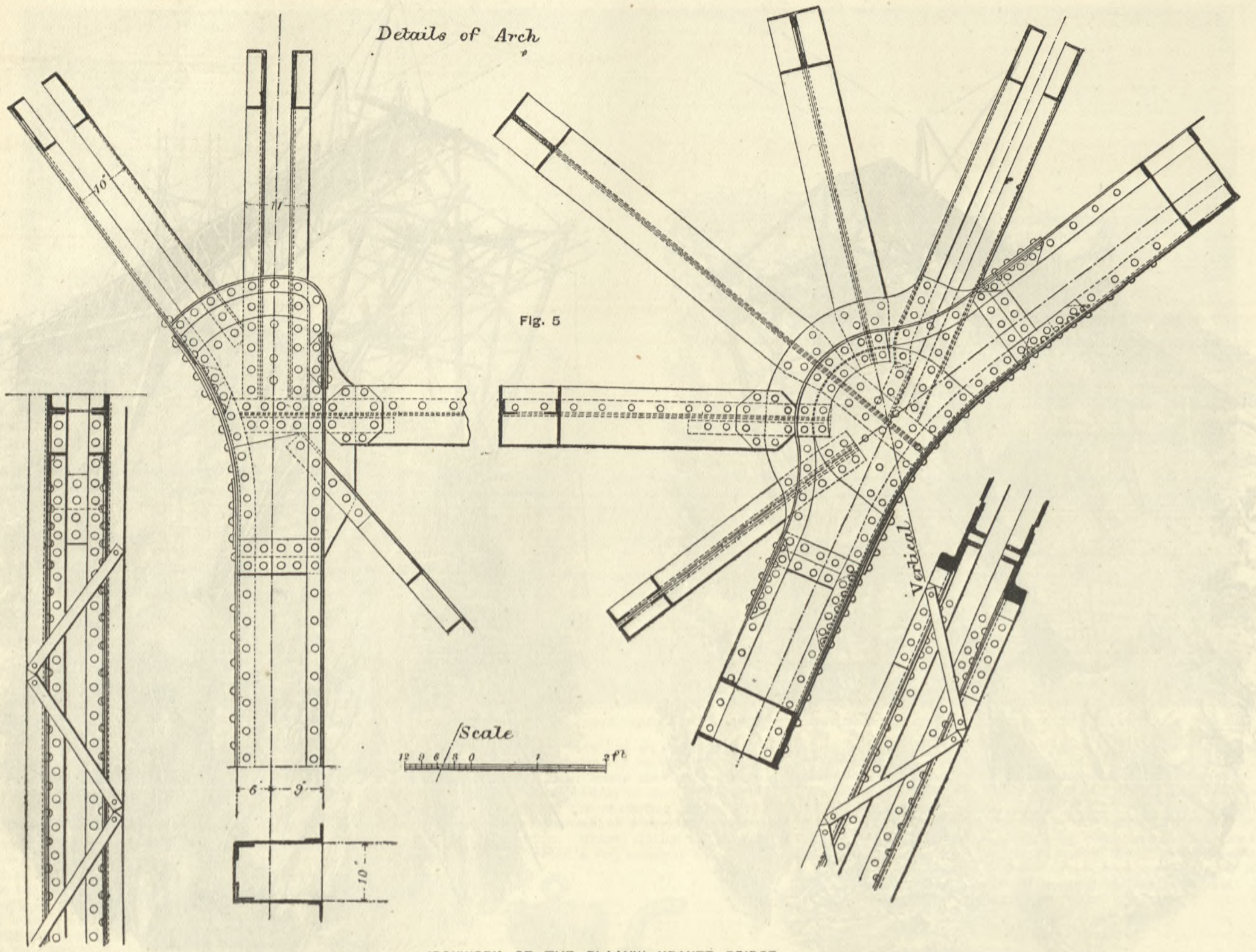



Calculation of strength.—Two principles of determining the sectional area of the various parts were here acted upon, viz., first, the rule of the Board of Trade in England, which sanctions a strain of 5 tons per square inch in every wrought iron part, not excluding, however, lesser strains; and secondly, the more modern principle which takes into account the change of intensity of the strains from the moving load. The latter principle—now more and more adopted in calculations of strength—is based upon the well-known Wöhler's experiments, and is expressed by a formula for the factor, which, divided into the maximum stress in a bar, gives its sectional area in inches. This formula, known as the Launhardt-Weyrauch formula, is as follows:—

$$\text{Factor} = a\left(b + c\,\frac{\text{minimum stress}}{\text{maximum stress}}\right) \text{ tons per sq. inch,}$$

where c may be taken between 0 and $\frac{1}{2}$, according to circumstances, viz., whether a structure is intended to resist a small number or an infinite number of changes of stress. In the present case, of a bridge upon which a very large traffic is not expected to be imposed within a considerable number of years, c was taken at $\frac{1}{4}$; a was taken at 4, so that the factor varies between 5 and 3 tons, being 5 tons for parts where the stress from fixed and moving loads together does not vary at all, 4 tons where it varies between 0 and the maximum, and 3 tons where the minimum and maximum stresses are equal but opposite. The sectional areas thus obtained were augmented by an amount due to the stresses from the change of temperature and the wind pressure, calculated by dividing by the factor 7·5. They were further increased, where necessary, so as to bring them within the rule of the Board of Trade. In many parts of the structure it would have been practically impossible, or at least, inconvenient, to adhere closely to the sectional areas thus calculated without using rolled bars of excessively thin metal. The consequence is that many parts are stronger than necessary, and the fact is worth mentioning, in so far as it indicates that the system of structure here adopted would have given still better results if the dimensions of the arch had been larger, or the load upon it heavier.

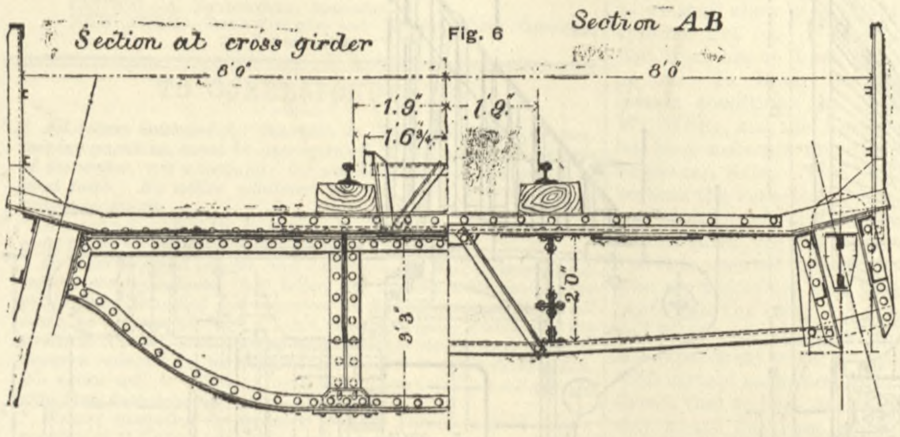
Details.—Some of the details of the arch are given in Figs. 2 to 7. One point may be mentioned with regard to them, viz., the way in which the intermediate bracing between the outer arches, especially the above-mentioned systems of wind bracing, are connected with them. In similar cases, where the two outer systems are inclined towards each other, the intermediate bracing has generally been placed in planes at right angles with the vertical plane, which contains the longitudinal axis of the bridge. If this plan had been adopted, all connections with the outer inclined systems would have contained irregular angles, which it would have been difficult to construct in the actual work. Instead of this, the intermediate bracing was placed in planes at right angles with the two outer systems. In this way the connections referred to become quite simple, and the difficulty is localised in the few connections which lie in the intersections of the planes, and, at the same time, in the vertical central plane. The opposite halves of the intermediate bracing thus meet in ridges, which give a somewhat peculiar appearance to the elevation of the structure, but this effect is almost lost in a perspective view. As the method of construction here spoken of has, perhaps, not been adopted before, it would be premature to recommend it for imitation; but at any rate it may be worth calling attention to it.

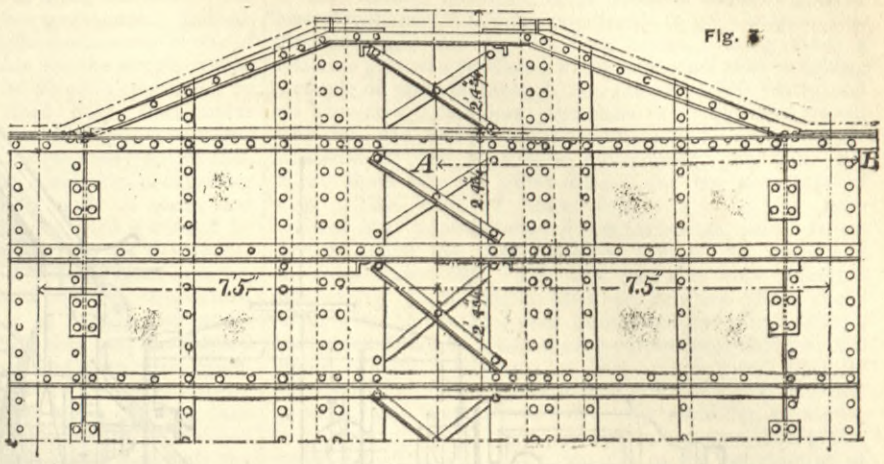


IRONWORK OF THE BLAAUW KRANTZ BRIDGE.

Erection.—It has been mentioned already that the continuous girders on each side of the arch were used as cranes for lifting the lower parts of the arch into position, and that after a connection was effected with the arch at the projecting end of each girder, the arch could be completed by building forward from each side towards the middle. Thus very little timber was used in the erection, except some poles, which were lashed to the ironwork of the panel just erected and which formed the beams of a stage for the erection of the next. It was originally intended to fix the lower part of the arch within convenient reach from the ground, with the bottom pivots in their right position, and then to tilt it up bodily, an operation which would not have required a greater lifting power than about 20 tons. The iron parts would in that case have been deposited on the slopes of the ravine. Eventually, however, the better plan of Messrs. Handyside and Co., and their resident engineer, Mr. H. Parker, was adopted, according to which the parts were deposited immediately in their final position from an overhead wire rope tramway stretched across the ravine. In conclusion of the description of the structure some of its characteristic features may now be enumerated, viz., (1) the combination of two continuous girders, with an arch resulting in great economy of metal and in the advantage of erecting without scaffolding; (2) the peculiar form of the arch, inasmuch as the platform of the bridge is treated as an indispensable member of its structural framework; (3) the introduction of three temporary pivots, in consequence of which the strains could be determined with accuracy; (4) the omission of cross-ties at the bases of the arch resulting in a lateral thrust upon the abutments as well as a longitudinal one; and (5) the connection of the

THE BLAAUW KRANTZ BRIDGE, CAPE COLONY.





lateral bracing with the two arch systems in planes at right angles with them. Some of these points are unusual in the practice of bridge-building, and the success of the structure depended upon the accurate calculation of the strains, which was an intricate one. In examining the design with a view to adopting it for the Grahamstown and Port Alfred Railway, the engineer of that railway, Mr. R. E. Cooper, had therefore to deal with an unusually difficult case, and to take upon himself the responsibility for the success of a work which might by some be called an experiment. Two series of trials were made with the bridge, viz., one in September, 1884, under Mr. Cooper's personal supervision, and the other in December last, according to his instructions. The first series of trials included one with two engines coupled together treated as stationary loads, one with a train of four engines and sixteen loaded wagons passing over the bridge with a speed of twenty miles an hour, and one with a train of four engines with a velocity of fifteen miles an hour, and the sudden application of the brakes in the centre of the bridge. The greatest deflection took place in the centre of the arch and amounted to ⅝in. Lateral vibrations were just noticeable, but too small to be measured. A permanent set did not take place. The second series of trials were made with three engines and tenders coupled together, and running over the bridge with velocities up to twenty-seven miles an hour. The greatest deflection in the centre was 0·72in., and so far as can be judged from the report there was no permanent set. The report of the second series does not mention any vibrations having occurred. In the course of these articles several authors have been referred to.

The following papers may, among others, be referred to for the theory of taking into consideration the extensions of the single members in the calculation of statically undetermined systems. The formula, as stated in No. II., will be found in Schäffer u. Sonne, Brückenbau, p. 495, see below:—

Maxwell.—"On the Calculation of the Equilibrium and Strength of Frames," *Philosophical Magazine*, 1864, xxvii., page 294.

G. F. Schulze.—"Theorie einer Bogenbrücke," *Zeitschr. d. Vereins deutscher Ingenieure*, 1865, p. 536.

Lamé.—"Leçons sur la théorie mathématique de l'élasticité des corps solides," 1866, p. 79.

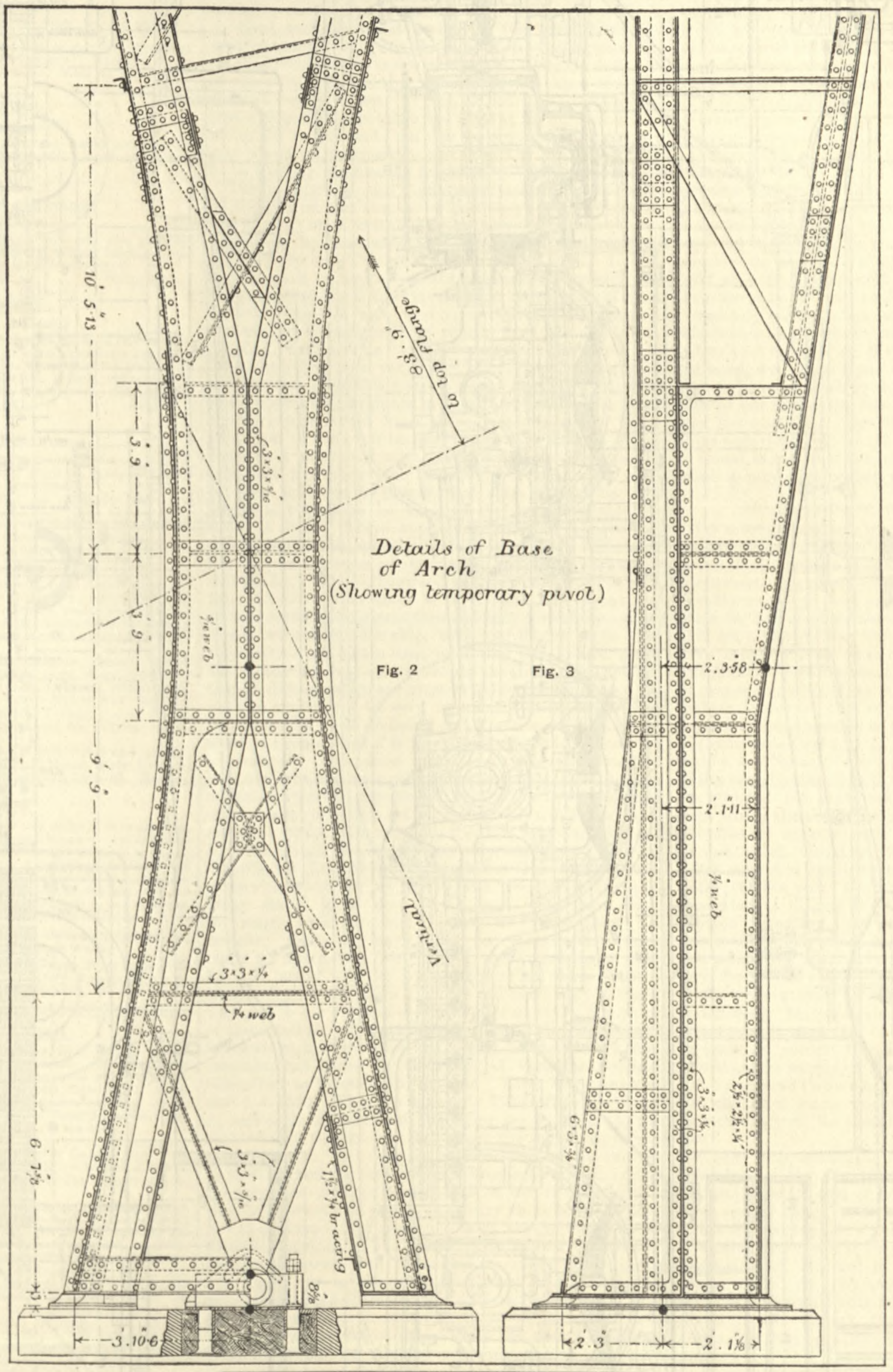
Mohr.—"Beitrag zur Theorie der Holz-und Eisenconstructionen." *Zeitschr. d. Arch. u. Ing. Vereins zu Hannover*, 1868, p. 19.

Mohr.—"Beitrag zur Theorie des Fachwerks," *Ibid.*, 1874, pp. 223, 509; 1875, p. 17; 1881, p. 243.

Schäffer u. Sonne.—"Der Brückenbau," *Handbuch der Ingenieurwissenschaften II.*, 1882.

Swain.—*The Journal of the Franklin Institute*, 1883, pp. 102, 194, 250.

"Stresses in Statically Undetermined Systems," *Engineering*, 1883, II., p. 509.



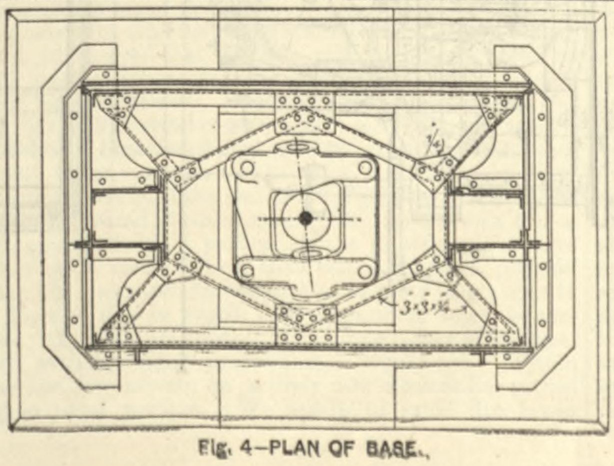
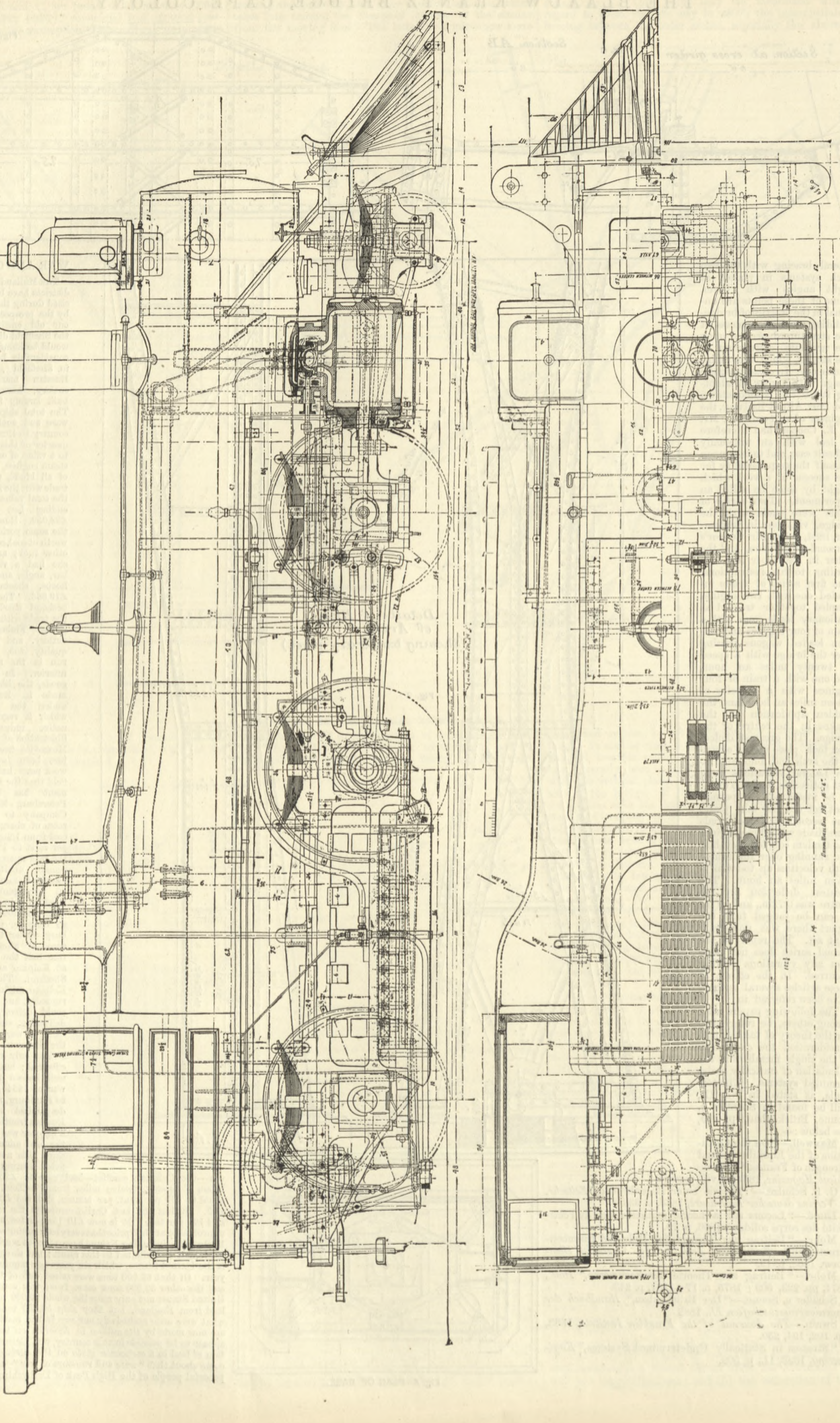


Fig. 4—PLAN OF BASE.

WAR AND COMMERCE.

THE Midland manufacturing districts have been much exercised during the last fortnight by the prospects of war with our old enemy, Russia. In the Sheffield district the effect would be immediately felt. A considerable business is done in Sheffield goods with the Russian market. Sheffield cutlery, however, does not bulk largely in the exports. The total shipments of hardware and cutlery from this country to Russia for the first quarter of this year amounted to a value of only £6807. For steam engines, and machinery of all kinds, there is a brisk trade with the Russian Empire, the total value for the quarter ending last March being £93,059. Russia also took in the same period over £33,000 worth of coal, coke, cinders, and other fuel; and in pig iron she had a value of £6215; bar, angle, and bolt, £2000; hoops, sheets, and plates, £19,863. These items comprehend nearly the whole of the trade with Russia in hard goods. Finland makes much cutlery, and of very good quality, too, which has the run in the markets at the interior. In fact, no foreign goods, the like of which are made in Russia, can live under the Russian tariff, which is regulated to foster native industry. Another illustration of this principle of Muscovite trading policy has just been furnished. This week news has reached Sheffield that the Russian Government has instructed the Petersburg-Moscow Railway Company to increase their rates of charges upon English coal from 1·2 copecks per poud per verst to 1·8 copecks, while the rate upon home coal is to remain unaltered. Messrs. Charles Cammell and Co. have an arrangement with the Russian Admiralty by which Wilson armour plates are made at Kolpino, near St. Petersburg, under the superintendence of Sheffield managers. One half the plates are made at Kolpino and one half at Sheffield. The production at Kolpino might go on uninterruptedly, but no English firm could deliver, or dream of delivering, such clear contraband of war. A blockade of the Russian ports would be serious only in so far as it was effectual; but it is perfectly well known that during the war of 1854 goods were sent to Hamburg, and from thence despatched by rail to the Russian frontier. At one time a big war was a great boon to the lead mines on the Derbyshire hills not far from Sheffield. During the last Russian war—the Crimean conflict—lead rose to £25 per ton. The Eyam Company, twelve miles from Sheffield, paid dividends equal to 400 per cent. per annum, and the £3 shares rose to £65. During the last Carlist campaign the value of lead was £24 10s. per ton. It is now £10 15s. per ton, and is so utterly unprofitable at that price that every lead mining company in North Derbyshire, including Eyam, have stopped working. Germany has largely contributed to this result; but the great competitor is the United States, which six years ago required 90,000 tons a year. Of that 60,000 tons were raised out of their own mines, and the other 30,000 tons came from this country. Now the United States not only raise the whole 90,000 tons and take no lead from England, but they ship 50,000 tons to Japan and what were once exclusively our own Indian markets. Cartridges are now made by the million in America on better terms than appear to be possible in this country, and Germany has a mountain of lead in a carbonate state on the surface. Thus does it come about that "wars and rumours of war" no longer stir the peaceful people of the High Peak of Derbyshire.



