COMMERCIAL ELECTROLYSIS.

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

No. V.

Before leaving the application of electrolysis to the production of copper on a commercial scale, it is necessary to mention another large works depending on electricity as a chief agent. The Italian Copper Mining and Electro-metallurgical Company of Genoa has adopted the process for some time past at its works at Casarza, near Sestri-Ponente or Sestri-Levante. Part of the ore is smelted to a coarse metal or matte containing—copper, 34·7; iron, 38·6; sulphur, 25·3, as given by a representative analysis. Another part of the ore is roasted and lixiviated to obtain a solution containing as much copper sulphate as is required to render the ferrous sulphate of the anode available for the electrolytic decomposition of the copper salt.

The anodes are formed of the matte obtained directly after the fusion of the mineral, cast in iron moulds in plates 32in. by 32in. by 1¼in. The melting is effected in a small furnace fed by a fan, and 15 tons of ore are operated on in twenty-four hours, yielding fifty plates, each weighing 176 lb. To attach the plates to the conductor small bands of copper are cast in, and to prevent these bands when in the bath being eaten through, the liquid of the bath is kept about ¾in. below the edge of the plate. The residues from the anodes, after extraction of the sulphur, are returned to the furnace.

The cathodes are of very thin plates of red copper, 28in. by 28in. by $\frac{1}{64}$in., held in a wooden frame, and upon these plates the copper is deposited to a thickness of ¼in. By employing anodes of iron, copper, sulphur, such as ordinarily result from the first melting, the copper may be removed from the solution with an electrical efficiency comprised between 50 per cent. when there is no copper in the anodes, and of 100 per cent. where, on the contrary, there is no iron. With the use of metallic sulphides in the anodes, all the sulphur contained in the mattes may be regained in a metalloidal state. The deposit is of good quality so long as the baths contain in solution about 0·1 per cent. of copper. After exhaustion of the copper the solution contains basic persulphate of iron, proto-sulphate of iron, and sulphuric acid.

To produce the electrolyte or sulphate of copper solution very rich ores and mattes are roasted in a reverberatory furnace. The roasting is carried on so as to have more oxides than sulphates, because oxide of iron, not being soluble in dilute sulphuric acid, forms very little sulphate in the solution. Once prepared, the electrolytic solution is kept at normal strength of copper by circulation over roasted minerals. About 4 per cent. of metal is contained in the solution at the commencement, and no change is made in the solution until, from excess of iron, the deposit of copper commences to become pulverulent, and at the same time to disengage hydrogen. The baths are of wood, lined with lead, and are 6ft. 9in. by 3ft. by 40in. in height. About a dozen of these baths are required to produce 2 cwt. of copper daily. Twenty machines are employed, arranged in two batteries of ten each, and each dynamo is connected with a dozen baths, arranged in chain. Turbines furnish the motive power. Each bath is composed of 15 anodes and 16 cathodes, placed 2in. apart. The dynamos each furnish a current of 250 ampères at 15 volts.

Although, in these papers, the particular metal copper has been dealt with exclusively, it must not be considered that either the subject so far as regards this metal is exhausted, or that commercial electrolysis is confined to this metal alone. In fact, there has been touched upon only the refining of copper from the crude metal or from the prepared mineral; no reference whatever has been made to the deposits of the metal copper upon other metals, which as a process aggregates in the world many thousands of tons weekly. In this commerce copper appears a nearly indestructible material, because no sooner is the article to which the metal has been applied worn out than it can be, and is frequently, made the source of supplying this metal to a new object, similar electric currents being employed to effect its removal from the old object to the new as were used to cause its first deposition. Neither have the various applications of the electrotype process been alluded to either in regard to its use in daily printing or to its occasional employment in the replication of such massive works of art as the gates and doors prepared by Mr. Franchi for the authorities of the South Kensington Museum. All these applications are, however, more or less well known, whereas it is the aim of these papers to draw attention to those valuable and extensive commercial results that do not in the writer's experience appear to be matters of common knowledge.

This series of papers must, however, be limited to the metallurgical applications that have met with considerable application; otherwise it would be necessary to include reference to the preparation of magnesium—a method that has much promise; the preparation of pure oxygen for the oxygenation, under the pressure obtained by electrolysing the water from which the gas is produced in a confined space, of potable waters; the perhaps not so innocent improvement of wines and whisky, in which latter application a large works is being established by private hands; the preparation of pure alkalies, and some twenty other uses that have already passed much beyond the experimental stage.

To return, then, to the use in metallurgy of the electric current where commercial results have been obtained, there must be mentioned the refining of lead. This process is due to Mr. N. S. Keith, and is carried on by the Electro Metal Refining Company of New York. The lead to be refined is cast into plates and on to metallic suspension bars, which are connected to the positive pole of the dynamo machine. The bath is a solution of sulphate of lead in acetate of soda, which, under the action of the current, is decomposed, the lead being carried to the cathode—a sheet of pure lead—and the acid to the anode, where it dissolves the lead, iron, and zinc of the metal to be refined. The metals positive to lead, such as iron and zinc, remain in solution. The gold, silver, and antimony remain at the anode in the canvas bag in which this electrode is enveloped. Mr. Keith has given the following figures as the results of operating on large quantities of base bullion. With forty-eight baths, each containing fifty plates of base bullion weighing 36 lb. per plate, the production attained 10 tons in twenty-four hours, with an expenditure of 12-horse power. The plates have the following dimensions:—Thickness, ⅛in.; length, 60in.; depth, 15in. The composition of the metal before and after refining is—

	Before refining.	After refining.
Lead	96·36	99·9
Silver	0·5544	0·000068
Copper	0·315	0·0
Antimony	1·070	traces
Arsenic	1·22	traces
Zinc, iron, &c.	0·4886	0·0

The mud or slimes collected from the canvas envelopes of the anodes are dried and fused in crucibles with saltpetre and borax. The silver remains in the metallic condition, antimony and arsenic form a scoria which is treated with hot water, the arseniate of soda is dissolved and crystallised out, the antimoniate of soda is reduced with charcoal, the iron and copper are not reducible. The treatment of base bullion by the dry way costs 30s. a ton; by Keith's process Professor Barker has estimated the reduction to be effected at a cost of 10s.

These articles have extended to such length that very little more can be done than to merely make reference to the various processes of treating ores and minerals directly by the electrical way. This is of less importance as the various processes, although proposed by men of eminent standing, have not met with extended practical trial, and for this there is the sufficient reason that with such metals as copper, lead, and zinc, the cost of electrical treatment is always likely to be much too high. With the precious metals this objection will not apply, and here the electrician has before him an extensive field, especially with auriferous pyrites and the antimoniacal salts and arsenical sulphides of silver. But the proposition to treat gold, silver, and copper ores by electrical methods is of very old date. Becquerel, more than thirty years ago, proposed perfectly feasible methods, which were again brought to the notice of the scientific public in 1875 by the publication of the treatise "d'Electricité et de Magnetism"—C. and E. Becquerel. It is not here the place to give the details of processes that, however feasible in themselves, have not met with practical application even on a small scale. Yet it would be very interesting so to do, and might be of some value, were it only to prevent the so frequent repatenting of these methods. Briefly, the treatment was based on the property that chloride of silver and sulphate of lead possess of dissolving in a saturated solution of sea salt.

But Becquerel very clearly saw from the trials superintended by him at Grenelle that these electrical processes must necessarily be more costly than the processes of amalgamation and roasting commonly adopted. It is true that continuous currents were not then produced from dynamo-electric machines at the present cheap rate; but the electricity employed at Grenelle was obtained at a very small cost, too small to be the cause of economic failure of the processes.

Of the more recent processes for the treatment of gold and silver ores, that of Lambert has the greatest novelty. The ore is dissolved by nascent chlorine, obtained by the decomposition of a soluble chloride, with the aid of the electric current. A continuous subsequent treatment obtains the deposit of the metal. Polarisation of the anode is prevented by constant motion imparted to the mass of ore. The apparatus consists of baths divided into two compartments by a porous division. In one compartment is the cathode and solution from which the deposit is obtained; in the other is a plate of carbon facing the cathode, and carrying transversal divisions, also of carbon. In these divisions is placed the ore, which is agitated by a current of water.

Although electricity alone has not yet proved capable of providing means of reducing the precious metals from their ores, and may not, and certainly will not do so until better knowledge is got of the actions involved, yet as an auxiliary it is of the greatest practical value. We refer to its combination with the process of amalgamation. In America the patent electric amalgamators are very numerous, dating from 1859 and 1860. The first process to which attention is necessary was brought forward in 1869 by Nolf and Pioche, and this consisted in immersing the finely-powdered ore in a solution of salt and of sulphate of copper contained in a wooden vat or cistern, the sides of which were furnished with copper sheets to within 3in. or 4in. of the bottom. In the centre of the vat was a vertical axle carrying agitating arms covered with copper, and extending to a layer of mercury in the bottom of the vat. This mercury, by the intervention of the agitator, was connected with the negative pole of a powerful electrical source, whilst the plates of copper were connected with the positive pole. The contact of the particles to be reduced being with this apparatus of an intermittent character, the operation was very lengthy. To remedy this, Partz carried out some improvements, but eventually adopted a process dispensing with the direct treatment of the ores and employing sulphides previously chlorinated by roasting.

There must, however, be distinguished two amalgamation methods, accordingly as there are two conditions in which the gold or silver exists. In those referred to the metals are not in a free state, but are disengaged from their combinations by the electrolytic action, and the mercury might be suppressed if the deposit of metal could be made compact. Its use is, however, to fix at the negative pole those particles, which non-adherent to the electrode, would be carried away by the motion of the mass. In the processes of the extraction of metals by amalgamation, in which, either naturally or from previous treatment, the ore contains metal already reduced, the part played by the mercury is to extract this metal from the mass by solution, and to this action electricity is not necessary. It permits, however, of remedying some of the inconveniences of the process. At the contact of the different substances that contain the metal the mercury oxidises, and in this condition will not absorb the metal. The object of the use of the electric current is to produce hydrogen to reduce this oxide and render the mercury fluid. It was to produce this hydrogen, and the reduction, that Crookes employed sodium-amalgam. Barker introduced the amalgam of hydrogen with mercury by connecting this metal with the negative pole of a dynamo machine. Molloy combines not only the production of an amalgam of hydrogen, but adds others, such as the amalgams of sodium and potassium, as may be necessary to oppose the action of certain impurities of the ore. Thus the process is adapted to situations where water is scarce and where no currents of water are available. As a rule, only about 4 volts electro-motive force is necessary for these amalgamation processes, and the quantity of current required is so small that it may be economically derived from a good battery.

The remaining metal to which we shall refer in these articles, as concerned in the extension of electrolytic processes is zinc. The Lambotte-Doucet process has been applied to zinc ores at the Bleyberg mines. This process consists in dissolving the previously roasted ore in commercial hydrochloric acid, to obtain a concentrated and neutral chloride of zinc. The iron is eliminated by means of chloride of lime and oxide of zinc, being precipitated as ferric oxide. The chloride of zinc obtained is electrolysed with carbon anodes and zinc cathodes. Under the action of the current zinc is deposited on the cathode and chlorine is disengaged at the anode, by which polarisation is quickly set up and the deposit of metal stopped. The use of anodes of carbon, however, may be regarded as always entailing, with so positive a metal as zinc, a great waste of energy. This remark applies equally to Luckow's process, and to Létrange's method. Luckow directly employs the zinc ore as anode, and states that a convenient liquor for the direct extraction of zinc from blende is a solution of sea-salt slightly acidulated.

Létrange's process has been tried on the large scale at Romilly and St. Denis. Sulphate of zinc is obtained by roasting, a concentrated solution is obtained, and the metal is precipitated by the electric current from this solution. To produce 2000 tons of zinc yearly, the cost of works for the usual processes is estimated at £40,000, whilst with the use of electrolytic methods half the capital suffices. Twenty to twenty-five pounds of zinc can be produced daily per horse-power, as stated by Létrange; but M. Hospitalier disputes these figures, and states that it requires 5-horse power to produce 2·2 lb. an hour, and that theoretically 2·6-horse power are necessary to liberate 2·2 lb. of zinc. Practically, however, the writer would say no reliance can be placed on the results of any method employing anodes of carbon, on account of the unknown and difficult polarisation and secondary actions involved. The first step necessary to produce good results, and those that shall be economical, is the use of electrodes, or rather of anodes more nearly related in the electro-motive force scale than are carbon plates to zinc. The reason that carbon plates are used is that the acid of the bath, or that set free, would attack ordinary metal plates. To avoid the use of carbon plates, Kiliani of Münich treats such zinc ores as calamine with an ammoniacal liquor containing carbonate of ammonia. When the liquor is saturated, it is filtered and electrolysed with iron plates as anodes.

Were we to consider all the processes that have given successful results on a minor scale, we should have to include the production of many important chemical substances. Enough, however, has been advanced to prove the initial argument for these articles—namely, that electrolysis has a commercial value that is already of a high standard, but that its true value in the future is little appreciated.

THE NEW ORGAN IN WESTMINSTER ABBEY.

(*Concluded from page* 139.)

We will now proceed to describe the chief constructive and tonal features of the organ, the former of which are fully illustrated by our plans and elevations, and to which it will be necessary to refer as an accompaniment to our description. It will be seen by the transverse section and sectional elevation of north front, that this portion of the instrument consists of three tiers of sound-boards, the topmost of which is the solo organ—with its heavy pressure reservoir for tuba, &c.—the middle the great organ, and the lowest the reed portion of the pedal organ. Immediately below the great is a large reservoir for light wind, while there are other reservoirs for pedal reeds and north pedal flue work. The front pipes, of spotted metal, consist of double open diapason 16ft. and open diapasons 8ft. on the great organ, and these are "conveyed" off from their respective sound-boards. The three great reeds 16ft., 8ft., and 4ft. stand behind, looking into the aisle, and are somewhat heavily winded from a separate sound-board. Three of the solo reeds are enclosed in a swell-box, acted upon by a pedal at the console. In the chamber below are the 32ft. and 16ft. pedal reeds of metal, standing upon separate sound-boards. The former stop being of great size, is mitred down to about 20ft. in height, in order to prevent its appearance above the parapet, but its fine tone is, if anything, increased in value by this operation. The wind trunks here are of zinc, to ensure soundness.

If we refer to the transverse section and sectional plan at level of gallery, it will be seen that the 32ft. pedal diapasons] of wood lie prostrate along the western half of the screen. In the centre comes the choir organ of eleven stops, of which the diapason and bourdon pipes are turned over at the tops to hide them from view, in deference to the opinion of those who were afraid to interrupt the "vista" from west to east, although this theory is in opposition to received mediæval practice, and contrary to the advice of Mr. Pearson, R.A., the architect to the Abbey.

Conspicuous on the south side are the swell and remainder of the pedal organs. The swell contains fourteen stops, including four reeds, and is closely fitted to the arch enclosing it. Access for tuning is obtained by means of a central door. Under the sound-board is a large light wind reservoir, and at the back of the box, outside, are arranged certain of the pedal flue pipes. The 16ft. pedal diapason, metal, is arranged in two circular towers in front, and the remaining front pipes—dummies—are now being got ready to go in their places in front of the swell, according to Mr. Pearson's designs. The smaller stops of the pedal organ stand on their sound-board beneath the swell. In the chamber below is the staircase for the organist, and a large main reservoir of light wind for the pedal flue work and choir organ. Here, also, is a neat apparatus for supplying wind to the choir organ in case of a temporary failure of the engine in the vault. Three great wind trunks of zinc here form connection with the iron pipes coming from the cloister, and ramify, in various directions, all over the screen, both above and below the floor.

The action of the instrument, with the sole exception of the choir manual touch, is entirely on the tubular pneumatic system—an especial kind, the device of Messrs. Hill—being employed throughout. Every draw stop in the organ is connected with its corresponding slide in the sound-board by means of a metal tube, through which vibrates a column of air acting upon the pneumatic bellows which shifts the slide. The same general principle is applied in the case of the great, swell, solo, and pedal touches, which are all perfectly light and easy to play upon, whether couplers are being used or not. These tubes run in every direction along the floor of the screen, all starting from the console action, and thence mount to the various sound-board levels, where they terminate in a series of small pneumatic bellows, which act directly upon the pallets. The total length of metal tube is considerably over two miles.

The console is placed almost in the centre of the screen, towards the east side. The four claviers and pedal-board are very compactly arranged, and the draw stop jambs are inclined at a convenient angle, so that every stop can be reached with the utmost ease. The keys are of thick ivory, both for tops and fronts, while the knobs are of boxwood and ivory, sixty-eight in number. Above the pedals are arranged ten combination pedals, distinguished by red letters cut into the iron, which act upon the great, swell, and pedal stops. All the action being pneumatic, but slight effort is required to draw out the full number of stops; and the knobs themselves can be shut in by merely passing the hand over a number at the same time. There are, likewise, two extra pedals for shifting the couplers great to pedal and solo to great. The key fittings are of dark oak, contrasting well with the ivory keys and knobs. Above the solo clavier is a plate inscribed—

GVL : HILL . ET . FILIVS.
HOC . ORGANVM . LONDINI . FECERVNT.
A.D. MDCCCLXXXIV.

A distance of about 60ft. separates the bellows in the cloister vault from the reservoirs in the organ. The vault is below ground, and is lighted by a skylight in the green above. The drawings well illustrate this portion of the work. The feeders and bellows at various pressures are driven by an Otto gas engine of nominal 2-horse power, but which works at a higher power. The pulleys are driven by toothed wheels with chain gear, which prevents any slipping as in the case of belts. A wooden partition divides the engine from the feeders, and the fumes from the former are thus prevented from being sucked in by the feeders, and so driven through the sound-boards, to the great detriment of the stops. In order to maintain an equal temperature of air driven through the organ—and so keep the organ in good time—the feeders draw the atmosphere *from* the Abbey itself through the space left between the iron tubes and the brick shaft containing them, so that the air in the building is of exactly the same temperature as that passing through the pipes. This arrangement has been found to act admirably. The engine can be started in a few seconds on receipt of a signal from the organist, who is provided with a speaking tube, and the distance, of course, insures perfect silence, the blowing action being absolutely inaudible in the abbey.

The full power of the organ is immense, derived mostly from the great weight of the pedal and great organs, the former of which receives great dignity from the ponderous 32ft. reed of metal, which speaks with great promptness and decision. The solo stops are placed in a position of great acoustical advantage, being 45ft. from the pavement; while there is ample space for the free exit of sound under the new arrangements. The organ may, as a whole, be said to possess all the characteristics of the many instruments built by this old firm in the cathedrals and other important churches of this country; while they have not disdained to include in their new scheme of stops many registers which rank in *timbre* as among the best class of continental organ building.

At present no case is provided for want of funds, and it is estimated that nearly £2000 will be required in order to carry out Mr. Pearson's designs. It is hoped that some wealthy lover of music and of the Abbey may, ere long, come forward and present these cases as a gift to a Chapter whose old resources are now greatly reduced. The following is a list of the stops of this splendid organ, and we append also the account of the "opening" on May 24th in last year, which appeared in the following issue of the *Times*. The following is the scheme of stops as now carried out:—

GREAT ORGAN, CC TO A.

	Feet.
1 Double open diapason	16
2 Open diapason, No. 1	8
3 Open diapason, No. 2	8
4 Open diapason, No. 3	8
5 Hohl flute	8
6 Principal	4
7 Harmonic flute	4
8 Twelfth	3
9 Fifteenth	2
10 Mixture, 4 ranks	—

REED SOUND-BOARD (Heavier pressure of wind).

11 Double trumpet	16
12 Posaune	8
13 Clarion	4

CHOIR ORGAN, CC TO A.

	feet.
14 Bourdon	16
15 Open diapason	8
16 Dulciana	8
17 Keraulophon	8
18 Lieblich Gedacht	8
19 Principal	4
20 Nason flute	4
21 Suabe flute	4
22 Harmonic gemshorn	2
23 Contra fagotto	16
24 Cor Anglais	8

SWELL ORGAN, CC TO A.

	feet.
25 Double diapason	16
26 Open diapason	8
27 Dulciana	8
28 Salicional	8
29 Voix céleste	8
30 Stopped diapason	8
31 Dulcet	4
32 Principal	4
33 Fifteenth	2
34 Mixture, 3 ranks	—
35 Double trumpet	16
36 Cornopean	8
37 Oboe	8
38 Clarion	4

SOLO ORGAN, CC TO A.

39 Gamba	8
40 Röhr flute	8
41 Lieblich flute	4
42 Harmonic flute (In a swell box.)	4
43 Orchestral oboe	8
44 Clarinet	8
45 Vox humana	8

TUBA SOUND-BOARD (Heavy wind).

46 Tuba mirabilis	8

PEDAL ORGAN, CCCC TO F.

	feet.
47 Double open diapason, wood	32
48 Open diapason, wood	16
49 Open diapason, metal	16
50 Bourdon	16
51 Principal	8
52 Violoncello	8
53 Bass flute	8

REED SOUND-BOARDS (Heavier wind).

54 Contra posaune, metal	32
55 Posaune	16
56 Trumpet	8

COUPLERS.

57 Great to Pedal.
58 Swell to Pedal.
59 Choir to Pedal.
60 Solo to Pedal.
61 Octave Solo to Pedal.
62 Swell to Great.
63 Swell to Choir.
64 Solo to Great.
65 Swell 8ve.
66 Great to Pedal duplicate.
67 Swell Tremulant.
68 Solo Tremulant.
4 Combination pedals to Great.
4 " " Swell.
2 " " Pedal.

Two pedals to act upon couplers Nos. 57 and 64.

The stops numbered 14, 42, 43, and 45 were presented to the organ in 1872 by the Right Hon. G. Cavendish Bentinck, M.P. Nos. 21, 23, 24, 40, and 41 have been generously given by Captain C. A. Blyth, of Reading, who has likewise contributed towards the cost of No. 54. No. 16 is the gift of Mr. W. H. Houldsworth, M.P. No. 44 is given by the members of the Volunteer Sunday Evening Choir of the Abbey. £110 still remains to be raised for payment of balance on the cost of No. 54. "The famous organ of Westminster Abbey," said the *Times*, "which has been in the course of enlargement and reconstruction for the past year, was used for the first time on Sunday afternoon, at a full choral service held specially for its inauguration. The organ, it will be remembered, was originally built by Schreider and Jordan, in 1730. Many additions and improvements were made in the course of years, the last of which, just completed by Messrs. Hill and Son, has been so completely successful that the organ in its present condition may without exaggeration be called one of the finest instruments in existence. The chief features of the new organ—for new to all intents and purposes it is—were fully described in the *Times* some months ago, when the scheme of stops, amounting altogether to sixty-eight, was specially mentioned. It will suffice briefly to recapitulate that the organ is built at the two extremities of the screen, in the centre of which the organist is seated at a separate console. He is thus enabled to obtain a view of the singers below, and, what is of the utmost importance, to hear the effect of the different organs arranged north and south of him, as he strikes each manual. The connections between the console and the sound-boards, as regards draw-stops, manuals, and pedals, are by means of tubular pneumatic action. The main bellows, situated in a vault in the cloisters, and driven by a gas engine, convey the wind by means of three iron pipes to eight reservoirs, which are in immediate connection with the sound-boards. The idea of gas engines and iron pipes in connection with the shrine of Edward the Confessor may at first sight seem incongruous; but the entire mechanism is of course hidden from view, and, moreover, the absolute gain in beauty of sound would be sufficient to appease all sentimental regrets of this kind. The full power of the instrument is of the grandest effect, and anything more suave and mellow cannot be imagined than the stops of the solo organ, comprising gamba, three varieties of flute, oboe, clarinet, and *vox humana*.