AMERICAN MOGUL ENGINE.

(For specification see page 306.)

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*** *We are compelled by pressure of other matter to hold over a number of "Letters to the Editor" this week.*

PERPLEXED.—*There is no way of cleaning the water save by passing it through a filter in which charcoal is used.*

A. C. W.—*We could not answer your question without further information. Do you want to be a mechanical or a civil engineer? What line do you wish to take in either branch of the profession? What fee are you prepared to pay?*

TAN-BURNING BOILERS.

(*To the Editor of The Engineer.*)

SIR,—We would feel obliged to any reader who would give us a few names of makers of tan-burning boilers. We require a boiler for burning wet tan, and with automatic feed. J. G. N.

Liverpool, April 15th.

VENTILATING RAILWAY CARRIAGES.

(*To the Editor of The Engineer.*)

SIR,—I shall be much obliged to any reader who will give me some information as to the best method of ventilating railway carriages; the exclusion of dust and the free admission of air to be combined.

Madras, March 10th. WHIRLWIND.

ACID PROOF CEMENT.

(*To the Editor of The Engineer.*)

SIR,—Allow me to ask through your valuable paper if any of your readers having experience with acids can give me a recipe for making a cement which will permanently make the joints of stone cisterns in which muriatic acid is kept, or tell me where I could obtain such a cement ready made, the price, and probable life thereof. The ordinary cements serve only, at most, for a few weeks. CEMENT.

April 13th.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, April 21st, at 8 p.m.: Ordinary meeting. Paper to be further discussed, "On Non-Tidal Rivers," by Mr. W. Shelford, M. Inst. C.E. Paper to be read, time permitting, "Mechanical Integrators," by Professor Hele Shaw, Assoc. M. Inst. C.E. Friday, April 24th, at 7 30 p.m.: Students' meeting. Paper to be read and discussed, "Heat Engines," by Mr. John M. Davies, Stud. Inst. C.E. Mr. John Imray, M.A., M. Inst. C.E., in the chair.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, April 23rd, at 8 p.m.: Discussion on Professor Oliver Lodge's paper "On the Seat of Electro-motive Force in a Voltaic Cell." "Electrical Definitions, Nomenclature, and Notation," by Mr. Andrew Jamieson, F.R.S.E., Member.

SOCIETY OF ARTS.—Monday, April 20th, at 8 p.m.: Cantor Lectures. "Photography and the Spectroscope," by Captain W. de W. Abney, R.E., F.R.S. Lecture I.—The prismatic spectrum and the influence of the material on the spectrum—dispersion and resolving power—uses of the slit and collimator—the spectroscopic camera—application of photography for investigating the spectrum, and of the spectrum for investigating photography. Wednesday, April 22nd, at 8 p.m.: Eighteenth ordinary meeting. "Technical Education with Reference to the Apprenticeship System," by Mr. Henry Cunynghame. Sir Bernhard Samuelson, Bart., M.P., F.R.S., will preside. Thursday, April 23rd, at 8 p.m.: Applied Chemistry and Physics Section. "The Chemistry of Ensilage," by Mr. Frederick J. Lloydd. Lord Thurlow will preside.

THE PARKES MUSEUM OF HYGIENE.—Thursday, April 23rd, at 8 p.m.: Address by Sir Spencer Wells, Bart., F.R.C.S., "On Cremation."

THE ENGINEER.

APRIL 17, 1885.

OUR NEW SHIPS.

A KEEN discussion has been going on for some time concerning the merits and demerits of certain British men-of-war known as the "Admiral class," because they have been named after celebrated English admirals, such as Collingwood and Benbow. The arguments advanced by each party are so strong that they are apparently unanswerable, and whether we read the statements of Sir E. J. Reed against them, or of Mr. W. H. White for them, the result is the same—conviction for the time being that the contentions last heard, whether they be those of Sir E. J. Reed or of Mr. White, must be right. But we think that the subject admits of being discussed quite apart from the arguments of either gentleman. Indeed, as we shall show presently, the whole controversy is one of opinion, not one of fact; and this for the simple reason that there are no facts obtained by direct experiment to go on. In brief, Sir E. J. Reed holds that under certain conditions the Admiral class of ships must upset; Mr. White, and the Admiralty party generally, admit this, but they maintain that the requisite conditions of capsizing never can exist. This is the point really at issue, and because the experiment has never been tried it cannot be settled definitely one way or the other. To put the matter in a nutshell, the Collingwood has a narrow belt of armour, and it is asserted by Sir E. J. Reed and his supporters, who are numerous, that this belt is so narrow and inadequate that the bows and stern of the ship may be riddled and filled with water, in which case the ship must upset. An experiment was tried some time since by the Admiralty with certain scale models in a tank of water. It was then shown that so long as the water was smooth the riddled ship would float, but when its surface was agitated, the model turned turtle and went to the bottom. Now Sir E. J. Reed maintains that owing to the great power of modern quick-firing guns, the ends of the Collingwood can be effectively riddled and water-logged; while the designers of the ship maintain that nothing of the kind can take place in a naval action. It has, of course, been suggested that a ship should be taken and fired at for an hour or two to try the experiment; but this is obviously too costly a way of settling the question, and it will be left, we suppose, to be tried by our Russian friends.

The designers of the Collingwood stake the existence of the ship on the chance—which they call, and doubtless regard as, a certainty—that she cannot be water-logged in the time which an enemy could find available for the purpose. This we need not discuss at all. In fact, to discuss it is useless—or at least, such a discussion can only possess value as the expression of the opinions of more or less competent men who have no practical experience concerning the matters about which they talk and write. Sir E. J. Reed says he "knows" that the Collingwood can be water-logged in a very short time; but the impartial outsider sees that this simply means that he "believes." If he were giving evidence in a court of law on the point, that evidence would have value, not because it was a statement of fact, but because it was a declaration of his faith by a competent naval architect. We prefer, as we have said, to consider the controversy from another point of view, and ask, Is it well that ships should be built which may perhaps be sunk in the way indicated by Sir E. J. Reed? There appears to be at first sight but one answer to this, namely, that it is not well. We have here beyond question an experiment, and that a very costly experiment. The Collingwood is a ship of 9150 tons, with 18in. armour—what there is of it—and will mount four 43-ton breech-loading guns, tremendously powerful weapons. The Howe is a 9600-ton ship, with four 63-ton guns. The Benbow is a 10,000-ton ship, mounting two 110-ton guns. The Anson is a very similar ship to the Howe. It is obvious that if all these ships are constructed in the same way, we have an experiment of very imposing dimensions indeed on our hands. But confining our attention to the Collingwood, we repeat that if it was possible to avoid making her experimental in the sense we have indicated, it seems that it would have been wise policy to have done so. Two general statements may be reproduced here. The first is that the displacement of a ship is the capital with which the naval architect works. The second is that it is, above and beyond all other things, necessary that a ship shall float. Now, as regards the first, the naval architect has to deal with certain claimants for his capital, and the claims admit of being stated in a very simple way. We have, first, so many tons for hull; next, so many tons for armour; then, so many tons for guns and stores; next, so many tons for boilers and machinery; and lastly so many tons for coals. Let us call these: hull a, armour b, guns and stores c, boilers and machinery d, coal e. Then $a + b + c + d$ and $e = 10{,}000$, let us say. Every one of these factors is variable, and they all depend on and influence each other. We make any of them we please constant, but if we do, the range of variation becomes intensified, so to speak, for the rest. Thus, let us suppose that $b = 2500$. Then we have only 7500 left for $a\ c\ d$ and e; and it is evident that the more we augment b, the narrower are the limits within which the remaining letters can be altered. Let us again suppose that $a\ b\ c\ d$ amount to 9500. Then we have only 500 tons left for coal, and if the ship is of great power—that is to say, if d is large—then 500 tons of coal would go a very short way. Again, it will be found that certain letters always augment or diminish together. Thus, if b increases, a must increase too, because a strong hull is needed to carry heavy guns. The great art of the naval architect is displayed in dividing his capital among the different creditors so that the most satisfactory result will on the whole be obtained. The designers of the Admiral class say that by keeping down the extent of ship covered with armour, they have been able to make that armour more efficient; and they say, secondly, that they have also secured the most important advantage—that the ship will be able to steam at 16½ knots, which is a higher velocity than any armour-clad ship has yet attained. Now, the general answer to all this is, that with a capital of 9600 tons or so, 2500 tons of armour could have been distributed to better advantage than it has been—better, at least, in the sense that the ship could certainly float until the end of an engagement. Thus, for instance, instead of concentrating 18in. armour on a species of central citadel, a portion of the armour might have been made much thinner than 18in.—not more, perhaps, than 4in.—and used for the purpose of protecting her ends.

Here it may be urged that 4in. armour would be useless. On this point there is fortunately plenty of information available which shows that it would not. Within the last few months an entirely new element has turned up in naval warfare. We allude to rapid fire heavy guns. A little reflection will show that although it may not be possible to apply to the fullest extent the principle of the Gatling, Hochkiss, or Nordenfelt machine guns to heavy ordnance, it is quite practicable to go a step in this direction, and the step has been taken. Long since a machine gun was produced which sent steel shot weighing a couple of pounds through 3in. plates at 200 yards, and we have now 6-pounders; and there is no apparent reason why we may not get on to 40-pounders. It is in the existence of the 6-pounder quick-firing gun that Sir E. J. Reed sees the great danger for the new type of ship. The ends of these vessels are to be subdivided into a multitude of compartments, and various devices, such as cork packing, are to be employed to keep water out. All this may be very effectual against big guns, which, after all, can not plant shells enough in the unarmed ends to do much harm in a hurry; but quick-firing or heavy machine-guns have changed the whole of the conditions, as they could plant literally hundreds of shells in the bows and stern of a ship in a few minutes, and blow them, practically speaking, to atoms. It is against this danger that the 4in. or even 3in. plates would act effectually. Mr. Samuda, at the last meeting of the Institution of Naval Architects, called attention to the truth, too often forgotten, that no shell, as a shell, has ever yet been fired through an armour-plate; and this is a very important fact—so important that it modifies in the most material way every argument concerning armour-plates. It is so important that some persons hold that even the Warrior would be by no means so useless a vessel as she is commonly supposed to be. We certainly do not go so far as to argue for a moment that we use armour thicker than it ought to be on line-of-battle ships; but the fact still remains that even a thin plate will cause the explosion of a charged shell outside instead of inside the ship; and it must be remembered that in experiments such as those reported from time to time in our columns, charges of powder are not put in the projectiles, which are either solid shot or loaded with sand up to the full weight. Armour-plate of very moderate thickness would suffice to completely baffle the operations of any heavy machine-gun which it is likely will be produced for years to come.

Our own opinion on the whole subject will be readily gathered, we think, from what we have written. It is, that to leave so much to chance as is left to chance in the case of our new ships, has been unwise. The experiment was, however, to a large extent justifiable at the time the ships were designed; but it is in no sense or way justifiable to repeat it now that the heavy machine-gun element promises to play so important a part in naval warfare.

THE POSITION OF COLONIAL COAL STORES.

ON several occasions, when discussing in these columns the important question of colonial defence, we have referred to one branch of that subject which is of the most paramount importance—viz., the security which is needed that the stocks of coal accumulated at the various coaling ports in our colonies should not be liable to destruction. It is not necessary that we should recapitulate all that we have before written as to the several aspects under which this question presents itself, but there is one special point in connection with it to which we called attention in our earliest leader on this subject, our remarks as to which appear to have aroused apprehensions in one of our leading colonies—Ceylon. In a recent issue by our contemporary, the *Ceylon Observer*, its editor directed the attention of the island authorities to the insecure positions in which are situated the sheds wherein the large stocks of coal from which the numerous steamers calling at the port of Colombo are supplied, and acknowledged that position to be one which would invite attack in case of hostilities. After reference made to the fact that attention had been called to this point by ourselves, the journal in question proceeded to discuss the several dangers to which that exposed situation renders Colombo liable. We are informed that the sheds line the quays of the harbour, and that these are absolutely without the slightest covering save their tiled roofs. It was ably argued by the writer of the article that, in the event of warfare, it would undoubtedly be contended that coals constitute in the present day a munition of war; nor could any endeavour be made to contest this assumption. We may observe here that the supply of coal is forbidden by international law by neutral Powers to the war vessels of belligerents; and that fact alone would justify the acceptance by our contemporary of the postulate that coal is a "munition of war."

Under such conditions what would be the position of Colombo, as also of other ports where similar disabilities may exist, in case of hostile attack by sea? The aim of an enemy being, as far as possible, to cripple the movements of an antagonistic fleet, naturally the first endeavour of a commander would be most effectually to do so by the destruction of the coal by which alone such movements can be carried on. By another provision of international law it is understood that defenceless situations and private property are exempt from bombardment unless—and herein lies the gravity of the situation—these are so situated that they hamper attack upon fortified positions or magazines containing munitions of war. There is nothing, therefore, in the law we have referred to to prevent a hostile vessel from firing shell in the endeavour to ignite and thus destroy the coal; and, as in the case of Colombo—as also, we believe, at many other ports—the coal-sheds are just to the rear of the lines of merchant shipping, while the Government buildings, merchant offices, and numerous other private structures are again just to the rear of the coal-sheds, it is evident that any fire directed on the latter must infallibly seriously injure the shipping and buildings which are directly in its line. Hence the exemption which under the rules of civilised warfare might well be claimed for property of this class would be annulled, and most disastrous loss might result.

It may be argued that such loss is to be apprehended under almost any condition of hostile attack, but very little consideration—the circumstances under which warfare is waged in the present being exceptional—will prove such an argument to be fallacious. Let us suppose an armoured cruiser of great power and speed approaching Colombo with the object of destroying the coal. At a distance of 3000 yards her aim would be sufficiently accurate, and the chances of her armour being penetrated at such range not very great. She would therefore, we apprehend, have no difficulty in lodging shells charged with petroleum or some other even more combustible material among the sheds, and it would be a miracle hardly to be anticipated if some of those shells missed igniting the shipping or private buildings referred to. We were very much surprised to find a correspondent of the *Ceylon Observer*, when writing with reference to the editorial, contending that the danger pointed out did not exist; that, indeed, it would be extremely difficult to fire the coal "in a tropical climate." We should have thought the dry and dusty condition of the coal due to the heat of a burning sun would, on the contrary, render it more than customarily liable to ignition; and we fancy that there are few, if any, who would differ from us in such a view. We cannot resist the belief that such an argument can only have been advanced by someone whose interests would in some way or other be affected by the removal of the coal stores to a place of security, or at all events to some position less certain to involve, in the case of attack being directed against them, the danger to private property and shipping we have indicated. That such interests exist, which may be antagonistic to any proposed change of site, does not admit of reasonable doubt; but we should think that it would be a small cost to pay for proper security for the Government to compensate such interests. At all events, we may feel assured that they will not be allowed to stand in the way of the fullest action being taken should the conclusions at which we have arrived have weight with those to whom the details of colonial defence may be entrusted.

As this journal was, as we believe, the earliest in the discussion of this important matter, we may fitly claim to call the very serious attention of the authorities to this particular phase of it when the plans upon which ports and harbours circumstanced as is Colombo with regard to its coal stores are to be defended, have to be decided upon. It is one which we feel must most materially affect the arrangement and disposition of forts or batteries to be erected. When the particular danger about which we have written is absent, or may be readily averted, our military engineers will have their work much simplified; but if provisions for resisting attack upon vulnerable points, or to repel attempts at landing, has to be added the covering of an extended line of coal sheds on quays crowded by shipping, these difficulties will be enormously increased. Now, as our contemporary already quoted has pointed out, much foreshore at Colombo is being reclaimed by means of material already dredged and still yet to be dredged in the newly made harbour, and as fast as this work of reclamation is going on is the land recovered being utilised for coal storage. Surely such land can be put to some better use than in multiplying the disabilities we have named as already existing; and we concur most fully with the *Ceylon Observer* in its view that it is at the time such works are in progress that the question raised may with the greatest propriety engage the attention of the authorities. To these, of course, must be left the decision as to how the existing situation may best be ameliorated or the danger entirely overcome; but the article which has called from us these remarks suggests that as all coal supplied to shipping in the Colombo Harbour has to be boated, it would entail but very slight extra expense on such an operation if the boats had to be filled somewhat inland, whence communication with the harbour could easily be established by canal, and whereat the coal sheds could be located behind earthen ramparts. As we have said, such matters must be left to local authorities. It is not to Colombo alone that our remarks are intended to apply, for we believe the question to be one of very extended range, as also of the highest importance as affecting the whole design upon which the large—though relatively, as compared with the interests involved, trifling—expenditure is to be incurred for the defence of our colonies. We trust that we shall receive assurance, when the details of the defence of each colony have been decided upon, that this vital element of danger has been fully guarded against.

STANDARDS OF LIGHT.

A report possessing considerable interest, both from a scientific and a practical point of view, has just been presented to the Special Purposes Committee of the Metropolitan Board by Mr. W. J. Dibdin, the Board's chemist, the subject treated upon being the "Standards of Light." The Committee have laid the report before the Board, and the latter has it now under consideration, the question to be decided being whether or not the inquiry shall be carried further. According to his original instructions, dating from last July, Mr. Dibdin was to report "exhaustively" upon the standards of light, and in response to this requirement he has carried out a long series of experiments. The time at the disposal of Mr. Dibdin has necessarily been limited, owing to numerous other duties connected with his post, not the least being the initiation and management of the operations connected with sewage treatment at the main drainage outfalls. Nevertheless the report contains a vast amount of information, and shows that the inquiry has been sedulously and carefully pursued. As the matter now stands the report presents somewhat of a preliminary character, and it is obvious that while much has been gained, there is need to pursue the investigation beyond the point it has reached, so as to arrive at a perfect conclusion. The settlement of a proper standard of light is a matter of real moment, partly for the reason that it enters into the arena of legislation, and governs the infliction of pecuniary penalties. By the Gas Acts, the candle is recognised as the measure of light—a method which dates back to 1760, and therefore commencing at a period when gas companies were unknown. A candle may be of wax, tallow, paraffin, stearine, or sperm ; but the Metropolis Gas Act of 1860 prescribes "sperm candles of six to the pound, each burning 120 grains per hour." Candles have long been subject to criticism as unsatisfactory standards of light, and various substitutes have been proposed. Mr. Dibdin mentions numerous contrivances which have been brought forward at different times for this purpose. The incandescent platinum unit has been advocated in France as possessing decided advantages; but Mr. Dibdin is by no means assured of its excellence. The standards which he has deemed worthy of his immediate attention are the French "Carcel" colza oil lamp, equal to about 9½ candles; Keates' sperm oil lamp of 16 candles; Harcourt's pentane or air-gas flame, equal to 1 candle; Methven's screened Argand flame of 2 candles; and Sugg's test of 10 candles. The legalised English test consists of two sperm candles, such as we have already mentioned; and probably the higher the lighting power of the standard the less will the observer be troubled with the introduction of error. But the standard cannot be very high in power without practical inconvenience; and we may presume that the Keates lamp presents as powerful a photometric standard as can well be tolerated, at least so far as the gas supply is concerned.

At the Congress on this subject held in Paris in 1881, the Carcel lamp was recommended, the fused platinum and silver standards of MM. Violle and Cornu being rejected on account of the difficulty attending their application, and the colour of the light emitted by them. In the same year a committee appointed by the Board of Trade to inquire into the merit of certain standards of light, reported that sperm candles were untrustworthy; that Mr. Keates' lamp fell short of the requirements of a standard of light; that Mr. Methven's standard was not to be relied upon in all cases, although extremely useful under some conditions; and finally, that compared with the sperm candle, Mr. Harcourt's air-gas flame was exact and trustworthy as a standard of light. It would seem that the Keates lamp was not treated in accordance with the conditions laid down by its inventor. He required that it should only be used when the light afforded by it ranged between 16 and 17 candles. The Committee made but few tests with this lamp, and in no instance did they keep within the limits assigned for its use. Mr. Keates combated the conclusions of the Committee, and so in his own case did Mr. Methven. The Council of the Gas Institute were also greatly dissatisfied with the results arrived at by the Board of Trade Committee, and took the matter up themselves, appointing a Committee of their own, who engaged the services of Messrs. Heisch and Hartley to conduct an elaborate series of experiments. The result, as Mr. Dibdin says, was that these gentlemen "reversed the verdict of the Board of Trade Committee." They claimed better qualities for the Methven screen than had been allowed by the previous tribunal, and gave that standard the preference. Concerning the present legal standard, they declared themselves convinced that sperm candles generally had grown brighter than of yore, developing more light per grain than was the case some years ago. This startling conclusion, capable of being turned to account by the gas companies, is traversed by Mr. Dibdin, who gives results showing candles to be occasionally so erratic that he considers Messrs. Heisch and Hartley might with equal reason have found that the regulation sperm candle had decreased in luminosity rather than increased. The condemnation of candles seems to be general, and nothing can be more conclusive on this point than the experiments conducted by Mr. Dibdin. Thus, on one day the average of tests with candles made by firm A showed the illuminating power of a gas flame to be equal to 15·76 candles, while candles manufactured by firm B gave a value of 14·94 candles—a difference of 0·82 candles. On the second day the divergence became still greater, candles A giving a value of 14·81 candles to a constant gas flame, while candles B gave a value of only 12·86, or two candles less. These results are said to have been so often confirmed as to be placed beyond dispute. On another occasion tests were made solely with the candles of one maker and from one packet The greatest difference obtained in the average of three tests, each consisting of three complete observations, was 1·3 candles, while the greatest difference between any two single observations was 2·0 candles. On a subsequent day the greatest difference in the average of three tests made as before was only 0·31 candle, and the greatest difference between any two single observations was 1·33 candles. After making all due allowance for disturbing causes, Mr. Dibdin recommends with regard to candles that "as speedily as possible they should be rejected as the standard of light." The public have the more reason to desire a change, seeing that Mr. Dibdin states, concerning the alleged increasing brightness of sperm candles, that the tendency is the other way, thus enhancing the apparent value of the gas. A very unsatisfactory state of things is thus shown to exist. The question of half a candle may determine whether or not a gas company shall be fined, as in a case in which the Commercial Company lately came under the lash of the law. On the other hand, the consumer may be the sufferer—and this appears to be the greater risk—by being supplied with gas considerably deficient in lighting power, which is, nevertheless, officially reported as complying with the Act of Parliament. It is a curious fact that the tests made with the portable photometer recently devised by Mr. Dibdin give tolerably uniform results, although the candles used in this apparatus enjoy no special protection, being merely shielded from decided draughts. Screens, boxes, and other devices intended to enhance the regular burning of the candles appear to have a somewhat contrary effect. Passing from a consideration of the sperm candle to the standard offered by the Carcel lamp, Mr. Dibdin gives results showing that this lamp is by no means so steady in working as the lamp devised by Mr. Keates. He determines the mean value of the Carcel lamp to be 9·41 standard candles, a close approximation to the value recorded in 1870 by Mr. Sugg, who made it 9·6 candles. The late Mr. Keates objected to the use of colza oil, declaring that "a worse or more uncertain material" could not have been proposed for burning as a standard of light. The high reputation of Mr. Keates as an authority on the subject of oils entitles his opinion to great respect. Sperm oil had his preference, as a natural production, merely filtered to separate it from the solid spermaceti, and never undergoing any chemical treatment, its constitution, therefore, being altered in no wise artificially. Hence sperm oil is used in the Keates lamp, in addition to which there is careful provision for an even and well-regulated supply of air to the flame, in which respect it stands superior to the Carcel. As already stated, the illuminating power of the Keates lamp is 16 candles. Mr. Dibdin subjected the Keates lamp to a long series of tests, designed to try its qualities in every particular. The ordeal was a rigorous one, and certainly appears to establish the character of the lamp as affording a remarkable uniformity of results. In testing Mr. Vernon Harcourt's pentane or air-gas standard, Mr. Dibdin differs from Messrs. Heisch and Hartley as to the want of steadiness which they alleged to be apparent in the flame. His own conclusion is that the results which seemed to show a defect of this kind would not occur in practice. On other points also Mr. Dibdin defends the Harcourt standard, although he gives reasons for preferring the Keates lamp, partly because it admits of observations being made under circumstances which would be prohibitory to the pentane, the Methven screen, or the 10-candle test. To some extent this conclusion is affected by the fact that Mr. Harcourt has lately devised a lamp for overcoming the objection to the pentane standard that it is not portable, and that it involves expensive apparatus. This lamp was received by Mr. Dibdin so recently that he has not been able to submit it to such a thorough examination as he feels desirable. The investigation which it has undergone at his hands makes it appear that the lamp requires some improvement, and of this it may prove to be capable.