"Such are the intrinsic virtues of the new instrument. As yet its external appearance leaves much to be desired. Seen from the western end of the church, where, by the way, the tonal effect of forte passages may be heard to greatest advantage, a bundle of pipes ascends above each side of the screen in hideous baldness. The reason is want of funds, the Chapter having expended all the money in hand, as well as considerable contributions from private individuals, upon the mechanism and pipes. Subscriptions are therefore urgently solicited for the completion of the cases, which, as designed by Mr. J. L. Pearson, R.A., will cost at least £1500. It would be well if these designs could be exhibited, so that the public might be able to see for what manner of ornament they are expected to pay their money. For it must be remembered that these cases, the topmost canopies of which will reach to the triforium of the church, will form a conspicuous architectural feature in the Abbey. The musical celebration on Saturday afternoon was of more than common interest, the choral portions being almost entirely made up from the works of Abbey organists, beginning, chronologically speaking, with the great Henry Purcell, whose anthem, 'O sing unto the Lord,' was the most important feature of the service, and winding up with a tuneful Magnificat in G, by Dr. J. F. Bridge, the present organist. That excellent artist was intent upon showing the new instrument in its most favourable light. The accompaniments to the chorus and responses were marked by discretion, and each of the voluntaries was made interesting by that feeling for tone-colour in all its varieties which enables the skilful organist to reproduce the most delicate and most powerful effects of an entire orchestra. As the concluding voluntary, Dr. Bridge had chosen Bach's Toccata in F, which was played in admirable style, the intricate contrapuntal tracery of the great master's design standing forth with graphic distinctness. An interesting selection of organ music, played after the service, comprised specimens of all styles, from an 'Ave Maria' attributed to Arcadelt, the Netherlandish master of the sixteenth century, down to a fantasia by M. Silas. We should add that the Abbey choir acquitted itself in a very creditable manner, the soprani and countertenors being of special excellence. The amount of tone produced under skilful management by the last-named artificial quality of voice, which survives in English cathedral choirs, is truly remarkable."

ELECTRICAL ENGINEERING AT THE INVENTIONS EXHIBITION.

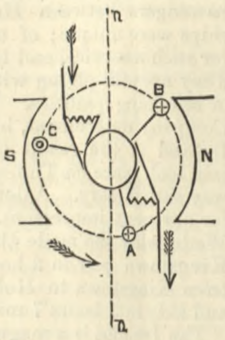
No. XII.

In our last article we had occasion to make some remarks about the inconvenience resulting from a too strict adherence to any special system; yet the Thomson-Houston exhibit we cannot describe otherwise than by referring to the system as a whole. Lest readers should accuse us of inconsistency, we hasten to remark that our criticisms were directed against those systems which try to be elastic, but from their very nature are rigid, and thus cannot be adapted to new requirements. The Thomson-Houston system is, on the contrary, extremely elastic and applicable to all possible requirements of arc lighting, and even to incandescent lighting on a limited scale. Nay, this flexibility is the very essence of that system, and it is therefore but right that we should consider and describe it in its entirety.

The Thomson-Houston dynamo is a most remarkable machine, not only because in external shape it is so very unlike any other, but chiefly on account of its electrical features, which differ in almost all essential points from what is generally considered good practice in dynamo engineering, and which are in some cases even directly opposed to our customary notions. In spite of this the machine works admirably well, and is only another illustration of the old saying that practice is better than theory. It is doubtful whether there is at the present moment any electrician in England who thoroughly understands the working of this dynamo, and if we may judge by what has appeared in our contemporary, *La Lumière Electrique*, it is even doubtful whether the inventor himself can satisfactorily explain some of the peculiarities of the machine. Although a great deal has been written concerning the Thomson-Houston dynamo, no quite satisfactory or even approximately correct explanation has as yet appeared in any scientific journal, and we will at once confess that we ourselves are as unable as our contemporaries to solve the mysteries. We shall content ourselves with describing the general principle of the dynamo, and to give such explanation of its working as comes within the scope of practical engineering; but as to the deeper theoretical questions involved, we will leave them to be solved at some future time by whoever is able to do it.

We illustrate this dynamo in a perspective view, Fig. 1, and in side elevation, partly in section, in Fig. 2. Fig. 3 is a longitudinal section through the armature. Its core consists of two cast iron circular plates S S, the outer rims of which are recessed for the reception of bridging pieces *d d*. Wooden pegs J are fixed at stated intervals into this inner shell, by which the winding of the copper conductor is facilitated. The magnetically active part of the core is a coil of soft iron wire—oxidised and varnished in order to insulate it—wound over the bridging pieces, so as to bring up the outline of the core approximately to the form of an ellipse. After insulating this core with thick varnished paper—fibre being considered as too untrustworthy for high electro-motive forces—the copper conductor is wound upon it, the direction of winding being parallel to the spindle, similar to that employed in the Siemens armature. As a natural consequence, the radial depth of the winding is greatest nearest the axis and least over the iron wire, thus giving to the armature an approximate spherical form. By properly choosing the proportions of the core and winding, the armature can be made to be a true sphere when finished. The field magnet cores are short hollow cylinders of cast iron, provided at one end with an external flange for connection to the yoke bars *b*, and at the other with an internal spherical pole piece, as shown in our illustration Fig. 2. The exciting wire is coiled round these two cylinders in the same direction, whereby opposite polarities are produced in the two pole-pieces. The central portion of each pole-piece is cut away, so as to facilitate ventilation. This can have no detrimental effect on the distribution of magnetism; the central portion, being shielded from the influence of the magnetising coils by the surrounding cylinder, would in any case be only a useless mass of metal. The exciting coils magnetise not only the cylinder directly, but also the bars which join the two external flanges, and which must be considered as the yoke of the magnet. In this respect the machine is similar to that of Hochhausen, where the extremities of the two magnets are also joined by iron webs which complete the magnetic circuit. If the bars are not arranged to come so near to the surface of the cylinder as to cause serious leakage of lines, the arrangement has the advantage of producing a strong and compact field with a comparatively small weight of metal.

The armature contains only three coils, which we shall call A, B, C, and which are wound as follows:—The first half of coil A is wound, the starting end being left near the axis and free. To this is joined the starting end of coil B, and the first half of it is likewise wound. The starting end of coil C is joined to the two others, and the whole of coil C is then wound. Coil B is next completed, and then coil A, which finishes the winding. The three finishing ends of A, B, and C are brought out through the hollow spindle and attached to three segments of a commutator, each a little less than 120 deg. long, so as to leave an insulating air space between adjacent segments. The object of winding the coils in the manner above described is to obtain a perfect mechanical and electrical balance between them, a point which was also found to be necessary in other machines, and the importance of which is the greater the smaller the number of coils. Thus we find that a similar system of winding the coils by halves is used in the Weston machine, which has generally only eight coils; but in this case, where only three coils are employed, it is of the utmost importance that each coil should get its fair share of the work. Since diametrically opposite points on the same turn of wire pass always before poles of opposite sign, the electro-motive forces created simultaneously in those portions are of opposite direction as regards a fixed point in space, but of the same direction as regards the coil itself. In considering the action of the machine, it will therefore suffice if we substitute for each coil one half turn, starting from the point of connection common to all the coils, and ending at its commutator plate. The effect of this arrangement would not be different in general character from that of a complete armature, but, of course, the electro-motive force developed would be proportionately reduced. Let in the annexed sketch A, B, C, represent the three wires revolving between the poles N S in the direction of the arrow, and assume that the lines of force pass straight across from pole to pole without being disturbed by the armature. In this case the line *n n* will be a neutral line, and no electro-motive force will be created in any of the wires whilst passing it. To the right of that line the electro-motive force will be directed towards the commutator—that is, upwards through the surface of the paper—whilst to the left of the neutral line the direction will be from the commutator, or downwards through the surface of the paper. To make this clear in our illustration, we denote the former direction by a cross placed into the little circle representing the wire, and the latter by a dot. On each side of the neutral line there are fixed two brushes forming an angle of 60 deg. with each other, and being in metallic connection as shown. The current enters the armature by the brushes on the left and leaves it by those on the right, as indicated by the arrows. Since the commutator segments form an arc of nearly 120 deg., it will be seen that A is placed in contact with the lower positive brush as soon as it has passed through the neutral line, whilst B only leaves the upper positive brush a moment before it reaches that line. The two wires are therefore connected in parallel for nearly a sixth part of a revolution, whilst C is connected in series with them. When B has passed the neutral line it is parallel with C, and A is in series with them. The next moment C and A are parallel and B is in series, and so on. The action of this armature bears a strong resemblance to that of a double-acting three-throw pump. When the first piston is in the middle of its stroke, and giving a maximum of water, the two others are near the end of the stroke and contribute only little to the yield, and whilst the first piston gets near the end of the stroke the second approaches its position of greatest velocity, thus rendering the stream delivered from the pump fairly uniform. The same with this dynamo. Although there are only three coils, the current given by the machine is fairly steady; but there is another reason which tends to efface to a great extent any pulsation the current may receive from the armature. This is the electro-magnetic inertia of the field magnet. An electric current, especially if circulating in a helix round an iron core, has a kind of inertia by which it opposes any sudden changes in its strength or direction, in the same way as the fly-wheel of an engine opposes any sudden changes of speed. It is impossible to stop a fly-wheel suddenly; even if we were to attempt this by throwing a crowbar across its spokes, the breaking of the wheel or other deformation would still occupy a certain time, during which the stored-up energy is expended. The same takes place with a current. If we try to interrupt it suddenly, an arc is formed by which its energy is quickly yet gradually spent, or if the arc does not suffice for the spending of this energy during the time required for the separation of the points between which the arc is formed, a discharge will take place in some other place across the insulation, destroying the same.



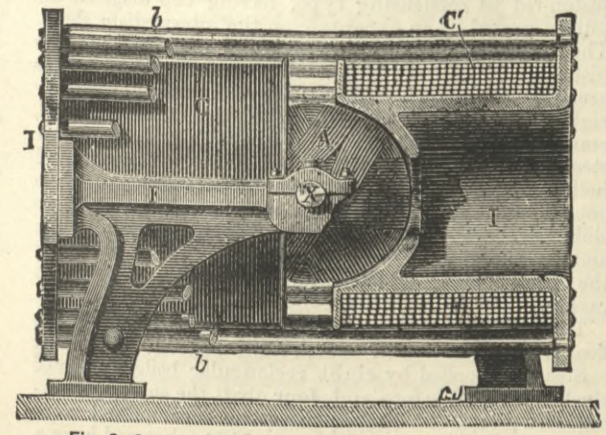


Fig. 2—Sectional Elevation, Thomson-Houston Dynamo.

This quality of a current of resisting any sudden change is most valuable in the Thomson-Houston machine. As will be shown presently, the regulation of the output of the machine is effected by periodically withdrawing the electro-motive force of the armature from the external circuit for longer or shorter intervals, and were it not for this law of electro-magnetic inertia the external current would become jerky and quite unsuitable for purposes of lighting or transmission of power. Electro-magnetic inertia plays also an important part in the armature itself, preparing each wire, so to speak, for the current which will be generated in it as soon as it has passed the neutral line, and yet preventing any undue amount of back-flow of current through a wire being in a weak part of the field, but for the time being coupled parallel with a wire in the strong part of the field. This action is of sufficient importance to merit being considered somewhat more in detail. If, as we supposed above, the field is absolutely symmetrical in respect to the neutral line, the electro-motive forces in A and B will be equal the moment these wires are equidistant from the neutral line. A moment later, when A has advanced into a position where its rate of cutting lines of force is greater than before, the wire B will have come into a position nearer the neutral line, where its rate of cutting lines is less than before, and consequently the electro-motive force in A will be greater than that in B. If there were no electro-magnetic inertia in B—or, as it is also called, if coil B had no self-induction—the excess of electro-motive force in A would simply be used up in urging a local current up through wire A, out by the lower brush, thence along the metallic connection to the upper brush and down wire B, this current being quite useless as far as the external circuit is concerned. Nay, more, the external electro-motive force would for the time being become reduced almost to that produced in wire B. In reality, however, this is not so. The wire B, although of lower electro-motive force than A, is able by its inertia to resist for a certain time the current which A tries to force back through it. The resistance can only last a very short time, after which, figuratively speaking, B would be overpowered by A; but the time during which the two wires are coupled parallel is also exceedingly brief. In a machine making 850 revolutions a minute it would only require about $\frac{1}{170}$ part of a second for the wire B to move from a position where it is equivalent to A to the position in the neutral line where it is already disconnected from A. Small as this interval of time may appear, it is probable that it suffices for the creation of some, though not a very large back current in B. When this wire arrives at the neutral line there will be a current in it directed downwards, that is, in the same sense as that flowing in C, with which it will be coupled parallel a moment later. At that instant B will still be close to the neutral line, and there will be no electro-motive force as yet created in it. Yet this wire is coupled parallel with wire C, in which there is a strong electro-motive force downwards. Were there no inertia in the coils B a strong local current would be forced through this coil, starting from the common junction with C and A, and directed up through B, out by the upper negative brush, in again by the lower negative brush, and down through C to the starting point. But we have seen that the wire B has, before entering the negative part of the field, been provided with a downward current, which has a certain inertia, and thus is able to offer opposition to the other current which C tries to send up through it. By the time this opposition could be overcome the wire B itself has passed into a strong part of the field, and has thus become the seat of electro-motive force. A moment later C enters the weak part of the field, and is charged by B with an upward current preparing it for the entrance into the positive part of the field, and so on. It cannot, of course, be expected that these interactions take place with mathematical precision, and that the forces be balanced to a nicety. Such perfection could not be attained in a dynamo intended for a variable output, and subjected to variations of speed which are almost inseparable from the use of steam engines. It is therefore necessary to make provision by which any want of balance in the interaction between the coils just described may be rendered harmless. For this purpose Professor Thomson has fitted to his dynamo an air blast, giving a puff each time a section of the commutator leaves its brush, thus extinguishing at once the spark which is formed. It is probable that without the air blast the machine could not work at all. If the brushes were always kept 60 deg. apart, as here described, the electro-motive impulse given by the armature, although periodically varying in strength, would never be completely withdrawn from the external circuit. But for purposes of regulation, the angle between the brushes is more or less increased, this causing each segment of the commutator to bridge for a longer or shorter time across from the positive to the negative brush. In this case, if B has arrived at the neutral line, its segment will be still in contact with the upper positive brush, and at the same time it will be in contact with the upper negative brush. The up current generated in it can at this moment either go to the external circuit in the usual way, or it can flow through segment B directly to the negative brush and down wire C. For the time being the armature is therefore in parallel connection with the external circuit, and its electro-motive force is apparently withdrawn from it. The external circuit continues to be supplied with current, nevertheless, by reason of the electro-magnetic inertia of the field magnets. A moment later the short circuit of the armature is again broken by segment B having left the upper positive brush, and the electro-motive force of the armature is again inserted into the circuit, giving the current a new impulse. The duration of each impulse depends upon the angle between the brushes. If it be 60 deg., the duration of each impulse will be one-sixth the time required to make one revolution, and as there are six impulses per revolution, we can say that the electro-motive force is continuously on. If the angle between the brushes were increased to 120 deg., leaving only 60 deg. between the positive and negative brushes, the short circuit of the armature would never be completely broken, and the duration of each impulse would be nil. With intermediate angles the duration of each impulse varies between these limits, and since the average electro-motive force in a circuit depends on the mean value of electro-motive impulses in unit time, it follows that by suitably varying the angle of the brushes any electro-motive force between zero and maximum can be obtained. This variation of angle is accomplished by means of an automatic regulator which is worked by the main current. It would occupy too much of our space to describe this apparatus in detail, but we can explain its main features with a few words. It consists of an electro-magnetic relais inserted into the main current, and a larger electro-magnet, the armature of which works a system of levers by which the angular position of the brushes is controlled. The levers are arranged in such a way that the leading brushes—shown somewhat longer in our sketch—are advanced at one-third the rate at which the rear brushes are pulled back. The relais is set by means of an adjustable spring for a constant current—generally 9·6 ampères—and if that should be exceeded its armature is pulled up and breaks contact between a carbon resistance and one branch of the main line, the other branch being permanently connected with the terminals of the electro-magnet. In consequence of interrupting that part of the main current which ordinarily flows through the carbon resistance, the whole goes now through the electro-magnet and causes its core—which is of parabolic shape so as to produce as much as possible a uniform pull—to be attracted, whereby the brushes are shifted. An air dash pot is attached to one of the levers in order to prevent over regulation. This system of regulation is one of the chief merits of the Thomson-Houston dynamo, for by it the inventors are able to vary the resistance of the external circuit at pleasure by inserting more or less arc lamps, groups of incandescent lamps, or even motors in series, without having to trouble about the dynamo. That can take care of itself very well. The current given by the machine is also independent of slight variations in speed, or in the steam pressure, the automatic regulator instantly rectifying any tendency to an alteration in the strength of the current. It is therefore possible to obtain a steady current from this dynamo even if it should be worked off the main shafting in a mill, which might sometime have an irregular speed, or off a steam engine with imperfect governor, provided there be always power enough to prevent the speed falling below a certain minimum.

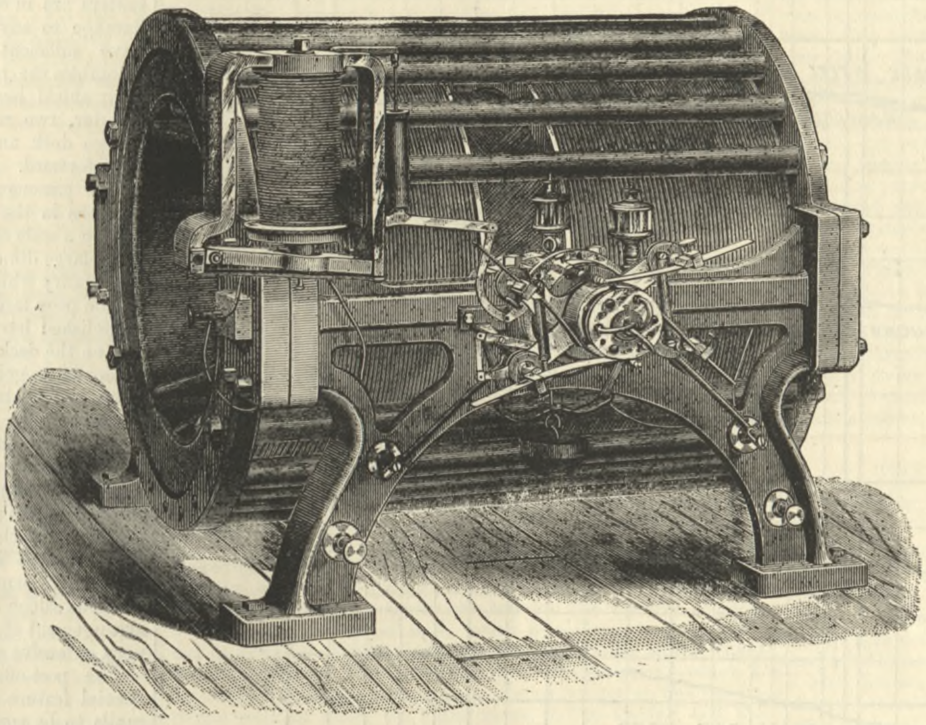


Fig. 1—The Thomson-Houston Dynamo.

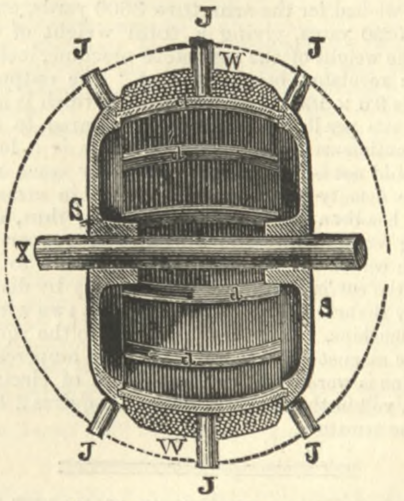


Fig. 3—Section of Armature.

Our readers might perhaps ask, Whilst all this perfect regulation goes on in the external circuit, what becomes meanwhile of the armature which is periodically short circuited six times during each revolution? Our answer, like that of everybody else who has investigated this subject, is that we do not know. It may be that self-induction in a manner somewhat similar to that already described steps in to prevent any excessive local currents in the armature coils, or, what is more likely, it may be that fairly strong local currents are indeed created, but tilt the neutral line to such an angle that short circuiting becomes almost harmless. Our assumption of a neutral line standing rigidly midway between the two poles is never realised in practice, since the neutral line is always that resulting from magnetisations nearly at right angles to each other — that of the field magnets called the primary field, and that of the armature current called the secondary field. In most modern continuous current machines of the Gramme or Siemens type, the field magnets are so powerful, and there are so few turns on the armature, that the secondary field has hardly any influence on the primary field, and the neutral line is only tilted by a very few degrees. In the Thomson-Houston dynamo, however, there is a comparatively weak primary field and a strong secondary one, which would tend to tilt the neutral line considerably. Indeed, the illustrations in the article in *La Lumière Électrique*, which has been compiled from notes furnished by the inventors themselves, show the neutral line inclined at an angle of 45 deg. The result of this would be to considerably weaken the resultant field and to make periodical short circuiting of armature coils by far less dangerous than is generally considered.