Into the details of the experiments connected with the Methven screen and Mr. Sugg's 10-candle test we cannot at present enter. Each of these standards is shown to possess certain merits. Taking a general survey of the subject, Mr. Dibdin arrives at the conclusion that whether we adopt the Harcourt, the Methven, the Keates, or the Sugg standard, we get something that is either better than the sperm candle, or can at least be made so. On the whole, Mr. Dibdin inclines to the Keates lamp. Yet he is content to say that which of the four standards should be finally adopted is, in his opinion, of little moment. But he recommends that before any one of these proposed substitutes for candles be adopted as the standard of light, a systematic series of tests should be made on a three or four-way photometer; that is to say, three or four photometer bars should be arranged radially, so that one central light should be simultaneously tested by the competing standards, one at the outer end of each bar. Mr. Dibdin regrets that the space and apparatus at his disposal have hitherto precluded the adoption of this desirable arrangement. He has done the best that he could in the absence of such provision, and has used his resources to good purpose. It is evident that Mr. Dibdin has now gone far enough to upset the existing standard, and requires to go somewhat further in order to show finally what is to be done by way of remedy. He has proved himself to be a most able investigator into this important department of practical science, and we trust he will complete the inquiry in which he has already demonstrated such important conclusions. A few evenings ago, Mr. Dibdin brought this subject before the notice of the Society of Chemical Industry, when a discussion took place, in which Mr. Harcourt, Mr. Hartley, Mr. Methven, and others took part. The various methods of measuring light, more especially dwelt upon in Mr. Dibdin's report, were exhibited on the occasion, and Mr. Harcourt himself acknowledged the steadiness and excellence of the Keates standard. Concerning the pentane standard devised by Mr. Harcourt, there can be no doubt that it is eminently scientific, and has some very distinct points of merit. There is no wick, and the flame is wholly uncovered, besides which the proper intensity of the light can always be obtained with exactitude. For the present the choice seems to lie between the Keates and the Harcourt standard, though it is possible that further investigation may somewhat alter the aspect of the case.

THE AMALGAMATED SOCIETY OF ENGINEERS.

In the thirty-fourth annual report issued this week to the members, Mr. John Burnett, the general secretary of the Amalgamated Society of Engineers, states that for the general industries of Great Britain 1884 had not been a good year; but it was quite evident that the depression which had affected their own trade so grievously had not been the result of foreign competition or a lessening of demand from abroad for the articles which they produced. Want of employment for their members had been a characteristic of the year, and in their monthly returns of out-of-work members, which from 1893 in January had increased to 4090 in December, a retrogression from moderate to very bad trade was clearly shown. As the reason for this was not to be found in the foreign trade returns they must look elsewhere, and it was largely attributable to the collapse in the shipbuilding trade, which at a moderate computation had made a difference to the labour market of 7½ millions of money. With regard to the position of the Society, they had at the close of 1883 424 branches; since then they had opened new ones in Cheltenham, Glasgow South, Long Eaton (Derbyshire), Brisbane (Queensland), Winnipeg (Canada), and South Brooklyn, U.S., making a present total of 430 branches, which were distributed as follows:—England, 307; Scotland, 42; Ireland, 14; Australia, 10; New Zealand, 3; Queensland, 2; Canada, 7; Malta, 1; Bombay, 1; United States, 42; and France, 1. During the year admissions of new members had been much fewer and exclusions much larger than in 1883, the admissions numbering 2872 and the exclusions 1988; and with the close of the year they had only an increase of 263 members, the total being 50,681, as compared with 50,418 at the close of 1883. The income, owing to a special levy which had been made, had been the largest in the history of the Society, and had reached the large total of £157,484, an increase over the previous year of £22,835. The total outlay for the year had been £172,841, which was £48,117 more than they spent in 1883. Out-of-work support, which had required

£59,056, had taken the lion's share of this outlay; and special strike expenditure had been very heavy, the amount being £20,499 to their own and other trades. Sick benefit had taken £27,977, funeral benefit £8253, and superannuation £30,519. Briefly summarised, the present position of the Society was as follows:—At the end of 1884 they had 50,681 members distributed among 430 branches. Their total income for the year was £157,484, and their expenditure £172,841. They had thus spent £15,357 more than they obtained; and deducting this from their previous balance of £178,125, they had still left an accumulated fund in the hands of the branches and offices of £162,768.

STEEL SHIPS.

The demand for steel ship plates is at the moment greater than the supply, at all events on the north-east coast. At Consett one large mill is now exclusively employed upon them, and turns out about 450 tons per week. Ships which are nominally built entirely of steel are now frequently only partially composed of that material. The shells are of steel, but the bulkheads, floors, keelsons, and internal work generally are of iron. It is said that vessels so constructed are really better than those altogether built of steel, because the iron being of heavier scantlings, they are in consequence stiffer. There is a growing feeling that the reduction of scantlings allowed for steel is too great and will have to be altered. A steel ship which recently entered Liverpool after a voyage was so strained that the locality of every frame could be seen from the outside. The spaces between had actually in various places become concave from the pressure of fenders when rubbing against quay walls. The favour which steel as a material for ships enjoys is based principally on the fact that steel plates are not easily broken, as, for example, when a ship runs on a rock the tough metal gives way by bending; but there is something more than this wanted in a ship. Let us say, for example, that we have a perfect metal which will bear a strain of 60 tons on the square inch, and have an elongation of 50 per cent., then where a ⅝in. skin plate is now used a ⅛in. plate would in one sense answer if this perfect metal were employed; but no shipowner in his senses would use a plate so thin. Something more than tensile strength is wanting, and this seems to have been overlooked by Lloyd's. More will yet be heard on this point.

LITERATURE.

Our Gold Supply. By Thomas Cornish. 8vo., pp. 212. London: Eden Fisher and Co. 1884.

This volume, which "embodies the result of a long practical experience of gold mining in some of the chief gold-fields of the world," contains a series of more or less discursive notes on the production of gold in the different districts that have come under the author's notice since the introduction of gold mining, which, according to him, "may be termed a new or novel industry," that from the text appears to have originated in California in 1848. In the outset the author combats the generally accepted belief of economists, that gold is to be regarded in the same way as any other commercial product, by expressing a "belief" that the production of any given quantity of gold is of more direct immediate and permanent benefit than that of any other specific article of supposed equal value. Then follow accounts of the beginnings of gold digging in New South Wales and Victoria, where "the iniquitous and almost prohibitory measures adopted to extend the development of the gold-fields were such as could only have been expected to be initiated by some insane autocrat," the colony of Victoria being taken "as an example of the result of narrow-mindedness, incapacity, and vindictiveness of the governor and his ministry."

This strong and somewhat inconsequent language does not mean that the present state of these flourishing colonies is due to the incapacity of their ruler, but is incidental to an account of the differences between the miners and authorities as to the assessment of licence dues in the early days of the gold-fields. The author has also had some experience of the West Coast of Africa, and is very severe upon the doings of some companies, "who erected saw mills before putting up their stamps, which he denounces as an absurd waste of money, as any timber required can readily be obtained on the ground, and either cut by the pit saw or cut and squared by axe and adze;" while immediately before he has decided "that decent places of accommodation, with a supply of food and drink suitable to Europeans, should be provided on the road from the coast to the mines, through the tropical forest, to preserve visitors from England from disagreeable first impressions of a rough road in a strange country." This is straining at a gnat and swallowing a camel with a vengeance. As a practical suggestion, however, we fear it is not of much value, as the money wasted on the unprofitable saw mills would scarcely be sufficient to build and stock the wished-for hotels on the road.

In the section on the Transvaal some remarkable statements are quoted as to a great vein 80ft. thick by a mile long, and on an average 325ft. deep, containing 9,300,000 tons of ore, worth £25,396,875, which valuation another authority qualifies "as so astonishingly low that he cannot allow it to pass unchallenged," but makes it to be worth £59,536,000. The author, commenting upon this, remarks, somewhat drily, that it is difficult to understand why more gold has not been obtained from the Transvaal if the deposits are as rich as stated; and then proceeds to demolish the statements founded upon supposed analogies between the district and that of Ballarat. Towards the end of the book are some remarks upon the valuation of mines, which are of a sensible and practical character; as are those on development; although here the language is not quite as clear as it might be, as we can scarcely suppose that the statement that in laying out the surface works of a mine that has been sufficiently proved, provision should be made for ultimately sinking the shaft to a depth of over 2000ft. is to be taken literally. The final proposition in the book is the profitable nature of tunnel mining, which is proved by a quotation from the prospectus of a scheme for making a tunnel four miles long to connect all the mines now working near Georgetown, Colorado, showing how profitable the mines would be if the tunnel were only made. The large amount of statistical matter scattered through the volume will give it some permanent value as a work of reference, although the absence of both index and table of contents detracts considerably from its utility for this purpose.

EXPERIMENTS WITH A CORLISS ENGINE AT CREUSOT.

(*Concluded from page* 248.)

M. Delafond discusses at considerable length, not only the results which he has obtained, but the reasons for these results. Those of our readers who wish to follow him more closely we must refer to our contemporary, *Annales Industrielles*. In his final paper, contained in the impression of the journal just named for March 23rd, he gives a summary of his conclusions, from which we extract the following statements:—

(1) The engine tested worked with the greatest economy of steam, when the condenser was used, when steam was admitted to the jacket, when the pressure was moderate—about 64 lb. per square inch—when the expansion was moderate, say, about five-fold. Under these conditions the weight of steam used was about 17 lb. per indicated horse-power per hour, and about 21 lb. per brake horse-power per hour.

(2) The jacket is efficient with high pressures and grades of expansion; but its value rapidly falls off as the pressures and grades of expansion diminish, and it is quite useless for low pressures and grades of expansion. This apparently justifies the theory that it is useless to apply a jacket to the low-pressure cylinder of a compound engine, held by many engineers of very large experience.

(3) Compression is extremely useful when the engine is worked without condensation, and is more and more valuable as the compressive pressure approaches more nearly the initial pressure. This bears out the theory that the great compression which takes place in locomotives at high speed is a direct means of economy.

(4) The engine tested did best when giving off on the brake 120 to 170-horse power. It rapidly became less economical when these limits were passed in either direction. As the power exerted augmented, the value of the condenser became smaller and smaller, and after 175-horse power was reached as good results could have been obtained without the condenser as with it, by using compression and employing the exhaust to heat the feed-water. Dr. Alban, of Plau, said much the same thing thirty years ago.

(5) The initial condensation increased as the initial pressure was augmented. The weight actually condensed underwent very complex variations when the ratio of expansion was greater than 5 to 1; for ratios less than this it diminished progressively. It became *nil* when the steam was worked without expansion. The jacket diminished the initial condensation, whether the engine worked with or without the condenser scarcely modifying the results. The importance of initial condensation appears to depend above all on the subsequent cooling which takes place during expansion.

(6) The evaporations and condensations which take place during expansion are very complex, especially those which occur when high-pressure steam is used. For pressures moderate or low, when the ratio of expansion was diminished, the evaporation increased. For certain ratios there was no re-evaporation, but rather condensation. The jacket augmented re-evaporation. Pressures of from 64 lb. to 50 lb. gave the largest re-evaporation during expansion.

(7) Moderate pressures are the most economical, because they are accompanied by the smallest amount of initial condensation and the largest amount of re-evaporation during expansion.

(8) An augmentation of the piston speed, and the supply of the jacket with steam hotter than that admitted to the cylinder are favourable to economy.

(9) Lastly, keeping in view the results of experiments without a condenser, the pressures being 78 lb. and 50 lb., it is difficult to admit that there is any free water in the cylinder, at any time when the ratio of expansion is moderate.

M. Delafond concludes his valuable paper by saying that these conclusions are very valuable and complete from a practical point of view, while they are unfortunately unsatisfactory from a theoretical point of view; and we echo his wish, that the initiative taken by M. Schneider may find many imitators, who will render assistance in solving the very difficult problem of ascertaining what really does take place in the cylinder of a steam engine.

For ourselves we shall only say that we have done little more than place an outline of this most valuable series of experiments before our readers; but the very circumstance that we have so condensed it, and placed the prominent facts before them in the most compact form, will we hope the better concentrate attention on the figures we have given. We may perhaps be excused if we add that these figures confirm in the fullest manner our often-repeated statement that moderate are as economical as high pressures. This statement appears to be flatly contradicted by the results obtained with triple expansion engines. It remains to be seen, however, whether the type of engine is or is not able to modify the results. Who will now undertake a series of experiments with the compound engine which will be comparable with those made by M. Delafond? Such a work would not be unworthy of the Institution of Civil Engineers.

Association of Municipal and Sanitary Engineers and Surveyors.—The next meeting will be held at Burnley, on Saturday, April 25th. The members will assemble in the Council Chamber, Elizabeth-street, at 11.30 a.m., to elect honorary district secretary. Mr. J. E. Stafford, A.M.I.C.E., the borough surveyor, will give a short sketch on subjects of local and professional interest; also will show and explain the plans of the intended new waterworks, municipal buildings, and hospital. At 12.30 p.m. members will lunch, and at 1 p.m. will proceed to the store yard of the Corporation, and inspect the refuse destructor, elevator, the new public abattoirs; river invert and gasworks walls; Danes House, canal and railway bridges; Scott's sewage works, and, if time will allow, the Bank Hall Colliery, after which the Corporation will entertain the members at dinner at the Bull Hotel, at 6 p.m.

THE NEW ORLEANS EXHIBITION.

No. III.

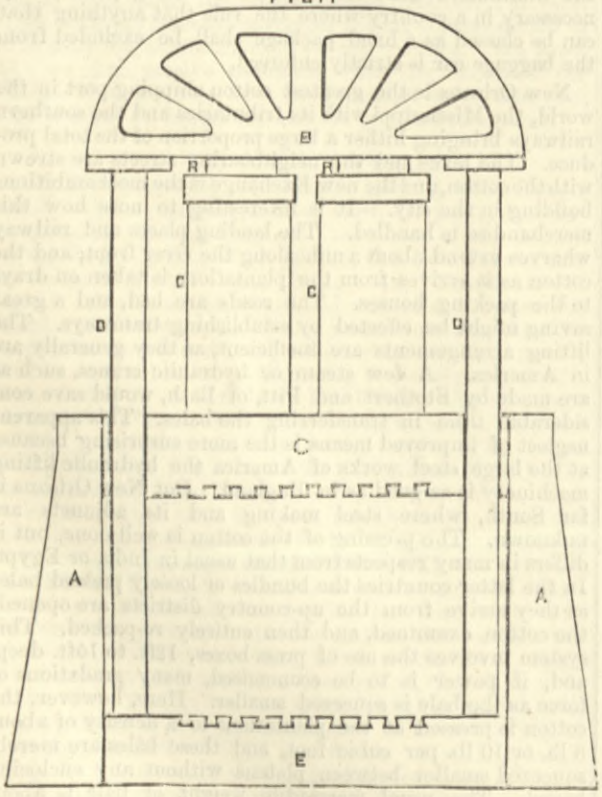
In looking at machinery and engineering appliances in this country, one cannot help feeling that, in the interchange of ideas between England and the United States, the westward movement is the slower of the two. This naturally follows from the fact that, while American manufacturers are free to send us what they please, so that we can, where their ideas are best, accept them and adopt any higher standard of excellence they may offer, they, by shutting out our goods, deprive themselves of much information which they by no means desire to exclude, and which they might receive with advantage. Of course many visitors to Europe take note of what they see; but the mass of the people engaged in manufactures never have the opportunity of examining points of excellence where they might learn from us. This is exemplified here in the agricultural exhibits. American reapers are well appreciated in England; we use many of their small implements at home and in the colonies; direct-acting steam pumps are used in thousands in England, to the advantage of American patentees; and we are constantly stimulated, to our great gain, by the competition of American inventors. But in looking at the portable engines here, one is reminded of those which were exhibited at provincial shows in England twenty years ago. They are less substantial and less symmetrical than ours; the boilers, and in most cases the cylinders, are not clothed in any way; the water space of the boiler is continued under the fire—a useless expense; double cylinders are seldom used, and the compound system is not adopted. Portable engines are not rated here as with us; there is an attempt to state the nominal nearer to the indicated horse-power. An engine, for instance, having a 10in. by 12in. cylinder is classed as 20-horse power, and one 5½in. by 6in. as 6-horse power. In regard to economy of fuel, we have in England constantly before us the never-ceasing improvements in the marine engine; here, though English practice is followed, if but slowly, in sea-going boats, the marine engine trade is in very few hands, and the stimulus of competition arising from an extensive trade is entirely wanting. Large river boats are still almost all made with non-condensing engines. Notwithstanding the long seaboard, the long navigable rivers, and here at New Orleans, one of the most important ports in the country, one small solitary steam launch of very indifferent design is the only representative of this branch of engineering.

The sleeping cars have been already alluded to. The place of honour in the centre of the building is given to a large relief model of the town of Pullman, situated near Chicago, showing workshops, houses, churches, and parks. This town has every sanitary improvement, and the houses are comfortable, but the place is governed absolutely by Mr. Pullman with a parental despotism strangely at variance with American ideas, and in its not too benevolent system, more like that of a petty German prince of fifty years ago than that which English-speaking people are accustomed to. It may be hoped that the introduction of the Mann and other competing cars may induce the Pullman Company to improve the details of its cars, for although every one appreciates on a long journey the comfort provided, there is great room for improvement. In the first place the car-builders here, in common with the rest of their countrymen, seem quite incapable of making a comfortable seat. Except in a few of the best clubs and private houses furnished according to English ideas, even the rudiments of chair designing are unknown. On a long journey in a so-called parlour car, or in the day use of a sleeping car, where passengers twist their bodies in the vain attempt to find a comfortable posture, one longs even for the third-class carriages of our northern lines, where one may occasionally stretch out at full length. The window fastenings and adjustments need alteration; serviceable racks or netting should be provided instead of the diminutive kind in vogue, this being particularly necessary in a country where the rule that anything that can be classed as a hand package shall be excluded from the baggage car is strictly enforced.

New Orleans is the greatest cotton shipping port in the world, the Mississippi with its tributaries and the southern railways bringing hither a large proportion of the total produce. The levee and the neighbouring streets are strewn with the cotton, and the new Exchange is the most ambitious building in the city. It is interesting to note how this merchandise is handled. The landing places and railway wharves extend about a mile along the river front, and the cotton as it arrives from the plantations is taken on drays to the packing houses. The roads are bad, and a great saving might be effected by establishing tramways. The lifting arrangements are inefficient, as they generally are in America. A few steam or hydraulic cranes, such as are made by Stothert and Pitt, of Bath, would save considerable time in transferring the bales. This apparent neglect of improved means is the more surprising because at the large steel works of America the hydraulic lifting machinery is as good as in England. But New Orleans is far South, where steel making and its adjuncts are unknown. The pressing of the cotton is well done, but it differs in many respects from that usual in India or Egypt. In the latter countries the bundles or loosely pressed bales as they arrive from the up-country districts are opened, the cotton examined, and then entirely re-packed. This system involves the use of press boxes, 12ft. to 15ft. deep, and, if power is to be economised, many gradations of force as the bale is squeezed smaller. Here, however, the cotton is pressed at the plantations to a density of about 8 lb. or 10 lb. per cubic foot, and these bales are merely squeezed smaller between platens without any enclosing boxes. The usual mercantile weight of bale is about 450 lb., but there is no uniformity in size, as this depends on the dimensions of the plantation presses, which vary considerably. These local presses are constructed mainly of wood, are many of them of very rude kind, and are either worked by hand screws or, more generally, by a combination of levers worked by oxen, mules, or men.

There are two leading types of packing presses in New Orleans, and they merit some description. One is a steam and hydraulic machine, and the other is a steam lever press. In both the operation is simplified by the shortness of the stroke, about 4ft. to 5ft. and by the absence of boxes. The annexed diagram will sufficiently illustrate the method of the steam hydraulic press, which, though some of its details are peculiar, involves no principle new in England. The press is entirely of iron of the form indicated by the diagram elevation, Fig. 1. Two standards A A support the upper or fixed platen, and the two hydraulic cylinders C C upon it. The rams, about 18in. diameter, enter the arched casting B, to which are attached four tension bars D D, each made of wrought iron 8in. square and fastened at their lower ends to the platen E. The plantation bale having been brought near to the press, the hoops are cut and about half their length thrown aside, and before the bale has time to expand it is placed upon the lower platen E, and the pressure water admitted to the cylinder C C. As the rams R R and the casting B rise, they pull up the lower or movable platen E and squeeze the bale. The hoops are then re-fastened round the original bagging cloth, the cloth is sewn over the ends of the bale, the rams descend, and the bale is released. There are no hydraulic pumps, the force which comes directly from the steam cylinders being graduated as follows:—Fig. 2 is a plan of the steam and hydraulic concentrating cylinders, which are fixed diagonally. The steam cylinders N are each about 54in. diameter, and the piston-rods are continued as rams R S into the hydraulic cylinders H J, the ram R having a diameter of 8in., and the ram S 20in. Steam being admitted into cylinder Q, the force upon the piston is concentrated on the ram S, which gives to the water a pressure per inch of about seven times that of the steam; namely, in the proportion of area of 54in. and 20in. diameter. The pressure water is conveyed to the press cylinders through the pipe P, and this force suffices for the greater part of the stroke. Steam is then admitted to the cylinder N, and the force upon the piston concentrated on the smaller ram R—about 25 to 1—and this higher pressure conveyed to the press by pipe V completes the packing. After the first bale has been pressed, instead of steam being admitted to cylinder Q direct from the boiler, the exhaust steam from cylinder N is utilised for the purpose. The force exerted on the cotton of course depends on the steam pressure. This in practice is about 85 lb. to the square inch, and the hydraulic pressure given by the 8in. ram is about 2000 lb. to the inch on the water in the press cylinders, affording through the two

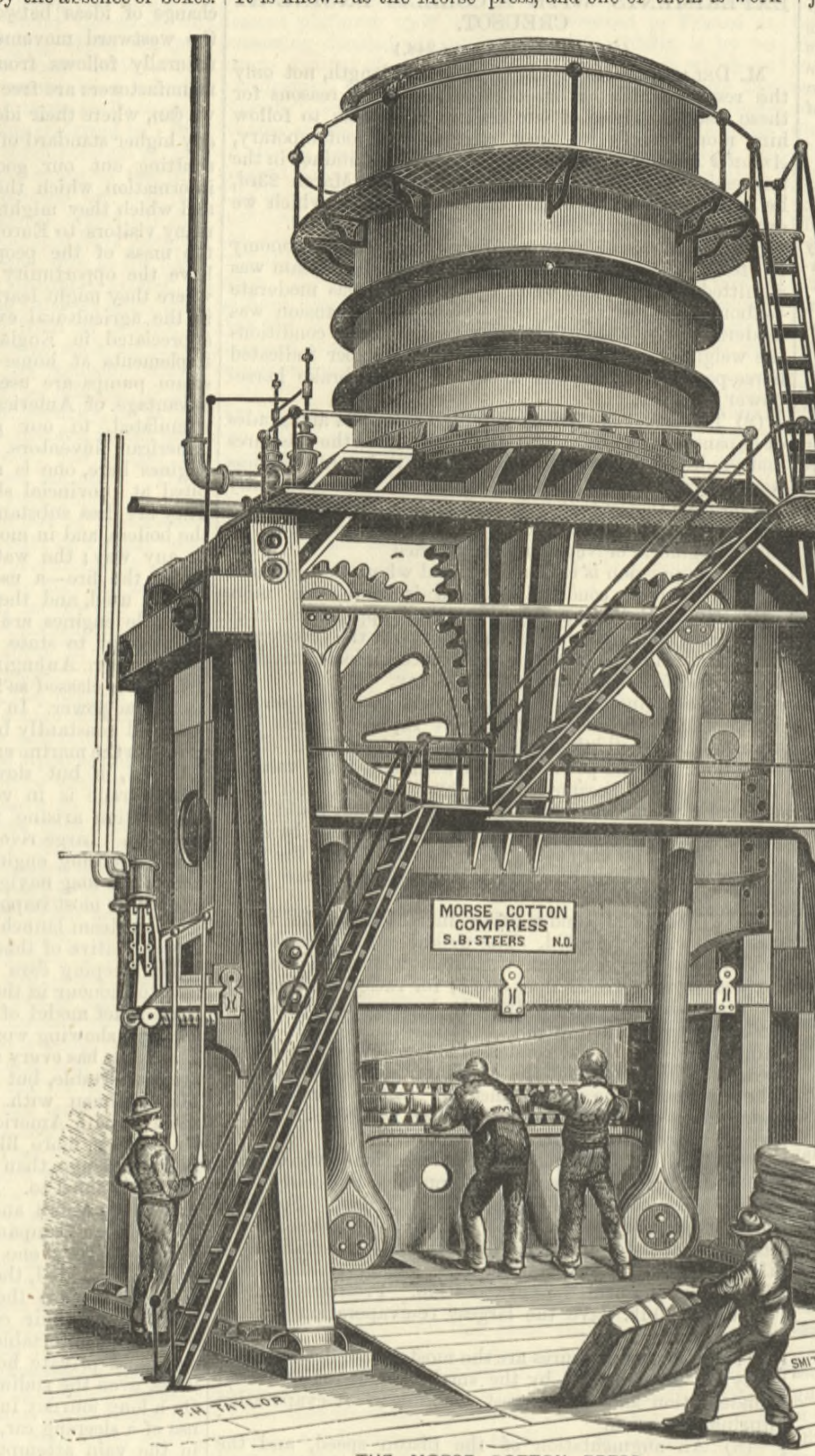
FIG. 1



STEAM HYDRAULIC PRESS.