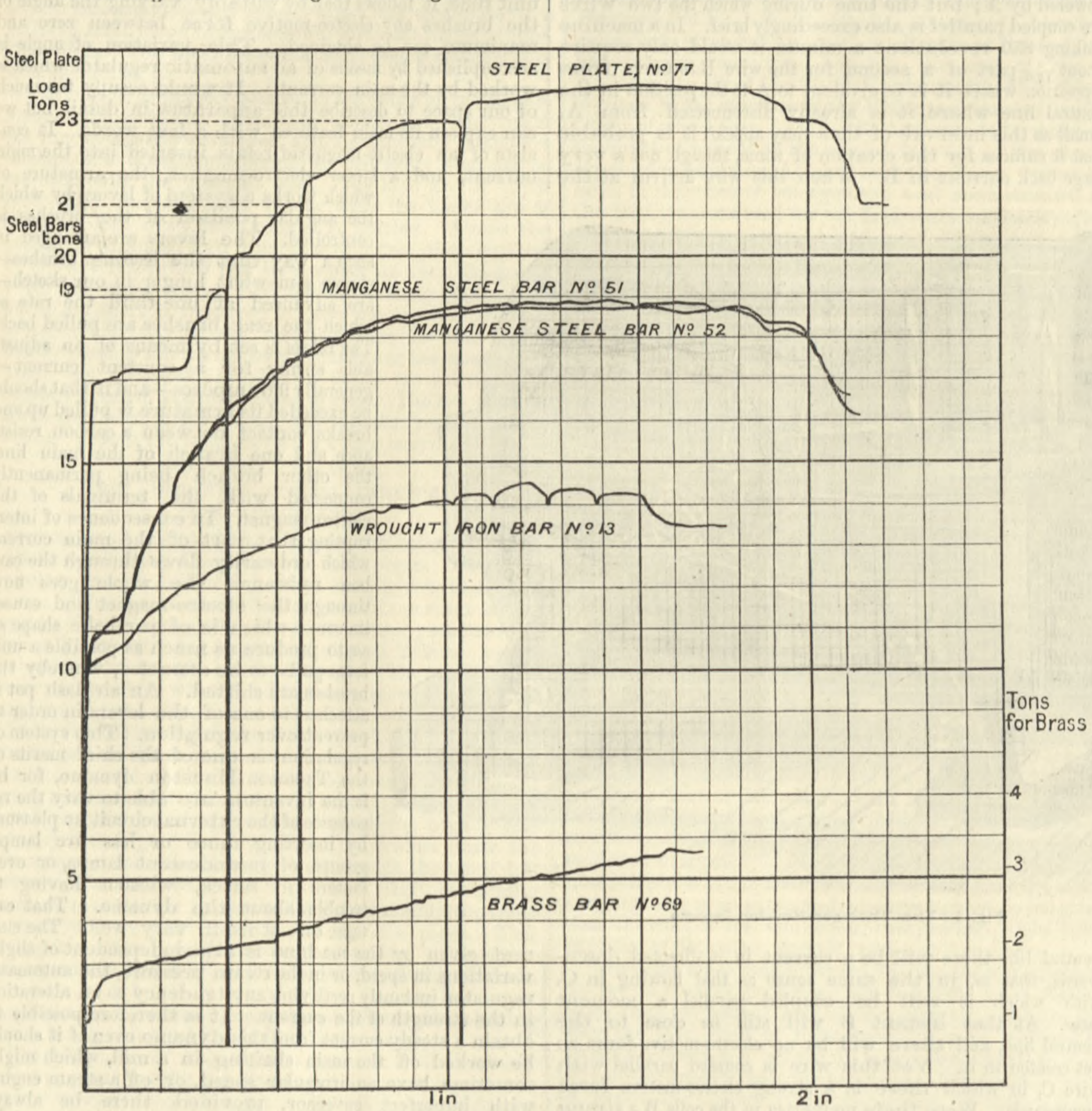
The electrical data of the thirty-five light machine are as follows:—Current, 9·6 ampères; external electromotive force, 1600 volts; speed, 850 revolutions per minute; average resistance of armature, 10·5 ohms, or 6 ohms for each coil; resistance of field magnets, 10·5 ohms. The armature is a sphere 23in. external diameter, and is wound with ·081 wire; the magnet coils consist of ·128 wire. Calculating from these figures the length of wire required, we find for the armature 3600 yards, and for the magnets 5250 yards, giving a total weight of copper of 980 lb., the weight of the complete machine, including the automatic regulator, being 31 cwt. The output of this machine is 9·6 × 1600 = 15,300 watts, which is at the rate of 15·6 watts per lb. of copper. Compared to the usual type of continuous current dynamos this is a low figure; but it should not be overlooked that, for some reason or other, the density of the current both in armature and field coils has been fixed extremely low, thus, of course, increasing considerably the amount of copper required. Since each coil of the armature has in turn to carry the whole of the current, we find the density by dividing the current by the area of one wire only, not two wires as in a Gramme machine. It is 1750 ampères to the square inch, that in the magnet coils being only 760 ampères. When the machine is working at its maximum of electro-motive force each volt in the external circuit requires 2·4 yards of wire on the armature.

AUTOGRAPHIC STRESS AND STRAIN DIAGRAMS.

By Professor W. C. Unwin.

For a few years past attempts have been made to render the testing machine for iron and steel self-recording, the machine tracing out an autographic diagram the ordinates of which are proportional to the loads and the abscissæ to the extensions of the specimen under test. Such a diagram, though necessarily less accurate than measurements made directly, is extremely convenient and useful, and has the advantage of being a continuous record. The point at which breaking down occurs, the manner of breaking down, the point of maximum load and the work done in breaking the bar, are very conveniently ascertained from such a diagram. The first autographic apparatus was that attached by Thurston to his torsion machine. Some hundreds of diagrams taken with this apparatus are given in the "Reports" of the United States Testing Board. But the tension diagrams in those reports are plotted from measurements. Probably the first apparatus for recording autographically a tension test was that of Polmeyer, which the writer saw at Dortmund in 1883. But Fairbanks and other American testing machine makers have constructed autographic apparatus for tension tests, and Mr. Wicksteed has shown an apparatus of this kind at the Inventions Exhibition.

The writer designed an apparatus for autographically recording tension tests in January, 1883. That apparatus takes a diagram 2ft. square. He has since constructed a smaller and handier apparatus with which the records shown in the figure were taken. The figure gives four out of the first six diagrams taken, and also a subsequent diagram showing the effect of repetition of loading. The movement of the pencil vertically is taken directly from the weight which loads the specimen, and hence the record of load is absolutely exact. The horizontal movement of the pencil which records the extensions is effected by means of a very fine wire, as in the Polmeyer apparatus, but with a modification permitting the extensions to be doubled or increased in any convenient ratio. From simultaneous measurements on the bar the writer believes that



PROFESSOR UNWIN'S AUTOMATIC STRESS DIAGRAMS.

the error in the record of extensions by this method does not exceed in any case $\frac{1}{100}$in. The diagrams shown were inked over for photographing, and hence the lines are much coarser than in the original diagrams.

The diagram shows two separate tests of manganese steel bars, the diagrams having been superposed by the engraver; one of a wrought iron bar; also one of a brass bar, with an enlarged scale of loads. This bar broke at the neck with very little local contraction. During the plastic or imperfectly plastic stage any pause in moving the weight is registered by a notch in the diagram. The bar extends during the pause, and at the same time its rigidity increases. Consequently after a pause the curve rises more steeply. In the diagrams shown pauses were made for the purpose of obtaining check measurements. During the last stages of the test the movement of the weight has sometimes to be reversed to keep the lever floating. There is no difficulty, with a little skill, in keeping the lever floating throughout the test. The diagram for the steel plate shows the effect of taking off and re-imposing the load. During the removal of the load the pencil traces an absolutely straight line, slightly inclined to the ordinates, and retraces the same line perfectly when the load is again imposed. The rise of the line to a new breaking down point greater than the greatest previous load, first noticed by Thurston, is well shown. But the writer does not get the kind of hummock, with a subsequent fall of load, shown on some autographic diagrams, and he believes this is due to the inertia of the testing machine. The rise of the breaking down point after taking off the load to a point above the greatest previous load is probably similar to the effect of a simple pause, during which the rigidity increases. It is not the same thing as the elastic after effect investigated by Bauschinger.

THE CITY OF DUBLIN STEAM PACKET COMPANY'S NEW MAIL STEAMER IRELAND.

We illustrate this week the City of Dublin Steam Packet Company's new mail steamer, the Ireland, constructed by Messrs. Laird Brothers, of Birkenhead, to ply between Holyhead and Kingstown. Some twenty-five years have elapsed since the City of Dublin Steam Packet Company had four steamers — the Leinster, Ulster, Munster, and Connaught—constructed to carry mails and passengers between Holyhead and Kingstown. These ships were unique; of unsurpassed dimensions and speed for such a service, and have been in every way successful. They are still plying without abatement of speed, comfort, or sea-going qualities. The City of Dublin Steam Packet Company determined, however, to add to its fleet, and the Ireland is the result of this determination. Her trial trip took place on Thursday—yesterday—and was in every way satisfactory. A detailed account of it we must reserve for our next impression. We may, however, note that on Wednesday she made the passage from Holyhead pier to Kingstown pier in 2 hours 58 minutes, and yesterday ran from Kingstown to Holyhead against a strong head wind and tide in 3 hours 7 minutes.

The Ireland is a magnificent specimen of naval architecture, graceful as a yacht, with finer lines than probably any sea-going steamer yet built, and of dimensions and power far surpassing any vessel ever turned out for similar service. She has a length over all of 380ft., or between perpendiculars of 360ft., with 38ft. beam, and a depth in hold of 19ft. 3in., her tonnage being 2590 tons O.M. She is built entirely of Siemens steel, in order that the greatest strength may be secured with the minimum of weight, so important for vessels designed for very high speeds, and is subdivided by steel water-tight bulkheads carried to the upper deck into eleven compartments, one of these bulkheads being between the engine-room and each boiler-room, so that the engines and each set of boilers are in separate compartments, and in the event of damage to any two compartments the ship would still have sufficient buoyancy. In appearance she much resembles the present mail packets, having a clipper stem with shield head, and a short bowsprit, a light elliptic counter, two raking masts and two funnels, a spacious bridge deck amidships, a long poop aft, and hurricane deck forward.

The passenger accommodation is in arrangement the same as in the company's present steamers as now fitted, and on a scale such as could only be afforded in a vessel of these large dimensions, and is replete with every comfort and luxury which the most fastidious traveller can desire. In the poop is a large saloon about 80ft. in length, panelled in polished hard wood, with state cabins on either side, and on the deck below is the spacious dining saloon, richly decorated in gold and colour, with a commodious serving room and pantry at fore end. Forward of these saloons are the upper and lower ladies' saloons, which are most elegant apartments. The saloons have a height of 10ft. 6in. from deck to ceiling; the stairways are roomy and well arranged, the ventilation and light being all that can be desired; forward, additional sleeping accommodation for first-class, so that in all there will be accommodation for about 200 first-class passengers. Handsome and convenient smoking cabins are provided amidships; a spacious saloon and cabins forward for second-class. The arrangement of pantries, lavatories, and such like offices is very extensive and complete.

The post-office arrangements—which have formed a special feature in the existing mail boats, enabling the mails to be sorted and stamped during the passage, so as to be ready for immediate delivery on arrival—have been carefully provided for, spacious rooms having been fitted for the purpose, and a cabin set apart for the post-office officials in the same way that has already been done in the present packets.

The vessel throughout is illuminated by the electric light —the fittings having been supplied by Messrs. Edmundson and Co., of Dublin—with the exception of the post-office, which is lighted on Pintsch's patent oil gas system by the Pintsch's Patent Lighting Company.

The steering gear and anchor gear are worked by steam, and all the arrangements conducing to the safe conveyance of passengers are of the most modern and improved type.

The engines are oscillating, of the ordinary double piston-rod jet condensing type, having two diagonal air pumps worked by an excentric on the intermediate shaft. The cylinders are 102in. diameter and 102in. stroke; the piston-rods are of steel, 10½in. diameter. The entablatures are of cast iron and of box form, and are strongly supported by eight wrought iron columns, each 9¼in. diameter. The shafts, cranks, and crank pins are of Whitworth's fluid compressed steel, the shafts being 24½in. diameter in the bearings and hollow throughout, the diameter of hole being equal to one-half the diameter of shaft. Each cylinder has two slide valves, worked by a link motion in the usual way; and a combined steam and hydraulic starting gear enables the engineer to handle these powerful engines with great rapidity.

The paddle-wheels are 33ft. 4in. in diameter over the floats, eleven floats to each wheel, 13ft. wide, and 5ft. 9in. deep.

Steam is supplied by eight rectangular boilers made of steel, four placed before and four abaft the engines, working at a pressure of 30 lb. per square inch. The boilers contain in all thirty-two furnaces, 3168 tubes, and have a total heating surface of 22,750 square feet, and a grate surface of 807 square feet. The boilers may be worked under natural draught or under air pressure, sufficient ventilation being provided for the former, while the stokeholes can be readily put under air pressure by closing the ventilators and working double fans placed on deck. These double fans are four in number, 8½ft. diameter, each driven by two separate engines, and capable of maintaining an air pressure equal to 2½in. of water in the stokeholes.

Jet condensing engines have been adopted on the score of lightness, in order to get the requisite power on small displacement; and indeed for this service, where the run from port to port is very short and good coal got at a low

THE SUTTON AND WILLOUGHBY RAILWAY AND HARBOUR AND THE GRIMSBY FISHING TRADE.

When a new project is brought before the public the question that is generally asked in the first instance is, Will it pay? When that question has been satisfactorily answered, people begin to take an interest in the scheme and want to know all about it. If they can convince themselves that by helping the scheme they will not only profit but be also able to pose as patriots and benefactors, then it may be taken as an axiom that the promoters of that scheme will have no difficulty in finding the requisite capital.

A most appropriate instance of the truth of this maxim is presented by the Sutton and Willoughby Railway, of which the first sod was cut on the 15th August by Mr. Burdett-Coutts. The capital of this railway company is proposed to be £60,000 in 3000 shares of £20 each. It is estimated that the cost of the railway, which will be about seven miles long, will be £49,000, and by the 15th of August £52,000 had already been subscribed. Comment is needless, unless it be to remark that the railway is essential to the proposed harbour, and the promoters can easily afford to subscribe the above amount in view of the project of railway and harbour as a whole. The proposed railway, small and modest in proportion as it is—there are not even any engineering difficulties in the way, the ground from Willoughby to Sutton being as flat as a billiard table—has a great national end in view, and will probably exercise a very powerful influence on the future of the fishing trade and the prosperity of Grimsby. To explain the inception of the scheme, it must be observed that twenty-five years ago Grimsby had no fishing trade of any kind; it has grown from nothing to 1000 smacks, but there is, unfortunately, accommodation for only 250 to 270 vessels. As far back as 1882 Mr. George Alward, of Grimsby, at a meeting of smackowners, fish merchants, and fishermen, stated there were something over 700 smacks registered as of the port. "It had been shown," he said, "that something like 15,000 vessels entered the fish dock during 1881, and that 60,000 tons of fish were landed from them, which quantity gave an average of four tons each ship. Now there was hardly a man in the room connected with vessels who would not, carrying his memory back to that year, be ready to say every vessel of the 700 lost at least one voyage owing to the want of accommodation in the dock at Grimsby. If they looked at the figures they would thus see that something like 2800 tons of fish might have been landed which was not landed, and at the smallest computation that would represent a money value to the trade of £33,600 positively lost to the trade during the year."

It is most disheartening to fishermen to find that, besides all the personal risk and peril incurred in the pursuit of their calling, they must, when returning heavy laden with the harvest of the sea, wait possibly days before they can disembark it, and this while their perishable cargo is rotting under their very eyes. Such a situation must demand a good deal more patience and endurance than most men possess. At present about one-fifth of the fish caught by our fishermen in the North Sea is wasted. The average earnings of a first-class trawler are estimated as follows:—Weight of fish: Prime, 22 tons 18 cwt. 2 qrs.; offal, 94 tons 7 cwt. 3 qrs.; total, 117 tons 6 cwt. 1 qr. Amount realised: Prime, £442 16s.; offal, £189 7s. 6d.; total, £632 3s. 6d. In reading these figures we must bear in mind that every hour's delay increases the amount of offal and decreases the amount of prime fish. Frequently as many as seventy-five smacks have been seen lying outside the dock gates, the majority of which could not land their fish for two days after their arrival. It has been estimated that during the past three years the smack owners have lost, through want of sufficient dock accommodation alone, at least £100,000.

That such a lamentable state of things should have existed so long is astounding indeed. For years the fishermen in the neighbourhood have been endeavouring to awaken public interest in their condition, but the English capitalists have resisted their appeals till only just recently. Sutton—or Sutton-le-Marsh—the site fixed upon for the proposed fishing harbour, recommends itself for many reasons. During the heaviest weather the waves are rarely so high as to prevent vessels running in for shelter; and in ordinary weather vessels not drawing more than 10ft. will be able to enter at all times of the tide; and if a greater draught than 10ft., they will be able to enter nine hours out of the twelve. The approach to the harbour is direct from the open sea, and free from shoals for several miles; and there are no cross currents to be guarded against in making the entrance. The works as designed consist of an outer tidal harbour of 35 acres, with an entrance 220ft. wide, and a minimum depth of 10ft. at low-water springs and of 29ft. at high water. The soil is stated by Mr. Alfred Giles, C.E., to be well adapted for building purposes; the sub-stratum being of hard marl, will afford excellent foundations for works of any magnitude without piling. Sutton-le-Marsh is in about latitude 50° 18′ N., longitude 0° 19′ E.; that is, on the coast of East Lincolnshire, midway between the Humber and the Wash, or about sixteen miles north of Skegness. Fish sent from Sutton would arrive in London nearly an hour before cargoes from Grimsby and several hours before fish could arrive from Hull. This does not, however, represent the total gain of time that would be obtained by the conversion of Sutton into a fishing harbour. Boats making for Sutton would have discharged their fish from ten to twelve hours before those making for Grimsby, whilst those bound for Hull would reach that port sixteen to twenty-four hours after the boats had reached Sutton. The fact that Sutton has no river at the back of it is another great point in its favour. The freshets which pass down a river contain a large quantity of foreign matter in suspension, and it is sometimse impossible to preserve fish alive more than a short time in such water; this is an important point in the face of the possibility of accidental delay in landing or of a glutted market.

It is also a great point in favour of Sutton that from its situation fishermen will have no longer any cause to continue the dangerous practice of fleeting, which is a sort of co-operative method of fishing, and consists of a number of vessels, which form themselves together into a fleet, and appoint one of their skippers admiral. Steam cutters take the fish from the smacks almost as soon as they are caught, and carry them to port. The method is expeditious, but fraught with danger, for a sudden gale works terrible havoc among the fleets. But it is believed that Sutton will not be confined for custom to the fish-trade. An enormous proportion of the vessels engaged in the coasting trade passes landward of the Inner Dowsing, and it is expected that the proposed harbour will be greatly used by that class of craft, and the promoters also have strong hopes of creating a Baltic and other general continental traffic. Of course, the saving of time will be as applicable to that trade as to the fishing trade.

As the Right Hon. Edward Stanhope pointed out on the 15th of August, no one who looks over the wreck register of the Board of Trade can have failed to notice that all around the mouth of the Humber, and the coast of Yorkshire north of the Humber, there is a succession of places where wrecks have occurred hardly to be paralleled in any other part of the United Kingdom. "Everybody in this country must desire," he continued, "that these disasters, as far as they are preventible, should be prevented, and I cannot for my own part but think that there is no more possible means of enabling an escape from this terrible distress than the provision of harbours at suitable places along the coast where an escape may be found from the perils of the sea."

We have dwelt so fully on the fisheries portion of this scheme because it will be the chief source of traffic for the railway. A railway over seven miles of even ground, to be constructed at an estimated cost of £6000 per mile, will connect Sutton with the Great Northern. This railway will not offer any interesting features from an engineering point of view, but the construction of a fishing harbour at the end of it, which is to follow, will be a national undertaking, and elicit wide support.

Already Sutton is frequented as a place of seaside resort, but to an exceedingly limited extent. The air is excellent, and the sea view magnificent. It is thought that this new railway will be the means of transforming the quiet little spot into a favourite watering-place for Nottingham and the dwellers in many of the great inland towns. The engineer is Mr. R. E. Cooper.

ELECTRIC LIGHTING IN SOMERSETSHIRE.

Sir Greville Smyth having decided to adopt the electric light at his Somersetshire seat, Ashton Court, near Clifton, coincidently with the alterations and embellishments which have been in progress at the court during the last twelve months, Mr. Thos. Dyke, his estate agent, consulted Mr. W. D. Gooch, director of electric lighting at the International Exhibition, South Kensington, as to the best means of carrying out the necessary work.

The following is a sketch of what has been accomplished, the installation having been carried out under the personal management of Mr. Sidney Sharp:—Motive power, a Crossley's twin 6-horse power gas engine, indicating 28-horse power, fitted with a self-starter; dynamos, two Hochhausen shunt-wound machines, by Messrs. Edmunds and Goolden, of Halifax, each giving 105 volts and 85 ampères in external circuit at 1100 revolutions. Fifty-four of the Electrical Power Storage Company's glass cells, twenty-three L-plates, coupled in parallel with the dynamos and lamp circuit, to act primarily as a regulator, also to supplement the engine power on special occasions, and to provide light in bedrooms and elsewhere when the engine is not running; the battery will maintain seventy 20-candle power lamps for eight or nine hours. The switch board, a speciality of the above-named company, and made by them, is arranged with an accumulator switch, with off, on, and ammeter blocks, two dynamo switches, having a similar arrangement and closing automatically the field before the main circuit, a regulator switch for adding cells as required, and lastly, a lamp circuit switch. All these being connected to the positive terminals of accumulators and dynamos, there is no possibility of any inexperienced person making a short circuit if interfering with the switches; volt and ammeters are also affixed to the board. Two large Cunningham magnetic cut-outs, by Messrs. Woodhouse and Rawson, protect the main cables. The mains, which are carried through the house a distance of 300ft. to the distributing board in the Buckhorn Corridor, are calculated at the rate of 625 ampères per square inch with the maximum number of lamps on, viz., 250. Throughout the building the branch leads are on a similar or more liberal basis. Placed in a central position is a large and handsome switch board, with mahogany case and locked glass door, made by Messrs. Paterson and Cooper; on its massive slate backing are fitted six Eidsforth switches, with as many Cunningham magnetic cut-outs for the various sections of the house. Attached to the board is a Cardew voltmeter; but in order that the engine-driver also may know at all times the difference of potential at this distributing board—which is rendered necessary by the fact that the switching on the various rooms will be under the management of the butler, and the number of lamps alight may vary from one to 200—the positive and negative bars of the switch board are put in connection with the engine-room voltmeter; the driver then switches on or off one or more cells to maintain a constant pressure at the central point.