18in. rams about 500 tons. This could obviously be increased by a higher steam pressure, but the cast iron cylinders will not endure the strain. Steel cylinders or compressed steel after Whitworth's method would cost too much here, and it has been proposed to substitute four or six cylinders of smaller diameter for the two of 18in., as being better able to stand a higher pressure.

The other press referred to as being used in New Orleans is a much more powerful machine than that just described. It is known as the Morse press, and one of them is work-

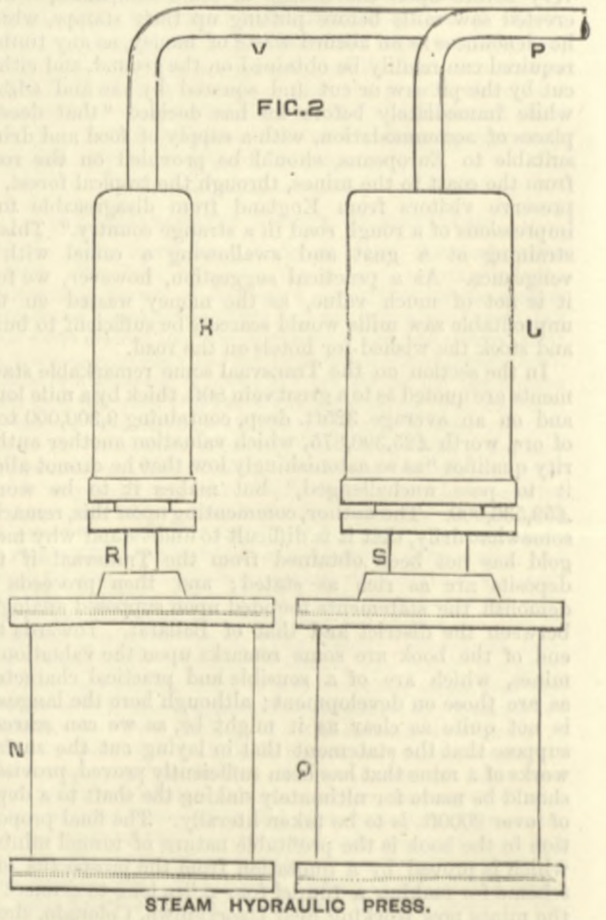


THE MORSE COTTON PRESS.

ing daily in the Exhibition. Its general design is shown by the annexed engraving. The supporting framework is entirely of timber, the other parts, except the two connecting rods, being mainly of cast iron. The steam cylinder at the top varies in different presses working in the city, but in the one exhibited is of the maximum diameter of 90in. The cylinder is open at the top, steam being only on the underside of the piston. The piston-rod is attached to a double rack, working on each of its two rows of cogs into cycloidal sectors, the engraving showing this rack at the top or finish of its stroke. The last teeth in the rack, which receive the greatest strain, are of wrought iron forged solid with the rack body and piston-rod. The toothed sectors are so designed as to move rapidly at the beginning of the stroke, when the resistance of the cotton is slight, and with slower and more concentrated force when the resistance is greatest. The upper platen is stationary, the lower one rising as in the hydraulic press just described, this arrangement facilitating the handling of the bales. The gross force exerted by this machine ranges from 1000 to 3000 tons, according to the steam pressure. The loss by friction must be considerable, probably not less than one-fifth. There is no need for the maximum force mentioned above in order to obtain the density of bale required by the merchants. Indeed, much of the power given is wasted, as the hoops, applied as is customary here, cannot hold the bale to the shape given it by the press; and as no mechanical means is used for pulling the hoops tight, fully 3in. is lost, the bale expanding this much when released, and this last 3in. has cost more in steam power and fuel than all the rest of the compression. This loss is partly due to the insufficient number of hoops, but it arises also from the large area of the bale in proportion to its thickness, as in practice it is found impossible to prevent the bale bulging into a rounded form, which—as the freight is calculated by measurement tonnage—is so much lost to the merchant. There is a natural rivalry between the Taylor and the Morse systems, each claiming points of superiority. The Taylor is simple and direct-acting, and though not so powerful, is said to compress the bales as small as will obtain the maximum saving in freight allowed by the shipowners. Moreover, whatever the thickness of the plantation bale, the maximum force is applied to it, while in the Morse machine the piston makes a certain stroke and no more, however slight the resistance of a particular bale may be. To meet this difficulty a wedge casting is introduced above the upper platform, serving as a packing or distance piece, and the engineer, judging by the appearance of the plantation bale as it is presented to him to what density it can be squeezed, adjusts the wedge so as to give the necessary width of gap between the upper and lower platen. Another plan by which the force of the press can be utilised without the loss just referred to of the bale expanding after it is released from the machine, is to pack two bales together, so that in the two bales there will only be two bulging surfaces instead of four in two single bales as at present. The merchants do not, however, encourage this. In justice to the Morse press it must be said that those at work wear well; there are eleven now working in New Orleans; and that of late years many more presses on this system have been ordered than on the hydraulic system. The cotton trade is an important one; more than six million bales annually are pressed at American ports, and the money stake is considerable. The speed of packing ranges from forty to sixty per hour. The bales weigh about 45 lb. per cubic foot as measured by the shipper, but while held in the press sixty, and even more, is sometimes attained. The cost of packing per bale, exclusive of the hoops, is about 60c.—2s. 6d.

FLETCHER AND MAN'S PATENT CUT-OFF VALVE.

It is now many years since the mechanical world was astir through the introduction of the Corliss cut-off valve, which, modified and improved, has maintained its position as a first-class cut-off valve actuated by "trip" motion. It marked an era in the construction and economy of the steam engine through the application of a principle that would indeed seem difficult to improve upon; but we lay before our readers drawings and description of a new cut-off valve, the invention of Messrs. G. Fletcher and Co. and J. H. Man, which is actuated on an entirely new principle, and which, through various and severe tests, has proved itself to possess advantages beyond the expectations of its inventors and advocates. To describe the principle of its action we cannot do better than quote from the preamble to the patent specification, which runs thus:—"When steam or gas at any pressure passes through an orifice into any lower pressure, its velocity is due to and varies approximately as the square root of the difference of pressures when this difference is small. If, then, the orifice be that of a valve free to close, but kept open by its own weight or a spring, it is evident the valve will not remain open when the difference of pressures on either side of itself produces a force greater than that tending to keep it open. The valve is in equilibrium when these forces are equal and opposite, and the velocity of the steam at the moment



STEAM HYDRAULIC PRESS.

of equilibrium is therefore definable. By introducing such a valve between the slide case and the cylinder, so that the velocity of the steam shall just produce equilibrium about the valve

FLETCHER AND MAN'S PATENT VALVE GEAR.

MESSRS. G. FLETCHER AND CO., DERBY, ENGINEERS.

Fig. 1

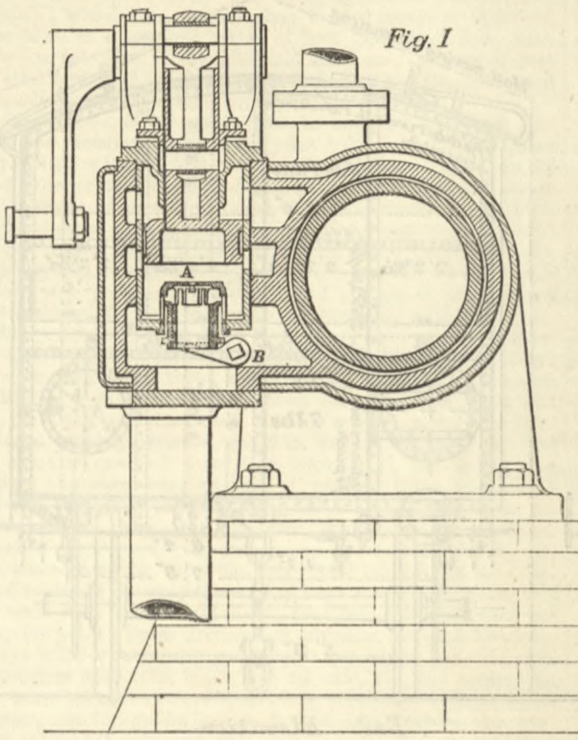


Fig. 2

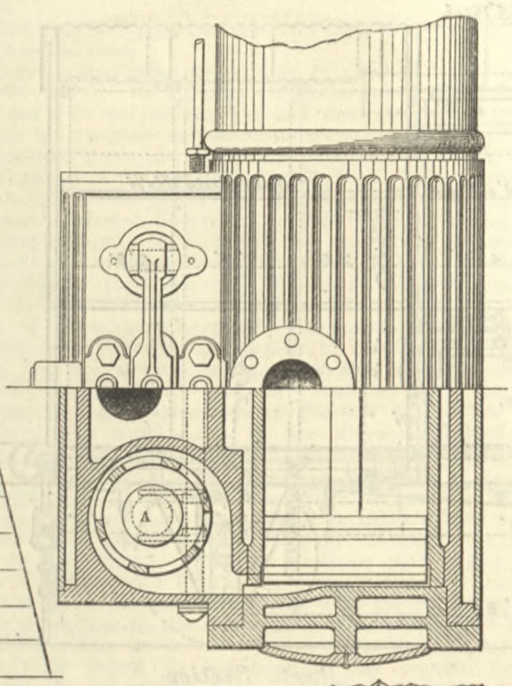


Fig. 5.

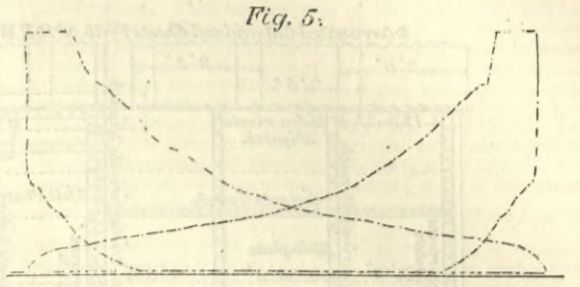


Fig. 7. Fig. 6.

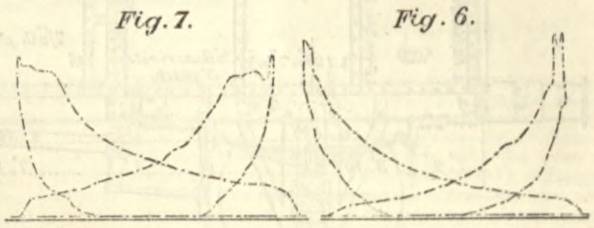


Fig. 3.

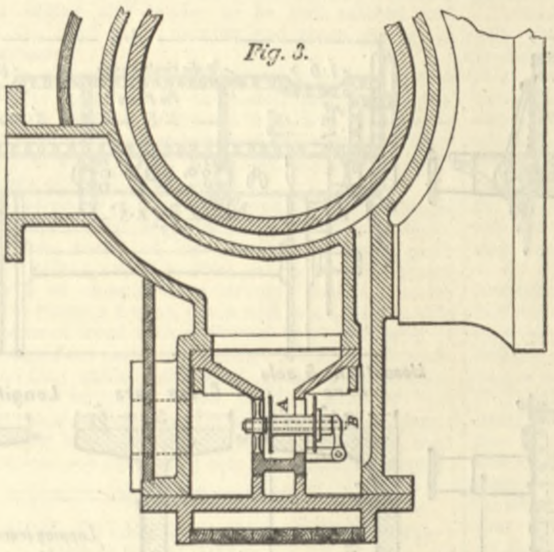
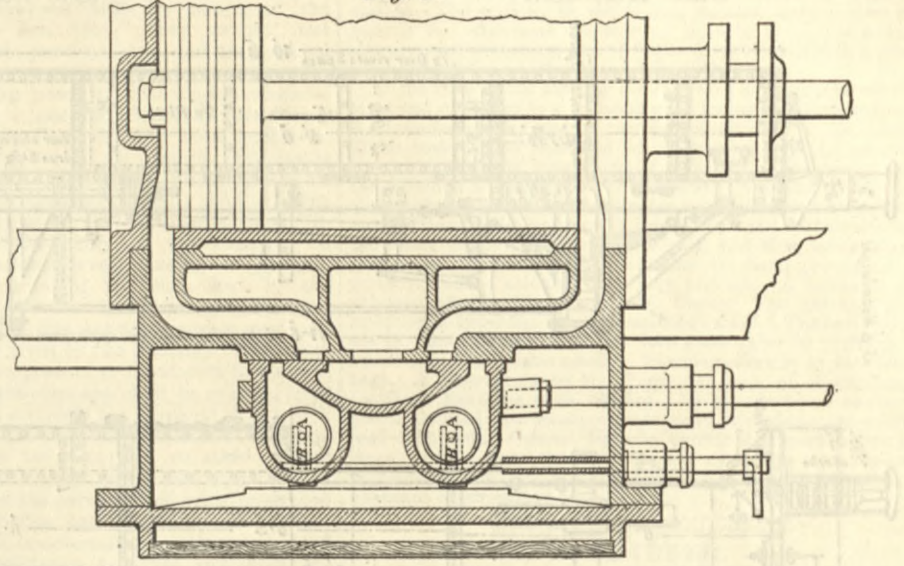


Fig. 4.



at the moment of maximum piston speed, the valve will close and give an instantaneous cut-off at about half-stroke. To effect the cut-off earlier than half-stroke, the phenomenon of equilibrium has merely to take place at some previous moment, which may be accomplished (1) by an increase in the speed of the engine; (2) a decrease in the area of the valve; and (3) a decrease in the load on the valve. From a study of the first of these causes, it appears the valve, when once adjusted, should be an automatic regulator of speed, and this is actually the case to a certain extent; but in practice it will be found necessary to adopt one of the other causes. Locomotive, marine, and other engines that require regulation of power at varying speeds can be fitted with mechanism by which the area of the valve or the load on it can be altered at pleasure, and so vary the point of cut-off to suit circumstances. In other engines requiring regulation of speed, any governor can be applied to actuate the cut-off valve or its load."

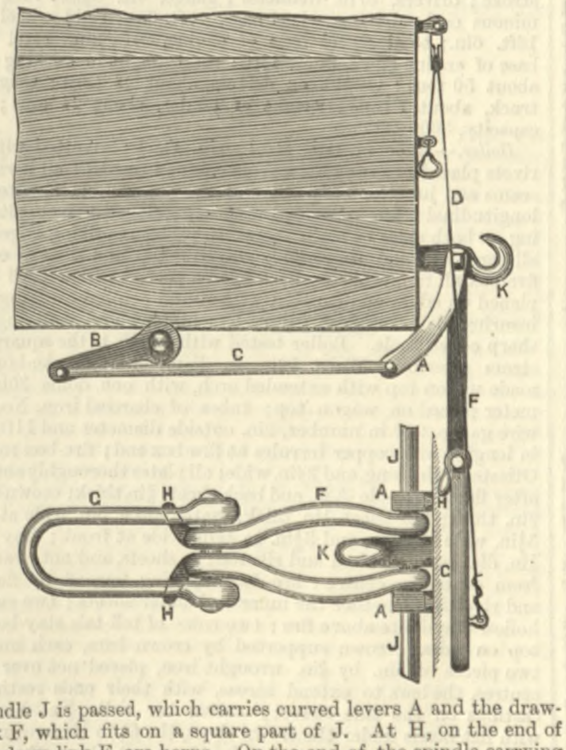
The particular design of valve preferred is shown in the accompanying illustrations. It is constructed on the differential principle, for the double purpose of increasing the area for the passage of steam and decreasing the weight of the valve. It is simply a hollow bobbin of steel or other suitable material that slides on a central spindle, which, in the type shown at Figs. 1 and 2, is hollow, so that the steam for the supply of the upper seating passes through the valve itself. At Figs. 1 and 2 we give sectional views showing its application to a pair of vertical balanced piston valves, and Figs. 3 and 4 show it as applied to the ordinary slide valve. The principle is, however, precisely the same, whether the application be to flat or cylindrical valves, working either horizontally or vertically, viz., the steam in passing towards the cylinder passes through the top and bottom seatings of the valve A; and if the area presented for the passage of the steam be not large enough for the maintenance of initial pressure within the cylinder, the steam will become throttled at some points in the stroke. In other words, there will be a slightly reduced pressure within the valve chamber, the excess of external pressure tending to raise the valve. It will thus be seen if the weight of the valve on its effective area—the difference between the areas of its two discs—represents a pressure downwards less than the excess of external pressure upwards, the valve will be closed by the steam at a velocity approximately equal to the influx of steam, thus producing an instantaneous cut-off. The exact point of cut-off is determined solely by the position of the valve—the amount of opening—in relation to the speed of the engine, and it is merely necessary to raise or lower the stop B on which the valve rests normally, to effect earlier or later cut-offs.

We shall also give at some future date its application to that class of engine known as the single-acting trunk piston engine. It is, however, equally applicable to beam engines or inverted cylinder engines. The principle is applicable to a valve of any design. Messrs. Geo. Fletcher and Co., of London and Derby, are the manufacturers of these engines, one of which has been running their works for over a year. It is a horizontal, 16in. by 20in., making eighty revolutions per minute, from which the diagram Fig. 5 was taken. Figs. 6 and 7 are taken from the type shown by Figs. 1 and 2, which is a 10in. by 15in. cylinder, making 225 revolutions per minute.

If any confusion still exists concerning the precise mode of action of this beautiful device, it will be set at rest by calling to mind what takes place if a room door be set open when a draught of air is blowing through; the door will clap. This valve is exactly in the position of the door. As the piston starts from the end of its stroke the steam flows at slow speed into the cylinder, but as the crank gets further and further from the dead point, the steam rushes in more and more quickly past the valve, and at last claps it to on its seat, where it will remain until the end of the stroke, when it will fall open again by its own weight. The governor causes the semi-rotation of the spindle, on which are keyed the toes B; that is to say, as the balls fly further apart the toes are raised or lowered according to the arrangement of the engine, so as to prevent the valves from opening so wide as they did when the balls were closer together, and the valve will then shut sooner, just as a door will clap to with less draught if nearly shut than it will when nearly full open. The working of the engine, which we have examined at Derby, leaves nothing to be desired, the only sound produced by the valves being a rhythmical clicking, not so noisy as the common type of Corliss engine.

MORRIS'S WAGON COUPLING.

THE accompanying engraving represents a wagon coupling invented and made by Mr. R. Morris, of Doncaster, and applied to ordinary wagons. Through a hole in the draw hook K, a

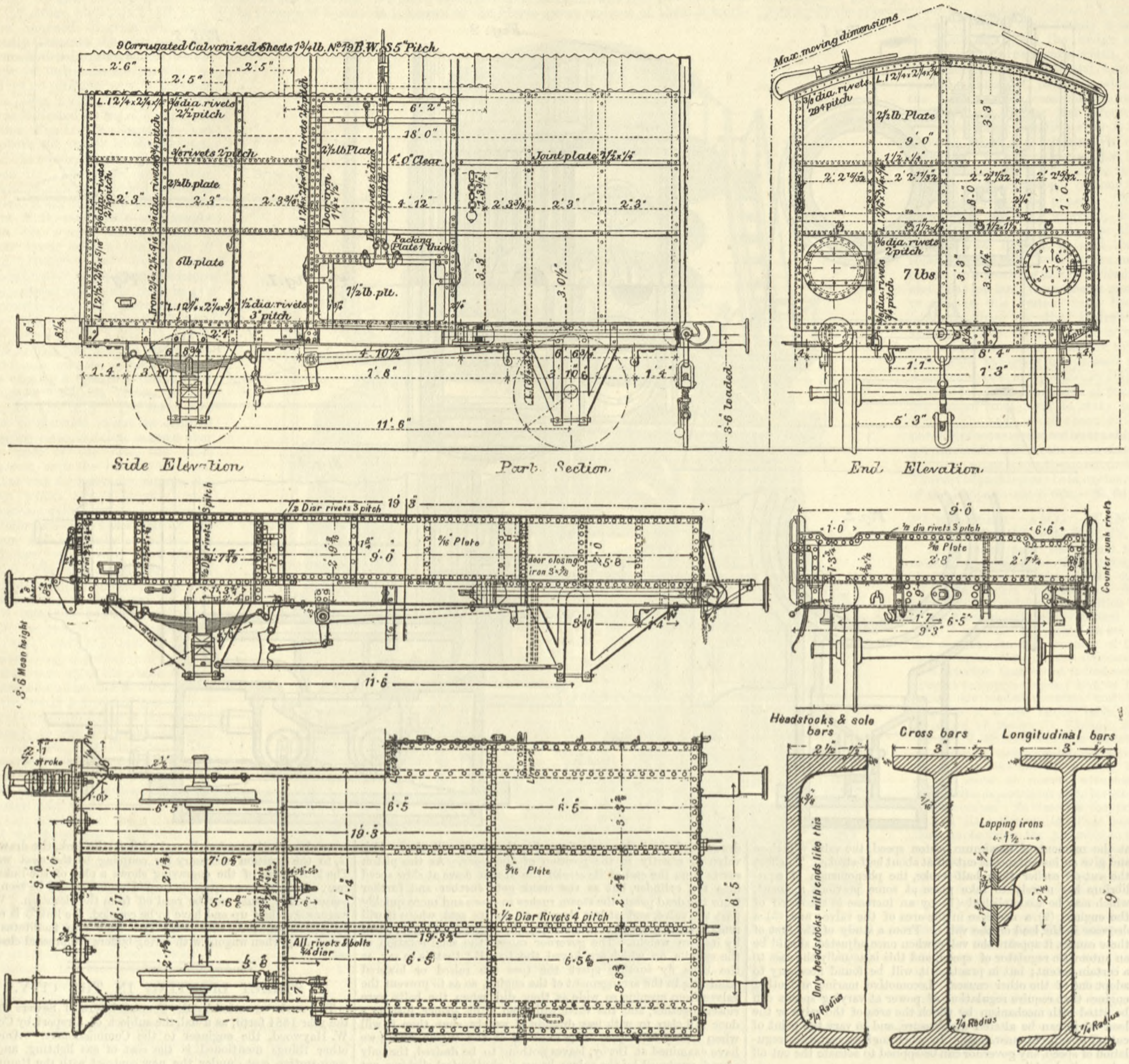


spindle J is passed, which carries curved levers A and the draw-link F, which fits on a square part of J. At H, on the end of the draw-link E, are horns. On the end of the spindle carrying the arm B is a handle, by moving which the rod C pushes the lever A, and thus raises F, and with it the link, the draw-link G, to the position necessary for coupling to the next wagon. The lower part of the engraving shows a plan of the links and gear. This, to save space, is turned round, as will be seen, and consequently must not be read off from the elevation. When wagons are close up and have to be coupled, the link G is raised by means of the wire cord D. This also facilitates the uncoupling when wagons with spring buffers are pressed close up.

STREET LIGHTING IN THE CITY.

THE works executed by the Commissioners of Sewers during the year 1884 form, as usual, the subject of a report by Colonel W. Haywood, the engineer to the Commissioners. Amongst other things mentioned is the cost of gas lighting, and the comparative cost, under the new contract with the Hammond Electric Light Company, for lighting a large part of the City. With gas at 2s. 8d. per 1000, the cost per lamp in 1884 was, for lamps burning 5 cubic feet per hour for 4300 hours, £2 17s. 4d., and for lamps burning 10 cubic feet, £5 14s. 8d. per year. The cost of lighting and repairing brought these figures respectively up to £3 15s. 4d. and £6 12s. 8d., except in the case of round lamps, which cost more for cleaning and maintaining, and these cost a total of £3 19s. 7d. and £6 16s. 11d. respectively. In several places large lamps were employed, as at crossings and open spaces—large lanterns of octagonal form taking the place of five small lamps on the large standards. The burners in each of these lamps consume 50 cubic feet of gas per hour, and are estimated by the patentee, Mr. W. Sugg, to give a light equal to 260 candles. The five lanterns and burners removed from each column to make place for these lamps consumed 25ft. of gas per hour, and were estimated to give a light of 70 candles. One of Bray's patent lamps and burners, consuming $16\frac{1}{2}$ cubic feet of gas per hour, and giving a light estimated by the patentee at 60 candles, was fixed in the centre of New-square, Minories. The extra expenditure of gas has, in these cases, been paid for by the patentees. However, after much negotiation between the Commissioners and the Hammond Company, a contract was arranged in February last, the company to deposit £5000 on executing the agreement and £5000 within two calendar months, as security for carrying out the contract. The company is to replace by 30-candle power incandescent electric lamps the public gas lamps in the following streets, viz.: Old Broad-street, Mansion House (in front of), Royal Exchange Buildings, Bartholomew-lane, Lothbury, Princes-street, Lombard-street, Birchin-lane, Bishopsgate-street Within, Throgmorton-street, Threadneedle-street, and Gracechurch-street. The company is also to gradually substitute electric lamps for all the other public gas lamps in the district, the price for each being £3 15s. per annum. The contract is for seven years from 1st January, 1886, the Commission having the option of renewing, on certain terms, for another seven years, and so on from time to time. The company is to lay mains for private lighting, but not to have the exclusive right of private lighting; and if default is made in the public lighting, the right to supply for private use is to cease. If this contract is carried out, the Commissioners are to have a better light at a cost per unit of light not half that of gas. It does not appear whether this sum includes maintenance and cleaning of lanterns as mentioned above for gas.

CONTRACTS OPEN—GOODS AND BALLAST WAGONS, INDIAN STATE RAILWAYS.



CONTRACTS OPEN.

INDIAN STATE RAILWAYS

This contract is for iron underframes, underframe and body ironwork, and roofing for covered goods wagons, and open-sided goods or ballast wagons, for the Cawnpore-Kalpi and Kutni-Umeria Railways, 5ft. 6in. gauge.

The work required comprises the construction, supply, and delivery in England, at one or more of the ports named in the conditions and tender, of iron underframes, underframe and body ironwork and roofing, with all requisite bolts and nuts, rivets, washers, panel pins, and coach screws, for putting the work together in India, and fixing the bodies to the underframes, for eighty iron covered goods wagons, 18ft. long; ninety open-sided goods or ballast wagons, 19ft. 3in. long. The covered wagons are illustrated herewith. The iron must be of such strength and quality that it shall be equal to a tensional strain of not less than the undernamed several tensional strains, and shall indicate the several rates of contraction of the tested area at the point of fracture that follow, namely:—

	Tensional strains per square inch.	Percentage of contraction of fractured area.
	Tons.	
Bars and rods	24	20
Plates	22	10
Channel, angle, and T-iron	22	15

The channel and angle bars and plates may be made of steel of such strength and quality that it shall be equal to a tensional strain of not less than 27 tons, or more than 31 tons, per square inch of section, and shall indicate a contraction of 30 per cent. of the tested area at the point of fracture.

The roof sheets for the covered goods wagons are to weigh before galvanising not less than 1¾ lb. per square foot, and after galvanising they are to weigh not less than 30 oz. per square foot. The whole of the sheets and other ironwork are to be galvanised with the best Silesian spelter. The roofing sheets for the covered goods wagons are to be corrugated after they are galvanised to a pitch of 3in. from centre to centre of flutes, and ⅝in. deep; they are then to be curved accurately to the radius shown on the drawing. The character of the work may be gathered from the drawing. Tenders to be sent in not later than 2 p.m. Tuesday, the 21st inst.

MOGUL ENGINE

We are indebted for the following specification of a Mogul locomotive engine—illustrated on page 300—having three pairs coupled wheels and a two-wheeled radial truck, to the *American Journal of Railway Appliances*:—

General description.—Cylinders, 19in. diameter and 26in. stroke; drivers, 57in. diameter; gauge, 4ft. 8½in.; fuel, bituminous coal; driving wheel base, 16ft. 6in.; rigid wheel base, 16ft. 6in.; total wheel base of engine, 24ft. 2in.; total wheel base of engine and tender, 46ft.; total weight in working order, about 50 tons; weight on drivers, about 43 tons; weight on truck, about 7 tons; weight of tender, about 24 tons; tank capacity, 3000 gallons.

Boiler.—Made of Otis steel $\frac{7}{16}$in. thick; rivetted with ¾in. rivets placed not over 2¼in. from centre to centre; all horizontal seams and junction of waist and fire-box double rivetted; all longitudinal seams provided with lap welt with rivets alternating on both sides of main seams, to protect caulking edges, and all parts well and thoroughly stayed; top and sides of outside fire-box all in one sheet; back head a perfect circle. All plates planed on edges and caulked with round pointed caulking tools, insuring plates against injury by chipping and caulking with sharp edged tools. Boiler tested with 180 lb. to the square inch, steam pressure. Waist 52in. in diameter at smoke-box end, made wagon top with extended arch, with one dome 30in. diameter placed on wagon top; tubes of charcoal iron, No. 12 B wire gauge, 200 in number, 2in. outside diameter and 11ft. 8⅞in. in length, with copper ferrules at fire-box end; fire-box made of Otis steel 78in. long, and 34in. wide; all plates thoroughly annealed after flanging; side $\frac{5}{16}$in. and back sheets ⅜in. thick; crown sheets ⅜in. thick; flue sheet, ½in. thick; water space, 5in. wide at sides, 3½in. wide at back, and 3½in. to 4½in. wide at front; stay bolts, ⅞in. diameter, screwed and rivetted to sheets, and not over 4¼in. from centre to centre; fire-door opening formed by flanging and rivetting together the inner and outer sheets; two rows of hollow stay-bolts above fire; two rows of tell-tale stay-bolts at top on sides; crown supported by crown bars, each made of two pieces of 5in. by ⅝in. wrought iron, placed not over 4½in. centres, the bars to extend across, with their ends resting on castings on the side sheets; crown bar bolts, ⅞in. diameter, with flat heads under the crown sheet, the fit in the crown sheet to be tapered and drawn to its place by a nut above the crown bar; the crown to be well and thoroughly stayed by braces to dome and outside shell of boiler; cleaning holes in corner of fire-box, and blow-off cock in side; smoke stack straight; grates, cast iron rocking, with dump; ash-pan, wrought iron dampers front and back; balanced poppet throttle valve, of cast iron, in vertical arm of dry pipe.

Frames.—Main frames of best hammered iron, forged solid; front rails bolted and keyed to main frame, and with front and back lugs forged on for cylinder connections; pedestals protected from wear of boxes by cast iron gibs and wedges, firmly secured by thimbles and through bolts.

Machinery.—Cylinders, 19in. diameter and 26in. stroke, of best close grained iron, as hard as can be worked. Each cylinder cast in one piece, with half saddle placed horizontally; right and left-hand cylinders reversible and interchangeable, accurately planed, fitted, and bolted together in the most approved manner; valve face and steam chest seat raised 1in. above face of cylinder, to allow for wear; cylinders oiled by oil valves placed in cab, and connected with steam chests by pipes running under jacket; pipes proved to 200 lb. pressure; Allen valve—Richardson's balance—in steam chest; piston heads and followers of cast iron, fitted with Dunbar packing; piston-rods of cold rolled iron, keyed to crossheads, forced and rivetted to piston; guides of close grained cast wheel iron, fitted to wrought iron guide yoke; crossheads of cast steel; valve motion of most approved shifting-link motion, graduated to cut off squarely at all points of stroke, links, sliding blocks, pins, lifting links, and excentric rod jaws made of the best hammered iron, well case-hardened; sliding blocks with long flanges, to give increased wearing surface; rocker shafts and reverse shaft of wrought iron, with arms forged on; driving wheels, six in number, 57in. in diameter; centres of cast iron, with hubs and rims cored out, and turned to 51in. diameter to receive tires; tires of Krupp crucible cast steel, 3in. thick; front and back pairs, flanged, 5⅝in. wide, middle pair plain, 6½in. wide; axles of hammered iron; journals 8in. diameter and 8in. long; driving-boxes of strong closed-grained cast iron, with wide flanges and heavy brass bearings; springs of best cast steel, tempered in oil, made by A. French and Co.; equalising beams of wrought iron and of most approved arrangement, with steel gibs and keys; connecting and parallel rods of hammered iron, forged solid, with straps and keys; crank-pins of steel; Friedman feed-water supplied by two non-lifting injectors and pump, or valves and cages of best hard brass, accurately fitted; cock in feed pipe regulated from foot-board.

Engine truck.—Centre bearing swivelling two wheel swing motion truck; truck frame and braces of wrought iron, with cast iron cross spider fitted with swinging bolster and cast iron pedestals; wheels two, double plate chilled wheels of approved make 33in. in diameter; axles of best hammered iron, with inside journals 5½in. in diameter and 8in. long; springs of best cast steel tempered in oil, made by A. French and Co., connected by equalising beams, resting on tops of boxes.

Accessories.—Cab of good pattern, built of ash, well seasoned and finished, fitted with joint bolts; pilot of seasoned oak; cylinders lagged with wood, and neatly cased with No. 12 iron; cylinder head casings of cast iron polished bands; steam chest casings of cast iron polished bands; dome lagged with wood and cased with cast iron on body, and cast iron top and bottom rings; boiler lagged with wood, and jacketted with planished iron, and secured by planished iron bands; hand-rails of iron pipe polished; running board nosings of iron; wheel cover nosings of iron; engine to be furnished with sand box, brackets, and shelf to receive head-lamp, bell, whistle, blower, and safety valves, heater, steam gauge, cab lamp, gauge cocks; also a complete set of tools, consisting of two heavy jack screws and lever for same, one heavy pinch bar with steel point and heel, one 18in. case-hardened monkey wrench, one 12in. case-hardened monkey wrench, one 2 lb. machinist's hammer, one soft hammer, one flat chisel, one cape chisel, one poker, one scraper, one slice bar, one set of packing irons, one set of hardened double-ended wrenches for all nuts and bolts on engine larger than ½in. diameter, including two packing wrenches—duplicates—for piston and valve stem glands, one 16in. flat bastard file, one 16in. half-round bastard file, one 16in. round bastard file, two padlocks and keys for tender boxes, two cab seats with covers and locks, two cab seat cushions, one clamp for pulling down driving-box oil cellar, one stud for same, one eye bolt for same, one galvanised iron water pail, one steel screw-driver with 10in. blade, five oil cans, viz., one squirt can with brass bottom, two one-quart long snout cans with cast iron bottoms, one two-gallon can with cast iron bottom, one two-quart tallow pot with cast iron bottom; one 23in. deep reflecting head-light; engine and tender to be well painted and varnished, with the road mark, number, and name put on as specified by purchaser.

General features of construction.—All principal parts of engine accurately fitted to gauges and templates, and thoroughly interchangeable; all movable bolts and nuts, and all wearing surfaces made of steel or iron, case-hardened; all wearing brasses made of ingot copper alloyed with tin as hard as can be worked; all threads on bolts cut to U.S. standard.

Tender.—Tank strongly put together, well braced with angle iron corners; bottom plates ¼in. thick; side plates ¼in. thick; top plates ¼in. thick; inside of legs ¼in. thick; rivetted with $\frac{7}{16}$in. rivets, 1½in. pitch; capacity 3000 gallons; tender frame substantially built of channel iron strongly braced; tender trucks, two centre bearing trucks, made with wrought iron side bars and crossbeams of wood with additional bearing at sides of back truck; springs, four cast steel springs in each truck made by A. French and Co.; chilled wheels of approved make 33in. in diameter; brakes on both tender trucks; axles of best hammered iron; outside journals 3¾in. diameter and 7in. long; oil-tight boxes with brass bearings; three tool boxes of hard wood; all patent fees not covered by this specification excepted.

THE LONDON, TILBURY, AND SOUTHEND RAILWAY BILL.

AFTER many delays and postponements, in some quarters attributed to the promoters, with a view to exhausting the vigilance of the opponents, the Bill for conferring further powers on the London, Tilbury, and Southend Railway Company, with respect to its own and other undertakings, and for other purposes, was brought forward for second reading in the House of Commons on Tuesday by Sir Selwyn Ibbetson. The honourable baronet, alluding to that part of the opposition referring to the use of an old burial-ground, explained that the company believed that it had power to do what it desired in this direction without any further Act of Parliament, but to avoid possible expensive litigation, it had inserted a clause in the Bill to make the matter quite clear. In consequence of the opposition anticipated, although the Bill originally took powers with reference to the burial-ground, the specific power sought for had now been abandoned, and it was deemed advisable to rely on the compulsory legal powers to purchase which they already possessed. Another cause of opposition to the Bill was an alleged infringement of the rights of way of the fishing inhabitants of the village of Leigh, near Southend, by the proposed abolition of a level crossing there. But he contended that, even if any public rights existed before the Companies Act of 1875, they were clearly and entirely abolished by that Act. He urged that the House seldom refused a second reading to a private Bill in the House itself, and pointed out that if the petitioners could show any case, it could be fully gone into before the Committee.

Mr. Ritchie said that, although the House seldom refused a second reading to a private Bill, it would never sanction a private Bill which proposed to set aside a public Act of Parliament. The hon. baronet now told the House that the promoters proposed to withdraw the objectionable clause and to act in defiance of the Act of Parliament. He desired, in the interests of his constituents, to preserve the burial-ground proposed to be purchased from being built over by the railway company. He wanted to know what sort of a position the poor of the locality would be in in raising an action against a powerful railway company. He was sure the House would agree with him that attempts of this kind ought to be watched with the extremest jealousy. He sympathised with the proprietors of this piece of ground, but, in his opinion, burial-grounds after they had been filled and closed ought not to be looked upon any longer as the property of private individuals. He begged to move as an amendment "That this House declines to assent to the second reading of a private Bill which proposes to set aside the provisions of the 'Disused Burial Grounds Act, 1884.'"

Colonel Makins seconded the amendment, and dwelt upon the interference with the rights of the fishing community at Leigh which would be effected by the abolition of the level crossing there as proposed. He could only plead *in formâ pauperis* for these poor people, to whom the Bill, if passed in its present form, would bring so much hardship and inconvenience.

Mr. Bryce, in whose name the following notice of motion stood on the paper, "That, in the opinion of this House, railway companies ought not to be permitted to acquire open spaces existing in crowded districts of London, except upon the terms of their undertaking to provide in the same neighbourhood other open spaces of equal area available for the recreation of the people," said that he was perfectly satisfied with the statement of the hon. baronet, that the clause which proposed to give the railway company power to deal with this burial-ground was abandoned. Now that the principle he advocated had been recognised by the company, he failed to see any reason for continuing his opposition to the Bill. He might also say that his hon. friend, the member for Brighton, who also had a notice of motion for the rejection of the Bill, was quite satisfied with the statement of the promoters, and would not persist in his opposition.

After some further and unimportant discussion, the Bill was read a second time.

It appears that under certain Acts obtained and agreements entered into by the company, it has acquired authority to purchase additional lands in West and East Ham and Leigh, in Essex; to extinguish certain rights of way over its railway; to construct goods and warehouse premises; to acquire the burial-ground of the "Seventh Day Baptists" in Whitechapel, and a part of the property of the trustees of the German Reformed Church in Hooper-square, Whitechapel; to construct a railway to form a junction with the railways authorised by the Metropolitan Outer Circle Railway Act of 1882; to acquire a coal depôt of the London and Blackwall Railway Company; and to build and work steamers across the Thames. But some of these powers cannot be carried out without a further Act of Parliament, and as it requires some additional powers, it has brought forward the Bill above-named. It, therefore, asks for statutory authority to acquire: (*a*) Lands lying between Plaistow Station and the northern main outfall sewer of the Metropolitan Board of Works; (*b*) lands near East Ham Station; (*c*) lands on both sides of their railway to the east of Leigh Station, to stop up and extinguish all rights of way across its railway at the crossing to the south-east of the Bell Inn, Leigh, subject to the payment of compensation where necessary; to stop up the pathway from Barking to Pitsea, on condition that it first provides for public use a substituted footpath from the point of intersection of the existing footpath with the railway on the north of the line to the Hacton-lane. These powers of compulsory purchase are to be exercised within three years; and then, with regard to the Seventh Day Baptists' burial ground, the promoters point out that by reason of the "Disused Burial Grounds Act, 1884," they cannot deal with this ground under their previous Act, and they ask to be exempted from the provisions of that statute by the present Bill. Its next request is for power to abandon the construction of the railway to form a junction with the Outer Circle, seeing that the Outer Circle Company has been unable to proceed with its undertaking under the Act of 1882, and is seeking power to abandon it. This power, however, is to be accompanied by the condition that the company shall be liable to pay compensation to any owner or occupier of land, for any damage occasioned by the entry of the company on such land for surveying, taking levels, boring or probing, or by the temporary occupation of any such land by the company. In the same connection it is also provided that "Where before the passing of this Act any contract may have been entered into or notice given by the company for the purchasing of any land for the purposes of or in relation to the railway or any portion thereof, the company shall be released from all liability to purchase or to complete the purchase of any such land; but, notwithstanding, full compensation shall be made by the company to the owners and occupiers, or other persons interested in such land, for all injury or damage sustained by them respectively by reason of the purchase not being completed pursuant to the contract or notice; and the amount and application of the compensation shall be determined in manner provided by the Lands Clauses Consolidation Act, 1845, as amended by any subsequent Act for determining the amount and application of compensation paid for lands taken under the provisions thereof." The promoters, owning a reservoir, well, and spring, mains and pipes, in East Tilbury, West Tilbury, and Chadwell St. Mary, in Essex, within the supply district of the South Essex Waterworks Company, they further propose to take power to purchase the works of the waterworks company on terms to be agreed upon; and in addition to their right to work boats across the Thames—under their Acts of 1852 and 1875—between West Tilbury and Chadwell, on the Essex shore, and Gravesend, they apply for authority to prohibit the anchoring or mooring of any vessel in the course of their ferries, and to require the removal of any vessels so moored or anchored. By another clause they seek power to enter upon the existing coal depôt of the London and Blackwall and Great Eastern Railway Companies, in order to make their new depôt, on giving a month's notice, and providing temporary accommodation for those companies, and making compensation to them for damage and inconvenience. Finally, all these proposals are covered by a proviso that, "Nothing in this Act shall authorise the company to purchase or acquire compulsorily or by agreement ten houses in any one parish or urban sanitary district occupied either wholly or partially by persons belonging to the labouring class—as defined in Standing Order 111 of the House of Lords—as tenants or lodgers;" and a further proviso that nothing shall exempt the company from the provisions of any general Acts relating to railways.

THE PHYSICAL SOCIETY.

AT the meeting of the Physical Society, March 28th, Professor Guthrie, President, in the chair, the President announced that the meeting on May 9th would be held at Bristol. Further particulars would be communicated to the members. Mr. Hawes was elected a member of the Society. The following papers were read:—"On Calculating Machines," by Mr. Joseph Edmondson. Calculating machines are of two classes—the automatic and the semi-automatic. The former were invented by Mr. Charles Babbage between 1820 and 1834, and were designed mainly for the computation of tables. The difficulties against which this inventor contended, and the perseverance he displayed in the construction of part of the "difference engine" he had imagined, are now a matter of history. On account of the great cost and high degree of complexity of this machine, it was never completed, and the calculating machines of the present day belong to the semi-automatic class, the first example of which is found in a rough and incomplete instrument by Sir Samuel Morland in 1663. From 1775 to 1780 the Earl of Stanhope invented machines which were a great advance upon those of Sir S. Morland. In these is found the "stepped reckoner," the basis of all modern instruments. This "stepped reckoner" was improved by M. Thomas, of Colmar, who in 1851 produced a machine which is now largely in use. This machine, somewhat improved in detail and construction, is now made by Mr. Tate, of London, and Mr. Edmondson has patented a modification in which the form of the instrument is circular, by which means an endless instead of a limited slide is obtained. A collection of various valuable instruments, which had been kindly lent for the occasion, were exhibited.

A discussion followed, in which General Babbage, Mr. Tate, Professor McLeod, Dr. Stone, the Rev. Professor Harley, Mr. Whipple, Professor Ayrton, and other gentlemen took part.

"On the Structure of Mechanical Models Illustrating some Properties in the Ether," by Professor G. F. Fitzgerald. The author had recently constructed and described before the Royal Society of Dublin a model illustrating certain properties of the ether.—*Nature*, March 26th. This model was one-dimensional, but the author now showed how a tri-dimensional model might be imagined, though probably mechanical difficulties would render its actual construction impossible. Each element of the ether is to be represented by a cube, on each edge of which there is a paddle-wheel. Thus on any face of the cube there will be four paddle-wheels. Now, if any opposite pair of these rotate by different amounts they will tend to pump any liquid in which the whole is immersed into or out of the cube, and if the sides of the cube be elastic there will be a stress which will tend to stop this differential rotation of the wheels. If, however, the other pair rotate by different amounts they may undo what the first pair do, and thus the stress will depend on the difference between the differential rotations of these opposite pairs of wheels. If η represent the angular rotation of one pair, and ζ that of the other, the stress will depend upon $\frac{d\eta}{dx}-\frac{d\zeta}{dy}$. In order that these four wheels may not similarly work with any other wheel it is necessary to place diaphragms dividing the cube into six cells, each a pyramid standing on a face of the cube. They must be so made that liquid may not be able to pass from one cell to another through the diaphragm or beside the paddle-wheels; to effect this the floats on the paddle-wheels would have to be drawn down while passing the diaphragms. Thus the energy of distorsion of such a medium would depend upon

$$\left(\frac{d\zeta}{dy}-\frac{d\eta}{dz}\right)^2+\left(\frac{d\xi}{dz}-\frac{d\zeta}{dx}\right)^2+\left(\frac{d\eta}{dx}-\frac{d\xi}{dy}\right)^2.$$

And Maxwell has shown that this is also true for the ether. The faces of the cubes should be filled up with diaphragms, past which the paddles should pump liquid, and whose elasticity should be the means of storing electrostatic energy in the medium. The most complicated results follow from supposing the faces of the cubes of which the medium is constructed to have different elasticities. Such a structure represents a crystalline medium, and vibrations would be propagated in it according to laws the same as those regulating the transmission of light in crystalline media. If the cubes were twisted, the structure would be like that of quartz or other substances rotating the plane of polarisation. To represent magnetic rotation of the plane of polarisation, it would be necessary to introduce some mechanism connecting the ether with matter. The author, in conclusion, insisted upon a view which regards the vibrations constituting light to be of the nature of alterations of structure, and of displacement executed in a medium possessing the properties of an elastic jelly.