The lighting is almost entirely from the ceilings, and so arranged as to ensure an even distribution of illumination in any part of the rooms. In the hall, drawing-room, and boudoir the lamps in the ceiling are arranged symmetrically, according to the designs of Messrs. Jackson and Graham, of London, who have executed the alterations and decorations of these portions. The ceilings of the south entrance, vestibule, and museum are the work of Mr. J. Long, builder, of Bath, under the direction of Major Davis, architect, of the same city. In the south entrance 20-candle power lamps with suitable glass shades hang from the crowns of the richly carved ground stone roof, and give ·2-candle power per square foot at a height of 11ft. A panelled oak ceiling has been erected in the museum; from certain intersections of the moulded ribs fifty-four 20-candle power lamps are suspended and yield a light of ·55-candle power per square foot at 15ft. 6in. from the floor. In asbestos-lined boxes let into the stone walls, behind opening oak panels, are the switches which regulate the quantity of light, beginning at six lamps and increasing by twelves, distributed throughout the room to the full number. Lamps for the keyboard of the organ are also provided. Turning from the south entrance through its open arches to the conservatory, here twenty single wrought iron foliated pendants, with flowers to receive the incandescent lamps—designed by Mr. Biddle, of Messrs. Jackson and Graham, and skilfully turned out by Messrs. Wayman and Co., engineers, of Guildford—give finish to the light iron frame of the roof. These twenty lamps—20-candle power—are equivalent to ·35-candle power per square foot. In the rockery and waterfall some few lamps peep out. The entrance porch has three in a ruby glass globe; one alone can be left on guard all night if desired. The ornamental design of the hall ceiling in bold relief takes the lamps close up to the scroll at a height of 16ft. There are eight 20-candle power and twenty-four 10-candle power lamps arranged in two circuits, the candle-power being ·57 per square foot. The vestibule, leading into the dining and drawing-rooms, has seven lamps as finials to the raised ornamentation of the ceiling, the illumination, at the height of 12ft., being ·37-candle power per square foot. On entering the drawing-room greater brilliance is observed. The panelling being of dark oak, and the frieze also dark, a liberal allowance of light is required. Here, again, the design of the ceiling marks positions for lamps, and bosses occur at certain positions to receive them. The grouping of the lamps on the ceiling consists of four stars of five Bernstein 50-candle power lamps, the intermediate spaces being occupied by 10-candle power lamps Each star of five has its switch concealed behind a movable panel, the 10-candle power being governed by one switch. Altogether the twenty 50-candle power and thirty-two 10-candle power give ·7-candle power per square foot at a height of 13ft. On the walls of the dining-room are four single wall brackets of severe design—from the Anglo-American Brush Electric Light Corporation—with pretty shades reflecting light on to the carving table and sideboards, whilst the dining table is illuminated by means of a pair of very handsome seven-armed candelabra, glow lamps taking the place of candles—the direct rays of light are carefully shaded from one's eyes and reflected on to the table. Under the carpet are let in two of Mr. Tayler Smith's pin floor connectors. Flexible wires lead from these through the table to the base of each candelabra, where a similar connector is provided, but with three pins, so that either the central 20-candle power lamp or the six 10-candle power lamps can be lighted, or all of them.

In the study we find some elegant single and double wall brackets by Messrs. Faraday and Son; also Mr. Tayler Smith's wrought iron reading lamps, which hang and stand in many positions, and are, with their flexible wire and wall connectors, movable from room to room. On the first floor we enter the boudoir, where, distributed on a very pretty ceiling, a dozen lamps throw down their rays. The decorations being of a light tone, the candle-power—·33 per square foot—gives an excellent result. Wall sockets of the Brush Electric Light Company, to take incandescent lamps, or plugs with flexible wires, are let into the walls of this room, as well as elsewhere, for reading or piano lamps. The neighbouring bed-room has double brackets over the toilet glass and over the fireplace; a lifting and lowering silk parachute lamp, with cords and tassel matching the decorations, made by Messrs. Faraday and Son, hangs down from the ceiling near the toilet glass. In addition to these may be mentioned a lamp over the bedstead, a movable reading lamp by the fire, and one in the top of the bath, each one having its own switch. The dressing-room adjoining is fitted somewhat in the same way, and the natural history room beyond has a three-light electrolier and an inspection lamp with flexible wire running off a reel. The brackets in these rooms are by Messrs. Verity and Sons, King-street, Covent-garden.

The upper and lower corridors and landing are fitted with Messrs. F. and C. Osler's wall brackets and cut-glass globes. On the broad staircase, where it divides to right and left, hangs a massive chandelier with four arms, each carrying a duplex oil lamp. The wicks are gone, and carbon filaments have taken their place. Through the glass globes the change is unnoticeable, but the action of a switch behind the panels reveals the secret. A turret staircase and sundry other places also have lights. Fusible plugs in great number, in addition to the magnetic cut-outs for each section on the main switch board, and the magnetic cut-outs on the main cables, render the installation perfectly safe, whilst all the details of wiring have been carried out carefully in accordance with the requirements of the insurance offices. Numerous switches in the different apartments enable the occupant to vary the amount of light as desired. These switches being on the return or negative wires, whilst those on the main distributing board are on the positive, any portion of the system can be completely cut off from the rest. The following is a *résumé* of the lamps:—20 Bernstein, 50 volts, 50-candle power; 160 Anglo-American Brush, 100 volts, 20-candle power; 12 ditto, 50 volts, 10-candle power; 24 ditto, 25 volts, 10-candle power; 32 Woodhouse and Rawson, 25 volts, 10-candle power.

THE RATING OF MACHINERY.

The following is the text of the Bill to amend the law relating to the rating of machinery, prepared and brought in by Mr. Norwood, Mr. Brinton, Mr. Jackson, and Mr. Slagg:—

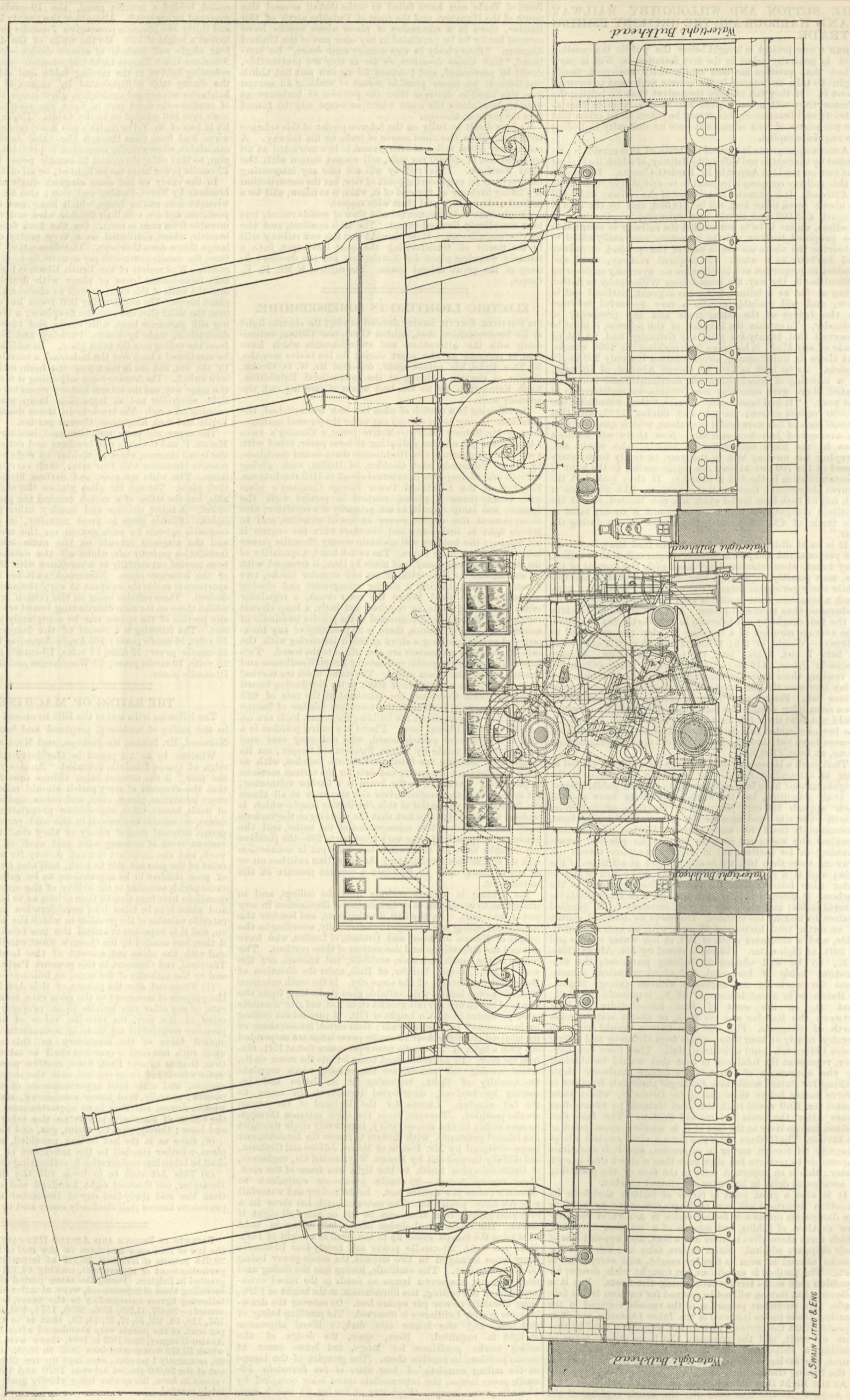
Whereas by an Act passed in the forty-third year of the reign of Queen Elizabeth, intituled "An Act for the relief of the poor," it was amongst other things provided and enacted that the overseers of every parish should raise by taxation of every inhabitant, parson, vicar, and other, and of every occupier of lands, houses, tithes, impropriate propriations of tithes, coal mines, or saleable underwoods in the said parish, in such competent sum and sums of money as they shall think fit, a convenient stock of necessary ware and stuff to set the poor on work, and also competent sums of money for and towards the relief of the poor not able to work, and also for the putting out of poor children to be apprentices to be gathered out of the same parish according to the ability of the same. And whereas questions have from time to time arisen as to how far machinery and plant is to be taken into consideration in estimating the rateable valuable of the premises in which the business is carried on, and it is expedient to amend the law relating thereto. Be it therefore enacted by the Queen's most excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

(1) From and after the passing of this Act, in estimating for the purpose of assessment to the poor rate, county rate, borough rate, or any other rate leviable upon property rateable to the relief of the poor, the rateable value of any tenement or premises occupied for any trade or manufacturing purposes, the annual value of the machinery in this section specified upon such tenement or premises shall be taken into consideration, that is to say: First, fixed motive powers, such as the water wheels and steam engines, and the steam boilers, donkey engines, and other fixed appurtenances of the said motive powers; secondly, fixed power machinery, such as the shafts, wheels, drums, and their fixed appurtenances which transmit the action of the motive powers to the other machinery fixed and loose; thirdly, pipes for steam, gas, and water.

(2) Save as in the last section provided, no machinery or plant, whether attached to the tenement or premises or not, shall be taken into consideration in estimating such rateable value.

(3) This Act shall be in force till the thirty-first day of December, one thousand eight hundred and eighty-seven, and from the said thirty-first day of December this Act and the provisions thereof shall absolutely cease and be of no effect.

Patents in Belgium and Austro-Hungary.—From the time the law of 1854 came into force to the end of 1883, no less than 29,213 patents of invention, 26,247 of importation, and 8674 of perfectionment or improvement, making 64,134 altogether, were granted in Belgium. During the same period 45,525 patents, not including those of improvement, were abandoned or annulled, the following figures corresponding to the years, beginning with the second:—20,457, 11,599, 5755, 2695, 1571, 988, 665, 412, 292, 256, 157, 118, 90, 109, 85, 27, 12, 14, 23, that is to say, more than 45 per cent. of the patents were abandoned after the first year. In Austro-Hungary, from 1852 to 1884, there were 34,569 patents, of which 10,479 were granted from 1852 to 1869. Of the latter only 98, or scarcely 1 per cent., were kept up for fifteen years; while, out of the 24,090 granted between 1870 and 1884, only 6422 still remain in force, this number being chiefly made up of the patents lately granted.



THE CITY OF DUBLIN STEAM PACKET COMPANY'S NEW MAIL STEAMER, IRELAND.

MESSRS. LAIRD BROTHERS, BIRKENHEAD, ENGINEERS AND SHIPBUILDERS.

(For description see page 158.)

RAILWAY MATTERS.