At the close of the meeting the following instruments were exhibited and described in a conversational manner by their makers:—A chronobarometer and a chronothermometer by Mr. Stanley. These instruments consisted of clocks regulated by pendulums formed in the first instrument of a mercurial barometer, and in the second of a similar barometer enclosed in a hermetically sealed air chamber, the enclosed barometer thus acting as an air thermometer. Increase of pressure in the one case and of temperature in the other causes the mercury to rise, and thus accelerates the pendulum. By the gain or loss of time the mean pressure or temperature can be calculated for any periods. A heliostat and a galvanometer by Mr. Conrad W. Cooke. The galvanometer is intended to show the internal current in a cell. The battery plates are in two cells connected by four glass tubes in multiple, and coiled round an astatic needle. The glass work is by Mr. Gimingham. A spherometer by Mr. Hilger was made of aluminium, and combined lightness with rigidity. By an electrical contact the maker asserted that measurements could be made to one-millionth part of an inch. Colonel Malcolm exhibited a spectroscope and a binocular field glass, in which the two eye-pieces were separately adjustable; and Dr. Watts exhibited a simple modification of a quadrant electrometer.

TENDERS.

LIST of tenders for alterations and additions to the premises containing the Roman Pavement in Jewry Wall-street, Leicester, and other works in connection therewith. Quantities and specification by Mr. J. Gordon, C.E., borough surveyor.

	£	s.	d.
Harry Bland, Leicester—accepted	400	0	0
T. B. Turner, Leicester	388	0	0
J. O. Jewsbury, Leicester	489	14	0
T. C. Tyers, Leicester	492	0	0
T. Duxbury and Sons, Leicester	500	0	0
J. Chester, Leicester	512	0	0
F. Major, Leicester	535	10	0
T. Bland and Son, Leicester	564	10	0

LIST of tenders for the erection of a boiler-house, coal-houses, and other works at the Borough Lunatic Asylum, Leicester. Quantities and specification by Mr. J. Gordon, C.E., borough surveyor.

	£	s.	d.
J. Stevens, Leicester—accepted	419	0	0
T. Richardson and Sons, Leicester	427	10	0
F. Major, Leicester	428	0	0
T. Duxbury and Son, Leicester	430	0	0
T. B. Turner, Leicester	434	11	6
J. Riddett, Leicester	435	0	0
J. O. Jewsbury, Leicester	435	15	0
C. Bass, Leicester	460	0	0
T. C. Tyers, Leicester	464	0	0
T. Bland and Sons, Leicester	500	0	0

KIDDERMINSTER URBAN SANITARY AUTHORITY.

WATERWORKS.—Contract No. 1: For the manufacture and delivery of cast iron pipes, &c.

	£	s.	d.
Staveley Coal and Iron Company, £4 10s. for 3in., 4in., 5in., 6in., and 7in. pipes, and £4 5s. for 8in. and upwards			
James Oakes and Co., London	1638	15	0
Newton, Chambers, and Co., Sheffield	1604	0	0
Clay Cross Company	1484	0	0
Cochrane and Co., Dudley	1440	0	0
J. and S. Roberts, West Bromwich	1361	0	0
C. E. Firmstone and Bros., Stourbridge—accepted	1345	0	0

WATERWORKS.—Contract No. 2: For the construction of covered service reservoir, and laying pipes, &c.

	£	s.	d.
Thomas Vale	8383	0	0
Herbert Hughes, Lower Gornal	7690	0	0
Richard Thompson, Kidderminster	7559	10	0
George Law, Kidderminster—accepted	5977	0	0
S. E. Frayne, Stourport	5441	10	4

SEWERAGE WORKS.—Contract No. 3: For the laying of culvert pipes and other works in connection with sewerage works.

	£	s.	d.
Thomas Williams, Swansea	9163	0	0
Herbert Hughes, Lower Gornal	6778	0	0
George Law, Kidderminster—accepted	5897	0	0

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, April 4th.

THE copper market is in an unsettled condition. Prices are declining; stocks are heavy; negotiations are pending for heavy exports. New copper mining regions are under process of development. The market for tin, lead, spelter, and zinc is active, though transactions are small in amount, and prices firm. The movements in tin-plates are free, and a much larger than ordinary distribution is predicted by wholesale and retail dealers during the coming season. The packing interests will be heavy purchasers. The steel makers throughout the country report a steady demand for all kinds of material, excepting steel rails. Machine and tool shops and agricultural implement establishments have secured a fair volume of business, and anticipate an even run of orders up into midsummer. This activity has been stimulated by a general shading of prices for products. The iron mills are running slack. Orders are small, profits are low, and future requirements are not anticipated in any case. Locomotive establishments are ordering very little. Several are barely able to continue in operation; two have received orders sufficient to carry them three months. The Baldwin's are finishing up a few orders for exportation. The leading railway companies are pursuing a backward policy in ordering motive power and railway equipments. The returns, while showing a little improvement, are not such as to justify a liberal expenditure. Steel rails are selling in a small way at 27 dols.; old iron rails, 17 to 18 dols.; old steel rails, 15 to 16 dols.; Bessemer, 19 to 20 dols.; 20 per cent. spiegeleisen, 25·50 to 26 dols. Scotch iron is in sluggish demand. There is but little activity at the Bath, Me., shipyards, or at the shipyards of the Delaware. The demand for iron and steel which imparts positive activity to the iron trade is withheld, and there are no immediate prospects for any substantial improvement. Prices must for the present continue depressed, and demand irregular.

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

(*From our own Correspondent.*)

IRONMASTERS display some anxiety this week as to the probable issue of the Russian policy, and attention is strained to forecast the probable effect upon trade of a declaration of war. Temporary advantage would result to some interests of the district, but this would scarcely compensate for the stoppage of a portion of the trade now being received from merchants. Meanwhile the uncertainty is checking business. Merchants are indisposed to operate, as they remain doubtful whether war risks are likely to prevail at date of export. Neither raw nor finished ironmasters are prepared to book orders for forward delivery at present rates. They are convinced that, should hostilities occur, prices will go up.

'Change in Birmingham to-day—Thursday—and yesterday in Wolverhampton reflected, in a slight measure, the firmer tone of the Cleveland market. The better bar prices in the North are encouraging. Makers here would like to read in the advance the first indication of lessened competition from Middlesbrough. The export season is now fairly started, and much depends upon it. At present the outlook is not very promising. The Australian colonies are here and there distributing more orders, but the South American trade is rather depressed, and the Indian demand is unsettled.

The orders which have been received since the quarterly meetings have not been of much account, and works continue irregularly employed. Numerous mills are idle. Sheets display more activity than any other description. Lattens range from £7 15s. upwards; marked sheets are £9 to £9 10s.; Monmoor singles are quoted £8.

The demand for galvanised sheets will be improved on Australian and New Zealand account by the rains in the colonies. At present, however, the demand is considerably within the supply. Complaints are made of the continued consignments, a course which tends to depress prices on the Sydney and Melbourne markets. Competition is severe, and the leading manufacturers are only running part of their plants. Prices are very varied. While the Association figure is £11 10s. for sheets of 24 b.g. delivered Liverpool, many makers quote £11 5s., and merchants declare that they can buy at under £11. The £2 extra for sheets of 26 b.g., and the still further £2 extra for 28 b.g., is preserved as far as possible, but this is not easy.

Marked bar makers this afternoon spoke of having hardly ever experienced so quiet a time. Nevertheless, Messrs. Wm. Barrows and Sons made known that they would accept no orders at below £7 10s.

The "list" of Messrs. J. Bagnall and Sons was named as:—1in. to 6in. flat bars, £7 10s.; 3⅛in., 3¼in., 3⅜in., and 3½in., £8; 3⅝in., 3¾in., 3⅞in., and 4in., £8; 4⅛in. and 4¼in., £8 10s.; 4⅜in. and 4½in., £9; 4⅝in. and 4¾in., £9 10s.; 4⅞in. and 5in., £10; 5⅛in. and 5¼in., rounds only, £10 10s.; 5⅜in. and 5½in., £11; 5⅝in. and 5¾in., £11 10s.; 5⅞in. and 6in., £12; 6¼in. and 6½in., £13; 6¾in. and 7in., £14; and 7⅛in. and 7¼in., £15. Turning bars are £7 10s.; plating bars, £8; and horseshoe bars—"shoeing," £7 10s.

Messrs. Millington and Co. are understood to quote cable iron, slating bars, and small rounds and squares, ⅜in., at £8; best chain iron, best plating bars, and rounds and squares, ¼in., £9; rivet iron, £8 10s., £8 15s., and £10 5s., according to quality; angles, 1½in. to 3in., £8 10s., £9, and £10, according to quality; tang iron, ½in. and 7/16in., £7 10s. for ordinary, £8 10s. for best, and £9 10s. for double best. Horseshoe and shutter bar iron, 1½in. to 2in., £7 10s.; rounds and squares, 5/16in., £8 10s.; ditto, No. 5, £9 10s.; ditto, 3/16in. and No. 6, £10; No. 7, £11; No. 8, £12; No. 9, £13 10s.; No. 10, £15 10s.; and No. 11, £17 10s. Treble best bars they quote £11 10s.

Foundry pigs are selling with some show of activity to the pipe founders, but forge pigs remain dull. Stocks in the hands of native makers are growing, notwithstanding that the output is decreasing. Lower prices are reported this week than on quarter day, in respect of pigs from the midland districts. Some brands of South Yorkshire pigs are quoted 53s. 6d., delivered here. Native second-class pigs are 40s. to 42s., and third-class, 33s. to 36s. 3d., in actual business.

The house coal trade upon Cannock Chase is already largely benefiting by the South Yorkshire strike. Big orders are being received from the London market, and more activity is noticeable at the collieries than at any time since the termination of the last Black Country strike. Better prices by 1s. per ton are also being secured than those which generally regulate sales on London account.

The German ironmasters are pushing the products of their rolling mills into this part of the kingdom with increased vigour. Constructive engineers hereabouts are being offered at the present time girders and plate iron for bridge building of German manufacture delivered at prices which are less than those of local makers. And the German work has, I am told, been proved capable of standing similar tests to those which engineers impose upon native iron. This again affords a striking illustration of the advantages which the cheapness of labour and the longer hours worked upon the Continent confer upon the continental producers. In the matter of labour alone, it is stated that whereas a Staffordshire bridgebuilder has to pay his first hands in the yards at the rate of 7d. to 8d. per hour, the Germans can get the same labour at half the value. From a patriotic standpoint, it is gratifying that certain bridge builders to whom the German products has been offered steadily refuse to employ the work.

There is belief here among certain of the deep stampers that the Government are now procuring some of their stampings, such as are needed in the construction of buoys, ordnance shells, and so forth, from German firms.

A good number of contracts continue to appear in the market for constructive ironwork, foundry goods, machinery, and railway stores. The Indian States Railways are inquiring for ironwork for ballast and goods wagons, and the Manchester, Sheffield, and Lincolnshire Railway are contracting for their annual stores supply, which include axles and tires, bolts, rivets, and screws, chain iron, springs, tools, pipes, castings, and telegraph materials. The Maidstone Waterworks are requiring cast iron sockets and spigot pipes.

The Newport Gas Company, Monmouth, are about to order six purifiers, each 20ft. square, with centre and other valves and travelling lifts. The Corporation of Stafford on Tuesday accepted the tender of Messrs. C. and W. Walker for a new gas purifier. There were twenty-one tenders, the highest of which was £1075. Messrs. Walker's tender was the lowest, being £792.

A valuable machinery contract is on offer by the Rotherham Corporation for their waterworks. It is for a rotative vertical compound condensing steam engine, actuating two double-acting pumps, one under each cylinder, capable of lifting 56,000 gallons of water per hour to a height, including friction, of 200ft., at a speed of sixteen strokes per minute. Two cylindrical double-flued boilers, to work at 80 lb. pressure, are to form part of the plant.

The orders under execution for the Government keep large in several branches. The tin-plate workers are turning out, for the use of troops in India, many thousands of steel basins, camp kettles, and other stamped and wrought iron goods. This week tenders are being submitted to the War-office for heavy supplies of tin-ware and galvanised goods. Bolts and nuts and pins, to be used chiefly in the construction of soldiers' bedsteads and forms, the War-office are requiring to the extent of over 45,000. Additional quantities of axes and spades and shovels have this week been also tendered for. The pipe orders for the Soudan are being turned out so satisfactorily that an early extension of contracts is promised.

The executive of the Birmingham Local Committee for opposing the Railway Rates Bills are about to send round to all the Parliamentary representatives of Midland constituencies asking them to give personal active support to the Committee's views. They desire that on the second reading there should be as large an opposition vote as possible. Mr. Henry Wright, Birmingham, has been appointed chairman of the Gloucester Iron and Wagon Company, in place of Mr. Joseph Pyons, resigned.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—So far as the iron trade in this district, in the very depressed condition by which it has been characterised for so long a period, could be injuriously affected, it may be said that the threatening warlike complications of the past week have operated as a further check upon the weight of business being done, which, for the moment, is limited to the smallest possible dimensions. In the present uncertainty as to the ultimate issue of the existing crisis, buyers hesitate to go beyond pressing immediate requirements, as they think the outbreak of war may tend to still further weaken prices; whilst makers, who consider that they cannot possibly get any lower, whilst there is a possibility they may harden, are disinclined to commit themselves very far forward, and business will continue thus to be checked until some definite decision either as to peace or war is arrived at.

The iron market at Manchester on Tuesday was fairly well attended, but the business doing was extremely limited; buyers generally hesitated about giving out orders, and where transactions were effected they were only in small hand-to-mouth parcels. Quoted prices were unchanged from last week, but in pig iron a weaker tone, if anything, was here and there noticeable. Where buyers are prepared to give out orders for prompt delivery, they are in many cases able to obtain some concession from makers, and with 40s. to 40s. 6d., less 2½, still the quoted prices for good local and district brands delivered equal to Manchester, there would be a little giving way upon these figures where actual present business could be done. There is, however, some pushing to sell at considerably under these figures, and one or two district brands continue to be offered at about 38s. 6d. to 39s. per ton, less 2½, delivered here.

The hematite trade continues in a very depressed condition, and good foundry brands are offered at as low as 52s. per ton, less 2½, delivered here, without inducing buyers to give out orders.

In the manufactured iron trade a generally dull tone has again to be reported. The further giving out of shipping orders which were gradually coming into the market with the opening of the season has been checked, and the Baltic trade practically stopped. Prices, however, are maintained on the basis of £5 7s. 6d. for good qualities of Lancashire and North Staffordshire bars delivered into the Manchester district, and so far as north country iron is concerned, makers who have booked tolerably large orders recently are even holding out in many cases for an advance of 2s. 6d. per ton upon the very low prices which were being taken a few weeks back.

The condition of employment in the engineering trades continues to show an improvement, according to the returns of one or two of the trades union societies, and the calling out of the reserves will to some extent make itself felt, as during the long continued depression of trade a considerable number of the unemployed men in the engineering branches of industry found their way into the army. This month's report issued by the Steam Engine Makers' Society shows a moderate reduction in the number of men in receipt of out-of-work support, there being now only about 3½ per cent. on donation out of the total membership. The one bright feature in the returns seems to be a continued improvement in the shipbuilding centres, whilst private locomotive building firms are, generally speaking, full of work; but railway shops are full handed, and in some cases working short time; whilst the holidays have been utilised for extended suspensions. Tool makers are moderately employed, but engineers and millwrights are reported to be not so fortunate, especially those in mining districts, from which the statements of returns are far from cheering.

At the closing sessional meeting of the Manchester Association of Employers and Foremen, held on Saturday, Mr. W. H. Bailey, the president, offered a few very pertinent remarks with reference to the want of information frequently displayed by men who thought they were inventors. He said he was often consulted by such men, and his very first question was always—Have you made yourself familiar with the failures and the work of other men in the direction in which you are now working; indeed, have you made yourself familiar with the whole published literature on the subject? Do you know the work of the best men, and do you think yourself better than the best? If an inventor could not answer these questions it was often useless to waste further time upon him. He had especially been struck by the number of gas engine inventors who had tried to bring out engines, but who knew nothing about the various engines that were already in the market. A man who had made himself acquainted with the wisdom, the experience, and who fully appreciated the trials and the troubles of his predecessors, would, under ordinary circumstances, if he added his own experience, be more likely to do something useful than one who worked on in ignorance of what those who had preceded him had done.

The safe working of mines, with special reference to the prevention of explosions, was under discussion at the meeting of the Manchester Geological Society on Tuesday, and Mr. Hy. Hall, inspector of mines, who occupied the chair, expressed some opinions upon the subject which will be of interest to mining engineers. With regard to shot-lighting, he had long been of opinion that this ought to be prohibited in every mine giving out gas, whilst the men were down; and in the face of the now well-known fact that coal dust was so very dangerous an element when the air was even only partially charged with gas in producing a disastrous explosion, more attention would have to be paid to the watering of dry mines in the future. In fact, this dangerous element of coal dust in connection with only a small quantity of gas was one of the most important questions before the mining world, and he was afraid there would be the greatest possible difficulty in getting firemen, who had been accustomed to encounter small quantities of gas without apprehension, to fully appreciate the danger. In connection with shot lighting, Mr. Hall added that particulars which had recently been brought under his notice proved that it was not necessary that a shot should "blow out" for a working place to be filled with flame, as shot lighters had informed him that this not infrequently took place even when the shot had done its work properly; and under ordinary circumstances shots might and would light gas. The utility of the "Warnings to Colliers," published in the newspapers, was also very much questioned by several of the members, one of them remarking that they simply amounted to this: "When the barometer is rising, take care; when the barometer is falling, take care; then if anything happened from four to five days in the meantime, we told you so."

The Manchester and Salford Trades Council have passed a resolution to the effect that they view with alarm the proposal for increased terminal and other charges provided for in the Bills introduced into Parliament by the English railway companies, and they add that the trade in the country has been injured and its expansion curtailed by unequal and very excessive railway rates, which had caused the removal to some of the industries to other parts of the country, and entail great hardship upon artizans by depriving them of their work, or compelling them at great loss to seek employment in other parts of the country.

The more serious aspect assumed by the Yorkshire strike, and the prospect of a more protracted stoppage of the pits than had been anticipated, is beginning to make itself felt in the coal trade of this district, and during the past week there has been somewhat a pressure of orders from buyers who have hitherto been getting supplies from the Yorkshire collieries. This has, however, been chiefly for house fire coals; other descriptions for iron making, steam, and engine purposes still meet with only a very moderate demand. For house fire coals prices have shown an upward tendency of about 3d. to 6d. per ton upon the minimum rates which have recently been quoted, best coals now averaging 9s.; seconds, 7s. 6d.; and common house fire coals, 6s. per ton. Steam and forge coals, of which large stocks are held at some of the pits, remain at about 5s. 6d. as the full average figure; burgy, 4s. 6d. to 5s.; and slack from 3s. to 4s. per ton at the pits, according to quality.

In shipping there has been rather more activity, but prices have not shown any material improvement, 7s. to 7s. 3d. having been about the average figures for good qualities of steam coal delivered at the high level, Liverpool, or the Garston Docks.

Barrow.—There is absolutely nothing new to report this week in the hematite pig iron trade. The demand is extremely quiet all round, and very few orders have lately been booked. The value of pig iron is steady at 44s. for No. 1 Bessemer net at works, prompt delivery, 43s. 6d. No. 2, 43s. No. 3, and 42s. to 43s. forge and foundry samples. Stocks remain very large. Steel makers are fairly employed in both the rail and merchant departments. Shipbuilders have not booked any new orders this week, but they are busier than they were, and an improvement is noticeable in the engineering departments. Iron ore is in quiet demand. Coal and coke dull. Shipping quiet. There are no new engineering features of interest to note in connection with the trade of the district.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

BUYERS of pig iron have shown more readiness to purchase during the last few days, but they do not inquire for large quantities or for delivery far ahead. The probability of war between this country and Russia is hindering business considerably. At the market held at Middlesbrough on Tuesday last No. 3 g.m.b. for prompt delivery was quoted at 34s. per ton by merchants, and at 34s. 3d to 34s. 6d. by makers. In a few cases small lots have been sold by merchants at 33s. 10½d. per ton, but as a rule they will not take less than 34s. Forge iron is firmer than No. 3, owing to a certain temporary scarcity and to a somewhat improved consumption at the finished ironworks. Consumers are freely giving 33s. 3d. per ton for it. This figure is usually accepted by merchants, and by some of the makers, but there are others who ask 3d. per ton more.

Warrants are offered at 33s. 9d. per ton, but there are no transactions in them.

No change has taken place in the stock of Cleveland pig iron in Messrs. Connal's Middlesbrough store during the last three or four weeks. The quantity held is 50,832 tons.

Shipments of pig iron from the Tees are not so favourable as might have been expected for the time of the year. Only 26,837 tons were sent away up to Monday last, which is about 6000 tons less than during the corresponding portion of April last year.

The improved tone of the manufactured iron trade is fairly well maintained, and producers are not now willing to sell at the low rates which ruled a month ago. Ship-plates are £4 17s. 6d. to £5 per ton; angles, £4 12s. 6d. to £4 15s.; and common bars, £5 to £5 2s. 6d., all free on trucks at makers' works, cash 10th less 2½ per cent. Steel plates are dearer than they were, £7 per ton being about the present value, whilst steel angles realise £6 10s.

The value of goods—exclusive of coal and coke—exported from the Tees during March was £183,100, being an increase of £3730 compared with March, 1884. The value of the exports from Newcastle was £191,675 last month, which is equivalent to a decrease of £40,853 as compared with March last year.

The accountant's certificate regulating the wages of the Cleveland miners and blast furnacemen was issued last week. It gives the net average invoice price of No. 3 g.m.b. for the three months ending March as 34s. 8·3d. per ton. Consequently the wages of blast furnacemen will be reduced 1¼ per cent., and those of the miners ·16d. per ton.

A company has been formed at Sunderland to take over and extend the shipbuilding business of Messrs. J. Knox and Co., of South Hylton. Mr. J. Thompson, jun., of Sunderland, is chairman of directors, and Mr. J. Knox is manager.

A meeting of the Cleveland Institution of Engineers was held at Middlesbrough on Monday, the 13th inst. The discussion on Mr. Macdonell's paper, on "Grinding Wheat with Chilled Rollers by the Gradual Reduction System," was resumed and concluded. It was elicited that 5000 sacks of flour per week were produced by a pair of compound engines indicating 500-horse power, with a coal consumption of about 2 lb. per indicated horse-power per hour. Professor Fleeming Jenkin, of Edinburgh, then read a paper on his system of aërial tramways, which he calls "Telpherage." The paper was a development of the one with a similar title recently read before the Society of Arts. The discussion was postponed till the next meeting of the institution.

The strike which has been proceeding for nearly two years among the operative mechanics at Sunderland has just collapsed. It was supported by the Amalgamated Society of Engineers, and must have been a terrible drain upon its funds. It is estimated that not less than £40,000 was spent over it by them without gaining their object. For a time a thousand hands were receiving strike pay, but latterly that number has dwindled considerably. The principle involved was the right of the men to control the number of apprentices employed.

The goods usually imported from Russia into North-east ports consist of grain, linseed cake, manganese ore, oil, rags, hemp, tar, pitch, and wood. The exports to Russia from the same ports comprise coal, coke, chemicals, cements, fire-bricks, pig iron, lead. Of course, in case of war, this traffic will either cease for the time being or will have to be diverted into fresh channels.

The freight market seems steadily rising, and for transit to all parts; but whether the extra money is given simply to cover extra cost of conveyance and extra risk, or whether it is likely to find its way into the pockets of shipowners, is so far very doubtful.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

SOME time ago Messrs. Newton, Chambers, and Co., Thorncliffe, gave notice to their ironworkers of their intention to dispense with their services. It was considered at the time that this was done as a precautionary measure, with a view to the action of the colliers in regard to the 10 per cent. reduction. The miners having decided to strike, and, in fact, the strike being now actually in operation, the notices have been put in force. The Thorncliffe Company has close on 3000 pit hands who are now unemployed. On Monday the situation was made more grievous still by the damping down of the large blast furnaces at Thorncliffe, which are amongst the most important in South Yorkshire. They were erected in 1873, and from that time to the present have been in full operation, pro ducing between 500 and 600 tons per week of the well-known Thorncliffe brand of pig iron. The damping down of the furnaces will necessitate the stoppage of about fifty coke ovens, and thus add at least 60 men to the thousands of colliers on strike. The firm have a large quantity of pig iron in stock, which will probably enable them to meet the demands until the wage difficulty in the coal trade is settled.

The adjourned conference of miners at Barnsley, which was stated to have been the largest representative gathering ever held in any colliery district, was not open to the press, but the Union officials gave the numbers represented as 32,000 coal getters and trammers. Resolutions were passed to adhere to the determination to resist by all legal means the proposed reduction of 10 per cent. A committee was elected, along with a secretary and treasurer, to collect and disburse the money collected for non-union men. It was also decided that there should be a central strike fund, from which the strike committee pay to all non-union men out of work equal proportions of whatever might be collected from non-union men. The determination of the conference to continue the struggle appears to have been very unanimous. Each unionist receives a strike pay of 9s. a week, with an additional 1s. for every child under the age of thirteen. Many union men are single, and it is stated that the average payment is 11s. or 12s. per family. It is somewhat singular, though a fact, that not one man in four in the Yorkshire colliery district now belongs to the Union, and it is said that of the entire number now on strike—over 40,000—there are not in the South Yorkshire district 6000 of them who are unionists. It is remarkable, too, that the collieries employing the largest number of unionists are some of those where work is still continued, and non-union men are in the greatest difficulties, for they have no funds to fall back upon, and even the funds which the unionists have can only bear the strain for a very short time. Appeals to the public have resulted in no substantial assistance—in fact, there has never been a strike of the present magnitude which has excited so little interest.

In consequence of the stoppage of the pits, the price of household coal has pretty generally advanced from 10d. to 1s. 6d. per ton.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been considerable excitement in the Glasgow iron market in the past week. This has arisen partly from the crisis with Russia, and also partly from an expected reduction of output in Scotland. For the time the Russians are taking no iron from us whatever, and it is expected that in the event of war they will draw their supplies from Germany. The business done in the warrant market has been largely speculative, the advances that have occurred in price resulting covering operations on the part of bears. The pig iron shipments of the past week were unsatisfactory, amounting to 9870 tons against 7525 tons in the preceding week, and 12,981 tons in the corresponding week of 1884. Merchants state that the prospects of the foreign demand are not at all encouraging. The current production in Scotland is above all requirements, and in the past week upwards of 1200 tons have been added to the stock in Messrs. Connal and Co.'s stores.

Business was done in the warrant market on Friday from 41s. 6d. up to 41s. 11d. cash. The price further improved on Monday to 42s. 2d., whilst on Tuesday transactions occurred at 42s. 3d., receding to 42s. 1d. cash.

Business was done on Wednesday at 41s. 10½d. to 41s. 11d. cash. To-day — Thursday — the market was irregular. Business was done in the forenoon at 41s. 10d. to 41s. 9d. cash; while in the afternoon the quotations advanced to 42s. cash.

The market values of makers' iron are steady as follows: — Gartsherrie, f.o.b. at Glasgow per ton, No. 1, 51s.; No. 3, 46s. 6d.; Coltness, 54s. and 50s.; Langloan, 53s. and 50s.; Summerlee, 51s. and 46s.; Calder, 51s. 6d. and 46s. 3d.; Carnbroe, 48s. and 46s.; Clyde, 46s. 9d. and 42s. 9d.; Monkland, 42s. 3d. and 40s. 3d.; Quarter, 41s. 9d. and 39s. 9d.; Govan, at Broomielaw, 42s. 3d. and 40s. 6d.; Shotts, at Leith, 51s. and 50s. 6d.; Carron, at Grangemouth, 52s. 6d. and 47s.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 48s. and 42s. 6d.; Eglinton, 43s. and 39s. 6d.; Dalmellington, 46s. 6d. and 42s. 6d.

The makers of steel ship-plates in the West of Scotland have advanced prices 2s. 6d. a ton, bringing the figure up to £7, which is 10s. more than at the beginning of the year. There was successfully cast a few days ago at the Vulcan Foundry, Coatbridge, the first large housing for the cogging and slabbing mill of the Glengarnock Steel Works. The housing is 21 tons in weight. The new steel works are to manufacture on the basic system.

Messrs. John Elder and Co. have received an order to build other two stern-wheel steamers for the Admiralty, to be employed in the navigation of the Nile. The whole dozen steamers of this class will be finished and shipped by the firm in the course of a few weeks.

Among the past week's shipments of iron manufactures from Glasgow were thirteen locomotives, valued at £20,250, for the Indian railways; £14,800 worth of machinery, including sugar-crushing machinery, valued at £12,250, for Penang and Singapore, and a consignment of the same class of goods, worth £1500, to Demarara; £2300 worth of sewing machines; £11,700 steel goods, including £5275 worth of bridge work and £2677 rails and sleepers, for Calcutta; and £36,000 general iron manufactures for different places.

The coal trade has again been quieter this week. For Quebec some good cargoes have been despatched, but the Baltic trade is in an unsettled condition, as a result of the differences with Russia. The week's shipments embraced 13,530 tons from Glasgow, 4744 from Greenock, 1413 from Irvine, 8678 from Ayr, 7731 from Troon, and 9810 from Grangemouth. There has been a rather improved demand for manufacturing purposes, but the household inquiry is described as slackening. In Fifeshire, where the trade has been in a backward condition for a succession of weeks, a more healthy tone now prevails. Several good shipping orders have been placed, and the miners are obtaining more steady work at the collieries. At some ports vessels are more difficult to obtain, and tendency of prices is upwards.

The Shotts Iron Company has given notice that it will make a general reduction in wages on the 1st of May.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

SWANSEA looks particularly brisk at present, and at Landore there is more life than in any of the ironworks and steelworks on "the hills." In addition to the Hooghly Bridge they have 15,000 tons of plates for the Forth Bridge, and this will keep things going well for some time to come.

Dowlais, Cyfarthfa, and other leading works maintain a tolerably good appearance, although the few clearances show that trade is slow and stocks accumulating. The only good rail clearance this week has been 2400 tons to Canada.

One slightly encouraging sign is the increased briskness of the iron ore trade. This week Blaenavon, Ebbw Vale, and Tredegar received large consignments. No better time for doing this can be found, as prices are at their lowest, and so far the uneasy condition of Eastern affairs has not materially affected freights. In the event of war with Russia our iron ore trade would be sensibly affected, and the possibility of such a thing may have something to do in the improvement of the ore trade. I fancy that a little financing is beginning, as the receipts of fresh Bilbao ore at Cardiff and Newport during the last week has fallen off considerably. Fortunately, many of the ironmasters are well bought, and our own ores at Cumberland and in the Forest of Dean are not to be despised.

Men are working tolerably well at the tin-plate works, now that the holidays are ended. Trade remains much about the same. It is known that experiments are going on with a view to eliminate black spots on "steel" plates, and a report on the subject will be prepared for the next meeting at Swansea. This is an important subject, and is being watched with a good deal of interest.

Things remain quiet at Machen. At Rhiwderin a dispute has arisen about the probable stoppage. It is said, but I cannot certify, that some of the men are offering two days' work per week to encourage their employers to keep going. My idea is that it is only intended to limit the make. A meeting is announced for Saturday next at Swansea, when certain tin-plate grievances are to be discussed, such as whether mills should turn out more than 450 boxes each per week; on the possibility of workmen bettering trade; on injurious patents, their unhealthy action on workmen and on the public; and other local matters, such as Association debts. I fancy that a thorough tin-plate government, well organised, and conducted on the lines of the sliding scale by the associated coalowners, is looming in the future.

A large meeting of the Merthyr Vale colliers was addressed this week by Mr. David Morgan, miners' agent, and at the close they agreed unanimously to join the Aberdare and Merthyr Miners' Union.

In coal I have not much encouraging news to tell. Things are quieting again, and every coalowner I come in contact with says the same. House coal has had no run at all of late. In fact, for months this branch has been in a bad state, and low prices have failed to tempt business. Second-class coal, too, is weak in demand. Holders of steam and rail contracts are moderately busy, and this is all that can be said. The hardening tendency of prices has gone off, and in the face of war contingencies trade is visibly affected. Cardiff only sent away 112,000 tons of coal last week, being a falling away of nearly 40,000 tons. Newport total was 34,000 tons foreign and coastwise, and was thus also proportionately slack. Rates remain about the same, those for the Mediterranean showing, perhaps, a little more firmness. If Lloyd's "war risks" continue ascending, these will alter, and freights will show a similar tendency.

Preparations for the battle of railways and docks are rapidly completing, and a stout fight may be relied upon both with Taff and Bute Docks, and Cardiff and Monmouthshire Bills. As for Neath Water Bill, it is proceeding well. With respect to the Bute Docks, sinister efforts are still afloat, the latest being, "rumoured decline in value of Taff Vale stock." When this is enquired into, the reply is that it is thought that the purchase of the docks will hamper the Taff and depreciate its property. The absurdity of this to anyone who knows anything about the facts is such that it seems idle to adduce any argument against. I may, however, quote independent and excellent authority to this effect, that if the Bute and Taff become one, Rhymney Railway will soon follow, and the three in one will be, for the next fifty years, one of the finest paying properties in the world.

The *Times* had an article, or letter, some twelve months ago on the axles of colliery wagons, in which the writer intimated that in the infrequency of examination of such axles, as compared with passenger carriage axles, lay one fruitful cause of accident. The writer was correct; the more frequent use of colliery wagons increasing, the crystallisation of the iron is one great cause of accident, and the only cure is more frequent examination and remelting. Last week the subject was generally commented upon in the district by a big accident at Machen, on the new Caerphilly line. Here an axle gave way, and the wreck of a colliery train and great damage to the road were the results.

A new coal company has been started in the Forest of Dean—the Parkend and Fancy Collieries Company. Subscribers are from Gloucester, Ross, Monmouth, Newport, and other quarters.

COAL IN SOUTH AUSTRALIA.—It has been announced by telegram, published by the *British Australasian*, that coal, seemingly of good quality, has been struck in South Australia, near Hergott Springs.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office Officials, by giving the number of the page of* THE ENGINEER *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* THE ENGINEER *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the number of the Specification.*

Applications for Letters Patent.

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

7th April, 1885.

4212. TWIST LACE FABRICS, J. Coxon, London.
4213. SHIELD CLAMP, H. Mills, Walsall.
4214. CARTRIDGES and CARTRIDGE CASES, W. W. Greener, Birmingham.
4215. DRAWING PENS, W. L. Dennis, Birmingham.
4216. HEMSTITCHING MACHINES, J. Holroyd, Manchester.
4217. PACKING for PISTONS, H. C. Ashlin, Liverpool.
4218. FIRE LIGHTERS, J. H. Crosby, Liverpool.
4219. SMALL ARMS, G. Wilkins, Birmingham.
4220. WOVEN BAGS, &c., J. H. Kenyon, Manchester.
4221. MACHINES for PREPARING COTTON, &c., W. and W. Lord, Manchester.
4222. VALVES for HYDRAULIC and other PURPOSES, R. M. Deeley, jun., Derby.
4223. ROUNDABOUTS, R. Healey, Manchester.
4224. GUN BARRELS, T. Parker and W. Ford, Wolverhampton.
4225. TAPS, W. S. Riley, Birmingham.
4226. FIRE-ARMS, W. W. Watts, Dublin.
4227. OVENS for BAKING PURPOSES, W. F. Mason, Manchester.
4228. MANUFACTURING OXIDE of IRON, T. Bayley, Birmingham.
4229. DOUBLE HINGED BEARING BRACKET for TRICYCLES, J. Carver, London.
4230. PREPARING PERFUMED PAPER for CIGARETTE WRAPPERS, A. B. Warhurst and J. Bedford, London.
4231. SUPPLYING CUT FLOWERS with WATER, W. Morgan, Birmingham.
4232. CYCLE TIRES, T. Hill, Glasgow.
4233. APPLIANCES for GRADING the SIZES of GRAIN, &c., C. Tomlinson and J. Porter, Lancashire.
4234. PHOTOGRAPHIC CAMERAS, W. Middlemiss, Yorkshire.
4235. STOPPERS for BOTTLES, B. Harrison, Manchester.
4236. MACHINERY for ROLLING METALS, F. Finlayson, Glasgow.
4237. GAS MOTORS, D. Clerk, Glasgow.
4238. DIMINISHING CORROSION of SCREW PROPELLER BLADES, D. Johnston, Glasgow.
4239. WASHHOUSE BINS, J. Miller and C. Cameron, Glasgow.
4240. PROPELLING TANDEM TRICYCLE, R. H. Charsley, Oxford.
4241. VENTILATORS, P. M. Walker, Halifax.
4242. ASH RECEIVER, S. Jackson and A. Barber, Hyde.
4243. BURGLAR ALARMS, H. J. Allison.—(*A. W. Hall, United States.*)
4244. GAS-CHAMBERED BOTTLE OPENER, A. Wilkin, Yorkshire.
4245. FASTENING WINDOW-SASHES, &c., C. Longbottom, Bradford.
4246. BOTTLES for CONTAINING AERATED FLUIDS, D. Rylands, Barnsley.
4247. FLUSHING APPARATUS for WATER-CLOSETS, G. Crowe and W. James, Chester.
4248. PRESSURE-REGULATING VALVES for WATER MAINS, S. Alley, Glasgow.
4249. SHIPS' PUMPS, S. Alley, Glasgow.
4250. OVER-EDGE SEWING MACHINES, D. R. Dawson, Glasgow.
4251. APPLICATION of ARMOUR to SHIPS of WAR, J. McIntyre, London.
4252. VALVE GEAR for STEAM ENGINES, W. and F. Wills, London.
4253. RING SPINNING and DOUBLING MACHINES, G. Shaw, London.
4254. ACOUSTIC or MECHANICAL TELEPHONES, H. and E. Seligman, London.
4255. ANGULAR SHAPED TUBES for CASINGS BENEATH CYLINDERS, W. H. Hall and J. T. Cox, Cheshire.
4256. VIOLIN HOLDER, J. V. Bendall, Cheltenham.
4257. PRESERVING LIFE at SEA, W. P. Thompson.—(*E. and G. A. Waters, United States.*)
4258. HAMMERLESS GUNS, W. P. Thompson.—(*A. Hyde, United States.*)
4259. WASHING MACHINERY, T. White, Leeds.
4260. WASHING MACHINE, E. J. Adams, London.
4261. SULPHATE of MANGANESE, &c., A. McD. Graham, Lewisham.
4262. SEATING HORIZONTAL STEAM BOILERS, J. Edge, London.
4263. LUBRICATORS, J. E. Walsh.—(*M. Schneider, Bavaria.*)
4264. FASTENER for BRACELET, &c., J. H. Hill, Birmingham.
4265. CONSTRUCTING CABLES, J. C. Sellars, London.
4266. MINERS' SAFETY LAMPS, C. Wolf and H. Friemann, London.
4267. DELIVERING PREPAID CIGARETTES, &c., J. C. Chambers, London.
4268. CIGAR and CIGARETTE HOLDERS, B. C. and D. Cross, Stonehouse.
4269. WASTE-PREVENTING CISTERNS, W. J. and W. F. T. Rowe, Plymouth.
4270. MILLS, G. H. Lilley, London.
4271. BUTTON-HOLE ATTACHMENTS, F. W. Smith and S. S. Williamson, London.
4272. METAL PLANING MACHINES, E. P. and H. C. Walter, London.
4273. TELEGRAPHY, J. C. Ludwig, London.
4274. BI-CARBONATE of SODA, H. Gaskell, London.
4275. DOMESTIC FIRE-GRATES, T. Oakley, London.
4276. WHEELS, W. O. Aves, London.
4277. KITCHENERS, &c., J. Pearson, London.
4278. CORN and SEED-DRESSING MACHINES, S. Long, Cambridge.
4279. PACKING CARTRIDGE CASES and CARTRIDGES, L. G. Bachmann, London.
4280. VENEER, A. de B. and C. de B. d'Este, London.
4281. TARGETS, T. B. Ralston, Glasgow.
4282. JOURNAL BEARINGS, J. N. Williams, Glasgow.
4283. CONNECTING the TRACES of DRAUGHT ANIMALS to CARRIAGES, &c., C. Colombati, London.
4284. DYEING COTTON, &c., J. Barnes, Manchester.
4285. CONTINUOUS OXIDISING and DESULPHURISING ORES, G. Attwood, London.
4286. MODERATORS for ELECTRIC LAMPS, E. L. Roussy, London.
4287. COPYING TELEGRAPH INSTRUMENTS and CIRCUITS, A. M. Clark.—(*S. Percival, Denison, U.S.*)
4288. PORTABLE PHOTOGRAPHIC CAMERAS, S. C. Nash, London.
4289. MORTISE and TENON WORK, D. Waldie, Glasgow.
4290. CHROMATES and BI-CHROMATES, W. J. Chrystal, Glasgow.
4291. OILING and DAMPING YARN, S. J. Anderson-Laing, Glasgow.
4292. BELT SHIFTER and REPLACER, A. Anderson.—(*S. A. Bennett, United States.*)
4293. SLIP CARRIER for TRANSMITTING HIGH REVOLVING SPEED, S. Jönsson, London.
4294. ARCH or SPAN BRICKS or BLOCKS, P. Jensen.—(*— Steenstrup and B. Raven, Denmark.*)
4295. FASTENING DOORS, H. H. Lake.—(*La Société P. Pondra et Cie., France.*)
4296. HAND FIRE-EXTINGUISHERS, H. H. Lake.—(*G. L. Chapin, United States.*)
4297. LOCKS for FASTENING DOORS, H. H. Lake.—(*W. I. Ludlow, United States.*)
4298. ATTACHING BUTTONS to FABRICS, F. A. Smith, jun.—(*G W. Prentice, United States.*)
4299. ARTIFICIAL TEETH, S. Pitt.—(*E. T. Starr, United States.*)
4300. DIVIDING PAPER, W. P. Bruce, London.
4301. CENTRAL PIVOT GUN MOUNTINGS, J. Vavasseur, London.
4302. TOBACCO PIPES, A. M. Clark.—(*La Société Cawley and Henry, France.*)
4303. COMPOUND VALVE, A. M. Clark.—(*G. W. Appleby, United States.*)
4304. ORGANS and HARMONIUMS, J. Jones, London.
4305. PULPING COFFEE, S. Bevan, London.
4306. CLEANING and SORTING GRAIN, &c., S. Beavan, London.
4307. PENCIL-CASES, E. H. Schmidt, London.
4308. GALVANIC GAS BATTERIES, G. F. Redfern.—(*Wirth and Co., France.*)
4309. TREATING AURIFEROUS, &c., SAND, G. F. Redfern.—(*A. Clement and G. Perret, Italy.*)
4310. TRICYCLE, G. F. Redfern.—(*T. P. and J. B. Hall, Canada.*)
4311. CLOTH DRYING MACHINES, G. F. Redfern.—(*J. B. Bled, France.*)
4312. BELT FASTENER, J. Ashton and J. Rutledge, London.
4313. WASHING BOTTLES, E. Hoddinott, London.
4314. HYDRAULIC PRESS for FORGING, R. H. Tweddell, J. Platt, and J. Fielding, London.
4315. MOTOR ENGINES WORKED by COMBUSTIBLE GASES, G. Daimler, London.
4316. YIELDING COUPLINGS for ROTATING SHAFTS, R. H. Heenan, London.
4317. FORMING FEATHERING STITCHES by SEWING MACHINES, J. B. Robertson, London.
4318. MEASURING, &c., WEBS for HANDKERCHIEFS, J. Hamilton and R. Woods, London.
4319. FOLDING SHIELD for CANNON and MACHINE GUNS, R. S. M. de Ricci, East Molesey.
4320. KETTLES, &c., F. Braden, London.

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4321. WEAVING PILE FABRICS, W. Peers, Manchester.
4322. INDIA-RUBBER BOOTS and SHOES, M. Frankenburg, Leicester.
4323. COLLECTING FARES in TRAM-CARS, &c., J. Linton, Leeds.
4324. STOPPER and TAP for BOTTLES, &c., S. Bunting, Dublin.
4325. BEARINGS for AXLES of TRAMS, &c., G. W. Elliott, Sheffield.
4326. VENT TUBE, J. R. Taylor, Kingswinford.
4327. BILLIARD CUSHION IRON, J. Tufnail, Reading.
4328. PICKING MOTION of LOOMS, J. Cottrill and W. Brown, Manchester.
4329. CARDING ENGINES, R. Mellor, Manchester.
4330. RAKES, E. K. Dutton.—(*J. Sieper, Germany.*)
4331. WINDOW-CLEANING CHAIRS, W. P. Thompson.—(*A. Dormitzer, United States.*)
4332. DISINTEGRATING SUGAR CANES, &c., A. Cook, Glasgow.
4333. ORNAMENTING RUCHES, &c., E. Barlow, Nottingham.
4334. OVER-EDGE SEWING MACHINES, E. Hunt, Glasgow.
4335. EXTRACTING LEVER, J. Coster, Edinburgh.
4336. CLOSING TAP HOLES, J. Tenwick, Grantham.
4337. ATTACHING NUTS to SPOKESHAVES, &c., C. Marples, London.
4338. SELF-LUBRICATING BEARINGS, J. Greig, jun., Glasgow.
4339. DOMESTIC LIGHT LAMPS, J. Bannehr, London.
4340. COAL SCUTTLES, E. Negroni, London.
4341. WRAPPERS, E. Negroni, London.
4342. DRILLING WOOD, N. Lines, Luton.
4343. LINING STEAM BOILERS, &c., H. J. Allison.—(*Messrs. S. Dohlmann and Co., Denmark.*)
4344. WOODEN BLOCK FLOORING, J. R. Gibbard, London.
4345. LATCH LOCKS, W. K. Sidgwick and J. Day, London.
4346. SOLITAIRES, &c., J. C. Mewburn.—(*La Société H. et G. Rouze, fils, France.*)
4347. FIRE-ESCAPES, &c., G. Bray, London.
4348. POLYSEATED POLYCYCLE, J. A. Duthie, London.
4349. APPLYING TAPS to CASKS, J. Corrigan, Manchester.
4350. WET-SPINNING FRAMES, A. W. L. Reddie.—(*P. Haillez and L. G. Delandtsheer, Belgium.*)
4351. DISTRIBUTING OIL upon the SURFACE of WATER, S. Palmer and H. S. Barron, Constantinople.
4352. BRAIDING and other FLYER SPINDLES, G. F. James, London.
4353. FIELD or CAMP OVENS, J. J. Mellor, London.
4354. REFRACTION TEST, N. Lazarus, London.
4355. PICKERS for LOOMS, E. Edwards.—(*F. B. Fischer, Germany.*)
4356. BOXES or PACKING CASES, F. Myers, London.
4357. ELECTRICAL MACHINES, J. S. Williams, Riverton, United States.
4358. OPERATING ELECTRICAL MACHINES, J. S. Williams, Riverton, U.S.
4359. TRANSFORMING MECHANICAL FORCE into ELECTRIC, J. S. Williams, Riverton, U.S.
4360. CONSTRUCTING, &c., ELECTRICAL MACHINES, J. S. Williams, Riverton, U.S.
4361. HATS or BONNETS, W. R. Lake.—(*Madame V. P. Olive, France.*)
4362. MORTUARY ENVELOPE or SHROUD, A. M. Clark.—(*J. J. B. Gallerand, France.*)
4363. FIXING the CARBON FILAMENTS of INCANDESCENCE LAMPS, A. M. Clark.—(*The Electrotechnische Fabrik Cannstatt, Germany.*)
4364. LIGHTERS for the DISCHARGE of DECK LOADS, A. M. Clark.—(*J. Dunn and A. A. Howlett, U.S.*)
4365. MITTENS and GLOVES, A. M. Clark.—(*W. A. Lorenz, U.S.*)
4366. COAL CUTTING MACHINES, T. and R. W. Bower and J. Blackburn, London.
4367. BACK WASHING MACHINES for WOOL, &c., J. C. Walker, London.
4368. SOLDIER'S PORTABLE SHELTER, J. A. Young, London.
4369. ELECTRIC BATTERIES, P. Jensen.—(*W. Hellesen, Denmark.*)
4370. BRAKE APPARATUS, R. H. Lapage, London.
4371. ELECTRO-PLATING, W. R. Lake.—(*C. E. Quintallet and A. I. Mahu, France.*)

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4372. COUNTING or REGISTERING MECHANISM, W. P. Thompson.—(*T. Munnell, United States.*)
4373. WHEELS, J. Cannell, Liverpool.
4374. SAFETY SADDLE BARS, E. W. Gough, Bloxwich.
4375. BICYCLES, &c., W. Gay.—(*G. T. Warwick, United States.*)
4376. FACILITATING REFERENCE to the CONTENTS of BOOKS, A. Whalley, Halifax.
4377. HOT BLAST APPARATUS, T. W. Barber, Ulverston.
4378. DARK ROOM LAMPS, E. Marlow and H. Bishop, Birmingham.
4379. OPENING and CLOSING SASH WINDOWS, H. W. Ibbotson, London.
4380. RAISING BEER, W. I. Chadwick, Manchester.
4381. STEAM GENERATORS, J. Blake, Manchester.
4382. FIRE-ESCAPES, C. Coutts, Barrow-in-Furness.
4383. PLOUGHS, J. Hornsby, J. Money, and W. Grice, Grantham.
4384. FLAME REGULATOR for LAMPS, R. Garbett, Birmingham.
4385. VALVE GEAR of ROCK-CUTTING, &c., MACHINES, J. Clyne, Aberdeen.
4386. TUBULAR PNEUMATIC ACTION for ORGANS, C. Brindley, London.
4387. DIAGONAL HOE, J. Whittingham, Nantwich.
4388. AXLES, I. Walker and S. Brown, Rotherham.
4389. INDIA-RUBBER TOYS, S. E. Statham, Manchester.
4390. RINSING BOTTLES, &c., H. Goffe and A. C. Hands, Birmingham.
4391. AUTOMATICALLY MEASURING LIQUIDS, J. H. Johnson.—(*J. F. Riepert and C. D. Somerville, Canada.*)

4392. Raising Beer, &c., J. H. Johnson.—(*L. Morel, France.*)
4393. Shuttle Guards, N. Drake and S. Feather, London.
4394. Dials of Clocks and Watches, R. Atherton, London.
4395. Low Water Alarms for Steam Boilers, H. Wilson, London.
4396. Measuring Distances, H. P. Flavelle, London.
4397. Ventilators, J. M. Lamb, London.
4398. Making Bricks, C H. Murray, London.
4399. Design Bearing Canvas for Needlework, G. H. Hughes, London.
4400. Emery Wheels, F. W. Sturm.—(*J. Pfungst, Germany.*)
4401. Expelling Percussion Caps, J. Atherton, London.
4402. Preventing Purloining of Letters, J. G. Moxan, London.
4403. Embossed Wall and Ceiling Decorations, M. Conrath, London.
4404. Arresting Gear for Pumping Engines, M. Watson, London.
4405. Feed] Motion of Sewing Machines, C. Welch, London.
4406. Reversible Swivel Oven, &c., T. H. Fleming, London.
4407. Rotary Motor, J. Fielding, London.
4408. Hat Leather with Ticket Pocket, &c., L. Marsh and J. B. Harrison, London.
4409. Steam Engines, J. and D. Paterson, Edinburgh.
4410. Vessels, A. F. Barth, London.
4411. Self-righting Shore Lifeboat, J. Wright, London.
4412. Valves for Air and other Fluids, V. Willis, London.
4413. Securing Sliding Window Sashes, W. Pope, London.
4414. Treating Coal Dross, W. Black, Glasgow.
4415. Anti-fouling Composition for Ships, P. Denniston, Glasgow.
4416. Illustrating the Motions of the Earth and Moon, J. J. Brewer, London.
4417. Anti-friction Metal, A. Lavroff and A. Schensnovich, London.
4418. Elastic Wheel Tires, H. Barrett and J. J. Varley, London.
4419. Bakers' Ovens, W. Stein, London.
4420. Stoppers or Covers for Bottles, &c., H. L. Phillips, London.
4421. Turning Circular Rings of Wood, G. Perry, London.
4422. India-rubber Tobacco Pouches, A. Oldroyd, London.
4423. Electro-telephonic Instruments, S. P. Thompson, London.
4424. Ordnance, P. M. Parsons, London.
4425. Bottles and Jars, A. W. Birt and R. J. Foster, London.
4426. Transporting Loads by Ropes or Cables, W. L. Wise.—(*J. P. R. and P. R. Bedlington, Spain.*)
4427. Folding Tables and Seats, E. A. Clowes, London.

10th April, 1885.

4428. Swivel Shackle for Ships' Anchors, C. Boyce, Tipton.
4429. Fixing or Hanging Sun Burners, &c., T. Redman, Bingley.
4430. Safety Bicycles, S. Leek, Walsall.
4431. Solid Flame Burners, D. Russell, Leeds.
4432. Nose Bands for Controlling Horses, &c , E. K. Dutton, Oakfield.
4433. Blowers, J. H. Clark, Hewell Hall, near Redditch.
4434. Knives, J. Broome, J. Hallworth, and C. W. Foster, Manchester.
4435. Bedsteads, G. and E. Woods, Liverpool.
4436. Carbonate of Soda, C. Wigg, Liverpool.
4437. Cutting-off the Heads or Points of Rivets or Bolts, J. S Wilson, Southampton.
4438. Cooking Ranges, A. H. Oakden and W. C. Sharpe, Grimsby.
4439. Carding, &c., Machines, W. Tatham, Rochdale.
4440. Burglar and Fire Alarm, S. B. Wilkins, Edinburgh.
4441. Tiles for Stairs, W. Tapp, Bristol.
4442. Apparatus for Use in Billiards, &c., K. Beresford, London.
4443. Simplifying Writing and Reading Music, A. J. Thomas, Weston-super-Mare.
4444. Ventilating Houses, &c., D. P. Menzies, Glasgow.
4445. Loose Reed Motions, &c., of Looms for Weaving, C. Thompson, Halifax.—*9th April*, 1885.
4446. Basden's Patent Screw Stopper, C. I. C. Bailey and A. Basden, Fulham.
4447. Perforating Apparatus, J. Shelton, London.
4448. Military Ammunition Pouch, W. J. Boyes, Bishop's Stortford.
4449. Casement Stays, T. Elsley, London.
4450. Lawn Tennis Rackets, J. W. Bennett, London.
4451. Drying Ring for Oil Lamps, L. A. Groth.—(*W. Henschen and Co., Germany.*)
4452. Shaving Pot, L. A. Groth.—(*J. Fuchs and J. Schweickert, Germany.*)
4453. Railway Signalling, J. Tomlinson, jun., and A. Chambers, London.
4454. Illuminating Gratings, A. W. Lake.—(*T. Hyatt, United States.*)
4455. Winding Machines, H. J. Haddan.—(*H. H. Dignowitz, Saxony.*)
4456. Boilers, C. Heirons, London.
4457. Movable Ironclad Tower, M. M. A. Bussière, London.
4458. Damping, &c., Apparatus, P. Lawrence.—(*R. W. Peach, United States.*)
4459. Engravers' Ruling Machines, P. Lawrence.—(*T. A. Richards, United States.*)
4460. Hydraulic Presses, P. Lawrence. —(*T. A. Richards, United States.*)
4461. Lockets, J. W. Hoffman, London.
4462. Swing Lever for Superseding Steam Power, E. J. R. Baldwin, Deptford.
4463. Ploughs, W. Dewar, London.
4464. Gas Washers, A. Klönne, London.
4465. Propelling Boats by Manual Power, &c., J. Barrett, London.
4466. Surgical Appliances, W. Whitaker, London.
4467. Cricket Stumps, G. W. Frowd and P. Surridge, London.
4468. Electric Railway Systems, T. J. Handford.—(*F. J. Sprague, U.S.*)
4469. Securing Slates on Roofs of Houses, &c., B. Howetson, London.
4470. Breech-loading Ordnance, A. Noble, Newcastle-upon-Tyne.
4471. Decoration of Cakes or Tablets of Meat, F. W. Waide, London.
4472. Metallic Sleeper for Railways, H. Hodgson, London.
4473. Treating Semi-liquid Substances, E. Langen, London.
4474. Utilising the Waste Gases of Puddling and Reheating Furnaces, C. D. Abel.—(*F. C. Glaser, Germany.*)
4475. Combination Agricultural Implement, A. E. Bright and J. W. Robbs, London.

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4476. Spring Seats for Chairs, &c., S. Timings, Birmingham.
4477. Metal Shearing Machines, H. I. Knapp, London.
4478. Treating Waste Liquors, W. E. A. Hartmann, Swansea.
4479. Producing Harmony from the Ordinary Motion of the Air or Wind, C. Meier, Plymouth.
4480. Railway Signalling Apparatus, J. Beswick, Manchester.
4481. Hydraulic Packing Machinery, E. L. Bellhouse, Manchester.
4482. Expanding Engine Tubes, G. Lewis, Berkeley.
4483. Motive Power Engines, N. W. Curtis, Liverpool.
4484. Ribs and Fastenings of Umbrellas, H. J. Whyatt, Bristol.
4485. Carving of Meat, W. H. Thorne, Bournemouth.
4486. Paving Slabs, Blocks, Sinks, &c., E. Ormerod, London.
4487. Construction of Tricycles, S. H. Parkinson, London.
4488. Preventing Horses from Slipping, &c., T. H. Brigg, Bradford.
4489. Christmas and other Cards. V. Sockl, London.
4490. Mechanograph, R. Daum, London.
4491. Coupling Chain Lifter, &c., T. H. Heard, Sheffield.
4492. Grinding Machines, R. Rankin, Glasgow.
4493. Brake for Arresting Rotary Motion, L. Fish, London.
4494. Composite Projectile for Small-arms, &c., R. Morris, London.
4495. Fixing Bottoms to Sheet Metal Buckets, L. McI. Spackman and J. Chilton, London.
4496. Printing Machine, A. McC. B. Harcourt, London.
4497. Iron or like Metallic Hooping, R. Stroud, London.
4498. Coating of Metals, W. A. Thoms and H. F. Oddy, London.
4499. Metal Tubes and Cylinders, F. Elmore (F. Edward), London.
4500. External Screw Stoppering for Bottles, E. E. Hanslow, London.
4501. Exercising the Fingers, C. Debuysère, London.
4502. Lubricator, J. H. Spencer and A. Eaden, London.
4503. Interchangeable Coupling for Hose, E. Nunan, London.
4504. Smiths' Forges, T. Arscott, London.
4505. Steam and other Engines, S. Z. de Ferranti, London.
4506. Telegraphs, C. Langdon-Davies, London.
4507. Umbrella Frames, F. A. Ellis, London.

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4508. Horseshoes, A. B. Crossley.—(*A. Vanderkerken, Brussels.*)
4509. Heating Water for Baths, &c., W. Brown, Halifax.
4510. Automatic Pressure-changing Gas Governers, T. Caink, Malvern Link.
4511. Propellers for Ships, W. Welch, Portsmouth.
4512. Cramps for Flooring, &c., J. Powell, jun., Birmingham.
4513. Driving Gear for Spindles, &c., J. J. and G. P. Jaques and W. Holliday, Leeds.
4514. Multiplying Power in Screw Steamers, W. Hewson, Hull.
4515. Making Spouts for Tea-pots, &c., W. Cathcart, Kirkcaldy.
4516. Grate Bars for Furnaces, E. Whitworth.—(*F. V. Medynski, Iowa.*)
4517. Water Filters, G. Wilson, London.
4518. Compound Marine Steam Engines, G. J. Scott and J. King, Glasgow.
4519. Ventilation of Soil and Waste Pipes, J. Davidson, Egremont.
4520. Converting a Single into a Double Perambulator, A. Harvie, London.
4521. Water Waste Preventer, H. Yull, London.
4522. Shaping and Sharpening Tools, T. J. Ashton and J. J. Holtzapffel, London.
4523. Sliding Needle Guide for Knitting Machines, A. Angst, London.
4524. Preparing Grain for Use in Brewing, J. Death, jun., Cheshunt.
4525. Enamelling and Purifying Casks, J. Death, jun., Cheshunt.
4526. Enamelling and Purifying Casks, J. Death, jun., Cheshunt.
4527. Extinguishing Domestic Lamps when Upset, F. Marshall, London.
4528. Photographic Cameras, W. F. Stanley, London.
4529. Actinometer for Photography, W. F. Stanley, London.
4530. Protractors, W. F. Stanley, London.
4531. Spring Shutter for Cameras, W. L. Sarjeant, South Norwood.
4532. Treating Sewage and Polluted Water, J. W. Slater, London.
4533. Steam Engine for Raising Ships' Anchors, E. Wimshurst, London.
4534. Automatic Safety Devices for Electric Currents, R. P. Sellon, London.
4535. Velocipedes, F. Chapman, London.
4536. Fixtures and Mountings, L. Weber, London.
4537. Cleat or Grip for Holding Cord, Rope, &c., G. Huggett, London.
4538. Dental Forceps Guard, W. Lombardi, London.
4539. Roof Covering, H. J. Haddan.—(*J. Sporny and J. Zarski, Russia.*)
4540. Sample Boxes, H. J. Haddan.—(*M. A. Romroth and F. R. Wilhelmy, Saxony.*)
4541. Electric Telephony, J. G. Lorrain, London.
4542. Primary Electric Batteries, H. Mower, London.
4543. Circulating Water in Steam Boilers, A. W. L. Reddie.—(*W. Craig, United States.*)
4544. Marine Brakes for Vessels, P. A. Newton.—(*J., W. A., G. F., A. G., and E. A. McAdams, United States.*)
4545. Cartridge Cases, &c., N. and A. G. Salamon, London.
4546. Sectional Warping and Beaming Machines, J. H. Stott and I. Whitehead, Manchester.
4547. Nitrate of Ammonia Explosives, C. D. Abel.—(*F. Barbe, France.*)
4548. Lamps, A. G. Brookes.—(*R. Fritz, Germany.*)
4549 Under Garment for Infants, E. St. L. Walker, Leicester.
4550. Hand Grenades for Extinguishing Fire, W. R. Lake.—(*S. F. Hayward, United States.*)
4551. Transversely Piercing the Ends of Cigars, J. Barrett, London.
4552. Observing the Front of Travel of Row Boats by th Rowers, J. W. Barratt, London.
4553. Treating Illuminating Oils, &c., J. Roots, London.
4554. Sharpening the Knives of Reaping and Mowing Machines, G. W. Murray, Glasgow.
4555. Handles for Knives, &c., J. J. Mann, London.
4556. Preparing Alkalised Oxy-derivatives, J. H. Johnson.—(*A. Scheidel, Italy.*)
4557. Diving Dresses, W. R. Lake.—(*Société Generale de Sauvetages et de travaux sous-marins, France.*)
4558. Flat Wire Rope, R. S. Newall, London.
4559. Wire Rope, R. S. Newall, London.
4560. Finishing Pile Fabrics, S. C. Lister and J. Reixach, Bradford.
4561. Cutting Double-pile Fabrics, &c., S. C. Lister and J. Reixach, Bradford.

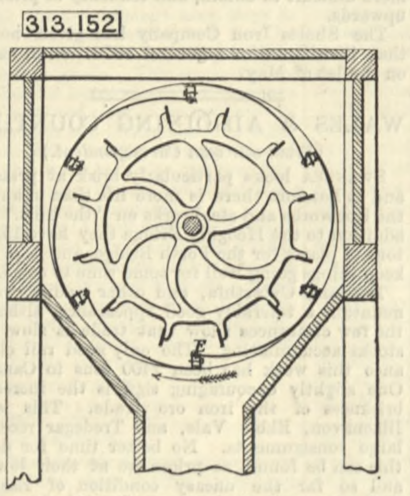
SELECTED AMERICAN PATENTS.

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

313,152. Flour Bolt, *James B. Allfree, Cumberland, Md.—Filed September 12th*, 1884.

Claim.—(1) In a flour bolt, the combination of the horizontal ribs and the cloth sections stretched from the upper edge of one rib to the lower edge of the adjacent rib, the said ribs being provided with grooves on their inclosed faces, for the purpose set forth. (2) A flour bolt comprising the ribs having the external grooves and the cloth stretched upon said ribs from the top of one to the bottom of the adjacent rib, in combination with an adjustable clamp for retaining the edges of the cloth sections in the said groove, substantially as described. (3) In a flour bolt, the combination of the cloth sections, the ribs E, and means for fastening the cloth, the ribs E having the internal channels for elevating the material to be bolted, and the outer channels in which the cloth sections are confined. (4) The combination of the ribs having the outer channel, and the cloth sections having corded edges, the said ribs being provided with screw threaded holes, and the confining strips extending parallel with the rib contained in the said outer groove and holding the edge of the cloth sections. (5) A centrifugal reel comprising the ribs, the cloth sections attached thereto and extending from

313,152

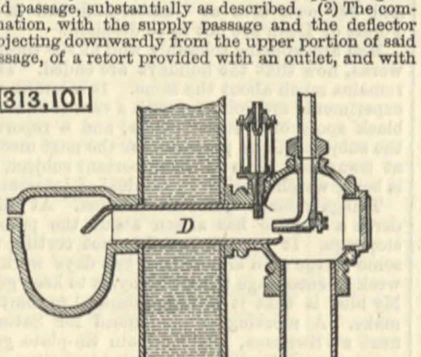


the upper edge of one rib to the lower edge of the adjacent rib, and the stretchers whereby the meshes of the cloth are held in a position best adapted for the passage of the flour, in combination with internally arranged beaters.

313,101. Hydrocarbon Furnace, *Orland D. Orvis, Chicago, Ill.—Filed January 16th*, 1884.

Claim.—(1) The combination, with the retort and the supply passage thereto, of a deflector projecting downwardly into the retort from the upper edge of said passage, substantially as described. (2) The combination, with the supply passage and the deflector projecting downwardly from the upper portion of said passage, of a retort provided with an outlet, and with

313,101

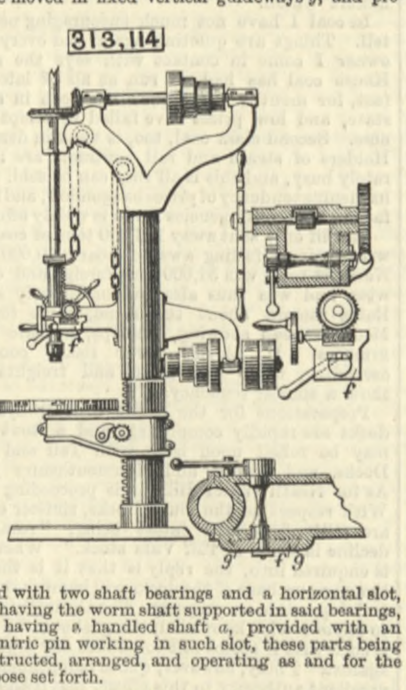


an expansion chamber extending below said outlet, and between the outlet and the opening of the supply passage into the retort, substantially as described. (3) The combination, with the injector, the oil supply nozzle, and the passage D, of the air pipe and a drip cup formed, substantially as described, below the oil nozzle, as and for the purpose set forth.

313,114. Vertical Drill, *Edwin Smeadley, Dubuque, Iowa.—Filed March 14th*, 1884.

Claim.—As a means for effecting a variable feed and permitting a quick return feed in vertical drills, the sliding head *f*, constructed as described, and arranged to be moved in fixed vertical guideways *g*, and pro-

313,114

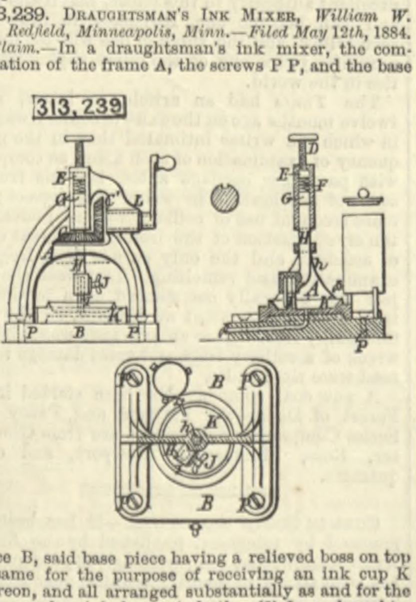


vided with two shaft bearings and a horizontal slot, and having the worm shaft supported in said bearings, and having a handled shaft *a*, provided with an excentric pin working in such slot, these parts being constructed, arranged, and operating as and for the purpose set forth.

313,239. Draughtsman's Ink Mixer, *William W. Redfield, Minneapolis, Minn.—Filed May 12th*, 1884.

Claim.—In a draughtsman's ink mixer, the combination of the frame A, the screws P P, and the base

313,239

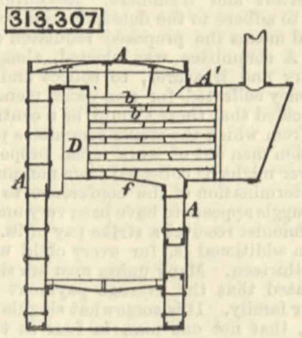


piece B, said base piece having a relieved boss on top of same for the purpose of receiving an ink cup K thereon, and all arranged substantially as and for the purposes hereinbefore set forth. (2) In a draughtsman's ink mixer, the combination of the frame A, with the shaft H, having its slot *h* and bearing the bevel gear wheel C, the pieces E and G, the spring F, the set screw D, the crank shaft L, bearing the bevel gear wheel C^1, and the set screw J, all substantially as and for the purposes hereinbefore set forth. (3) In a draughtsman's ink mixer, the shaft H, having its slot *h* and a recess at end for retaining a piece of Indian ink I, substantially as described.

313,307. Steam Boiler, *Patrick Fitzgibbons, Oswego, N.Y.—Filed August 11th*, 1884.

Claim.—The combination, with the cylindrical upright boiler A, provided with the horizontal extension A^1 and horizontal flues *b b*, as shown, of the fire-box consisting of a cylindrical shell set concentric in the

313,307

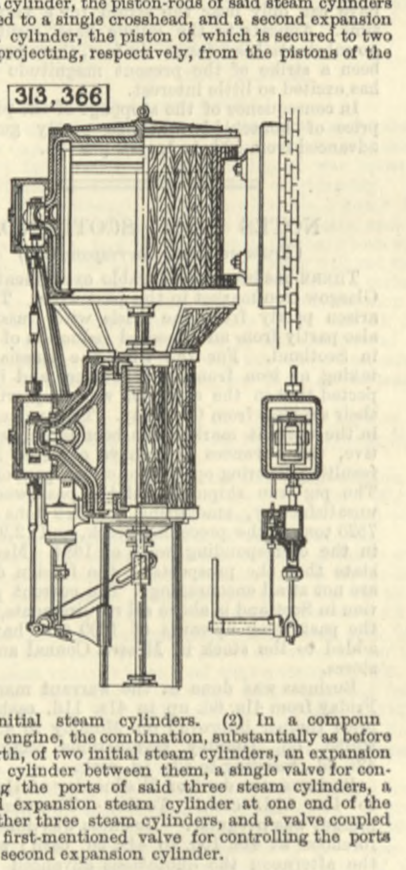


boiler shell under the flues and formed with the crown sheet *f*, the combustion chamber D, rising from one side of the fire-box, and the fire door arranged at the opposite side of the fire-box, all constructed and combined substantially in the manner specified and shown.

313,366. Compound Steam Engine, *H. Lansing Perrine, Brooklyn, N.Y.—Filed February 13th*, 1884.

Claim.—(1) The combination, substantially as before set forth, of two initial steam cylinders, an expansion steam cylinder, the piston-rods of said steam cylinders coupled to a single crosshead, and a second expansion steam cylinder, the piston of which is secured to two rods projecting, respectively, from the pistons of the

313,366



two initial steam cylinders. (2) In a compoun steam engine, the combination, substantially as before set forth, of two initial steam cylinders, an expansion steam cylinder between them, a single valve for controlling the ports of said three steam cylinders, a second expansion steam cylinder at one end of the said other three steam cylinders, and a valve coupled to the first-mentioned valve for controlling the ports of the second expansion cylinder.

CONTENTS.

South Kensington Museum.—Easter Week, Free.—Visitors during the week ending April 11th, 1885:—On Monday, Tuesday, and Saturday, from 10 a.m. to 10 p.m., Museum, 31,267; mercantile marine, Indian section, and other collections, 11,191. On Wednesday, Thursday, and Friday, from 10 a.m to 6 p.m., Museum, 6979; mercantile marine, Indian section, and other collections, 4270. Total, 53,707. Average of corresponding week in former years, 52,233. Total from the opening of the Museum, 23,910,338.