ACCORDING to the estimate of Mr. Hansell, the quantity of laminated springs at present in use on English, Scotch, and Welsh railways is 231,920 tons, and there are used annually nearly 12,000 tons, Sheffield makers producing about 10,000 tons.

A REMARKABLE illustration of the effect of steam tram-car traffic in Birmingham is given this week by the action of the Midland Railway in reducing fares along their line between Birmingham and King's Head. The reduction applies to the first and third-classes and also to season ticket holders, who have been given a uniform reduction of 10s. per annum, the company admitting that the competition with the tramways has rendered this necessary.

THE London and North-Western Railway Company began to experiment with Mr. Webb's steel permanent way in May, 1880; there are now on various portions of the line over 32,000 sleepers at work; the first have been down nearly five years and are showing very well at the present time. The advantage of the system is, that it is applicable to the present standard rails and keys without alteration. The weight of one sleeper and chairs complete, as used on the London and North-Western Railway, is 184 lb., the weight of the sleeper, 9ft. long, being 136 lb., and of two chairs and liners, 48 lb.

OF the total number of persons employed by the Great Western Railway Company, 36,878 may be considered as liable to be called on to work on Sundays if necessary. But of these 8920 in the permanent way department perform no labour on that day except in special cases, when bridges have to be reconstructed or portions of the line relaid, and then only when it cannot be done on week-days, while of the remainder 4413, or 11·96 per cent. in the traffic department, and 1574, or 4·26 per cent. in the locomotive department, have to work occasionally on Sundays, being relieved as often as circumstances will permit. Out of a total mileage of 14,620,840 passenger train miles and 15,836,411 goods train miles run in the year, about 541,613 passenger train miles, or 3·70 per cent., are run on Sundays, and 957,731, or 6·03 per cent., of the goods train miles are run on that day, out of which 551,894 miles are of trains which start on Saturday and finish the journey on Sunday.

A FATAL collision occurred on Sunday afternoon outside Earl's Court station, at the Warwick-road Junction, between a Great Western and a Putney Bridge train. Carriages were telescoped and smashed; one mounted on the Great Western engine, and both engines were very much, if not irretrievably, damaged. One account of the accident says:—"At first it was thought that the blame for the collision must rest upon the driver of the District train, as the signalman declared that the line was duly blocked. His levers, moreover, showed that this was the case. On examination, however, it was discovered that the pin holding the two joints of the connecting-rod on the signal-post had broken, and that, although the points had been moved for the Great Western train to cross the Putney line, the signal had not been raised, and it showed 'line clear' for trains approaching Earl's Court from Putney." It is difficult to see how this could be if the semaphores were weighted to fly to danger in case of such breakage. This is an accident that could not have occurred with electro-magnetically-worked signals.

AT the meeting last week of the Mersey Tunnel Railway Company the chairman stated that there was a prospect of the immediate opening of the tunnel for traffic. They had expected to be ready to open before now; but difficulties had come in the way which had in some degree deferred the date. These difficulties had been partly physical and partly of another kind. Last week only about thirty yards of the Mersey Tunnel remained to be executed; but on Thursday a deputation of tradesmen attended the Health Committee and complained of the noise of the blasting in the works below ground as affecting their business. On their representations the Health Committee revoked the licence of the Mersey Railway contractor to blast in the tunnel, and the engineer said the result would be that the work would have to be done by opening up the street, which would be a greater nuisance than blasting. Of the tunnel, 2300 yards and the ventilating arrangements would be completed in a few days. The company had made an agreement with the Liverpool Telephone Company to put their lines through the tunnel on terms very advantageous to themselves. They had come to the conclusion to have a station for themselves in the vicinity of the central station.

A GENERAL classification of the American railway accidents in June is made as follows by the *Railroad Gazette*:—

	Collisions.	Derailments.	Other.	Total.
Defects of road	—	13	—	13
Defects of equipment ..	3	7	3	13
Negligence in operating ..	23	5	—	28
Unforeseen obstructions ..	1	7	1	9
Maliciously caused	—	2	—	2
Unexplained	—	10	—	10
Total	27	44	4	75

Negligence in operating is charged with 37 per cent. of all the accidents, defects of road with 17, and defects of equipment with 17 per cent. A division according to classes of trains and accidents is as follows:—

Accidents.	Collisions.	Derailments.	Other.	Total.
To passenger trains	4	18	2	24
To a pass. and a freight ..	7	—	—	7
To freight trains	16	26	2	44
Total	27	44	4	75

This shows accidents to a total of 102 trains, of which thirty-five, or 34 per cent., were passenger trains, and sixty-seven, or 66 per cent., were freight trains. Of the total number of accidents, forty-five are recorded as happening in daylight and thirty at night.

THE length of the Swedish State railways at the end of 1884 was 2312 kilometres, and that of the private railways 4288 kilometres, or a total of 6600 kilometres. The private railways are owned by seventy-eight different proprietors. The length of railway in each county or läu in kilometres was as follows:—Orebro, 607; Skaraborg, 436; Jönköping, 422; Elfsborg, 476; Värmland, 508; Ostergötland, 279; Jeurtland, 334; Stockholm—city and county—231; Malland, 79; and Gothenburg and Bohus, 35 each. In 1856 the length of the Swedish railways was 66 kilometres; in 1860. 507 kilometres; in 1865, 1285 kilometres; in 1870, 1708 kilometres; in 1875, 3681 kilometres; in 1880, 5879 kilometres; and in 1883, 6400 kilometres. The total cost of the construction of the State railways at the end of 1884 was twelve million and a-half sterling, and that of the private ones thirteen and a-half million, a total of twenty-six millions. The total amount of capital invested in Swedish railways at the end of 1884 was twenty-eight million sterling. Every kilometre of railway was covered by 3089 trains on the State, and 1776 on the private railways. There were 25 cases of serious injury and death on the railway during the year, all being due to negligence on the part of the sufferers. The gross receipts of the Dalsland Railway for last year were £12,000, an increase against the previous year of 4·26 per cent., whilst the expenditure was £7000, an increase against 1883 of 2·82 per cent. The increase is due to extensive renovations of rolling stock. The net profit for 1884 was £4000, an increase against 1883 of 16 per cent. There are only two railways in Sweden, similar in construction, where the expenditure is less than on this railway. With regard to the relative cost of construction of Swedish and Finnish railways, it may be of interest to learn that in the former country, where the gauge is 4·83ft., it is from £5000 to £8000 per English mile; and in the latter, where the gauge is 5ft., only about £4000 per mile. In Sweden, shove-cars are used in the construction of the line; in Finland, engines and wagons.

NOTES AND MEMORANDA.

IN Greater London last week 3253 births and 1883 deaths were registered, corresponding to annual rates of 32·6 and 18·9 per 1000 of the population.

THE death-rate of Bradford during the week ending August 15th was 12·4 per 1000, being 7·5 per 1000 below the weekly mean for the past five years, as compared with 16·3, 15·6, and 23·8, the respective rates for the three preceding weeks, and 16·7 per 1000, the rate for the corresponding period of 1884.

THE deaths registered during the week ending August 22nd in twenty-eight great towns of England and Wales corresponded to an annual rate of 19·7 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of this year. The six healthiest places were Bolton, Hull, Bradford, Oldham, Halifax, and Brighton.

IN London last week 2535 births and 1473 deaths were registered. The annual death rate per 1000 from all causes, which had been equal to 22·4, 22·0, and 18·8 in the three preceding weeks, was again 18·8 last week. During the first seven weeks of the current quarter the mean death-rate was 20·2, against 21·6 in the corresponding periods of the nine years 1876-84.

A PAPER on certain alloys of cobalt and copper was recently read to the Paris Academy of Sciences by M. G. Guillemin. The alloy with 5 per cent. of cobalt is described as specially interesting, being capable of resisting oxidation, malleable as ordinary copper, tenacious and ductile as iron. The author said it might be used for rivets, tubes, and a great variety of copper-ware articles in daily use.

THE total energy stored up in gunpowder is about 340,000 kilogram-metres per kilogram of powder, or, in English measure, a little under 500 foot-tons per pound of powder. The potential energy of 1 lb. of gunpowder is as nearly as possible one-tenth of that of 1 lb. of coal, and one-fortieth of that of 1 lb. of hydrogen. It is not even equal to the energy stored up in the carbon which forms one of its own constituents.

IN 1884 the total share capital authorised to be raised in the United Kingdom for gas undertakings not in the hands of local authorities amounted to £39,575,330, while the total paid up was £29,594,464. The loan capital authorised was £9,395,859, and the total issued £5,330,550. There had been 5,361,576 tons of coal carbonised, 49,904,217,135 cubic feet of gas sold, 12,421 gas mains in miles, and 242,782 public lamps lighted.

DR. LENZ has described in the "Bulletin" of the St. Petersburg Academy an ingenious application of the telephone to the measurement of temperatures at a distance. Suppose two stations united by two wires, one of iron, the other of silver, soldered at the two extremities. If the soldering of station M is different from that of station N, a thermo-electric current circulates through the wires. On introducing a telephone and an interrupter into the circuit, the telephone will continue sounding until the observer at one of the stations raises or lowers the temperature of his joint so as to make it identical with that of the joint of the other station; the current then ceases, and the telephone becomes silent.—*Génie Civil; Les Mondes.*

SOME curious statements on tempering steel are made in a paper published in *Dingler's Polytechnic Journal* by Herr A. Jarolimek, "On the Influence of the Annealing Temperature upon the Strength and the Constitution of Steel." Hitherto it has been generally considered that to obtain a specified degree of softness it is necessary to heat the hard steel to a particular annealing colour—that is to say, to a definite temperature—and then allow it to rapidly cool. Thus, for example, that steel might anneal—be tempered—yellow, it had to be heated to 540 deg., and the supposition was formed and acted upon that it must be allowed only a momentary subjection to this temperature. Herr Jarolimek says the requisite temper which is obtained by momentarily raising the temperature to a particular degree can also be acquired by subjecting the steel for a longer time to a much lower temperature. For example, the temper which the annealing colour—yellow—indicates can be obtained by exposing the hard steel for ten hours to 260 deg. of heat; in other words, by placing it in water rather above the boiling point.

ACCORDING to a report by the British Iron Trade Association, the production of Bessemer steel ingots in the United Kingdom during the half-year ending the 30th June, 1885, compared with that for the corresponding half of the previous year, was as follows:—South Wales and Monmouth, in 1885, 191,581 tons; in 1884, 221,316 tons; decrease, 29,735 tons. North-East Coast, in 1885, 145,718 tons; in 1884, 164,475 tons; decrease, 18,757 tons. Lancashire, Cheshire, &c., in 1885, 88,917 tons; in 1884, 81,141 tons; increase, 7776 tons. West Cumberland, in 1885, 93,056 tons; in 1884, 88,851 tons; increase, 4205 tons. Sheffield district, in 1885, 104,500 tons; in 1884, 82,060 tons; increase, 22,440 tons; the totals being 623,772 tons and 637,843 tons, or a decrease of 14,071 tons on the half-year. Production of Bessemer steel rails in the United Kingdom during the half-year ending June 30th, 1885, compared with that of corresponding period of 1884, showed a decrease of no less than 92,718 tons. Of this South Wales and Monmouth showed 73,147 tons decrease, and the North-East Coast, 34,824 tons decrease.

THE great advantage of ammonia for refrigerating purposes over ether, and more particularly over dry air, is that the required effect is gained by a smaller expenditure of fuel. Ammonia boils at a temperature of 30 deg. Fah. at atmospheric pressure, and has a vapour tension of 120 lb. per square inch at 65 deg. Fah. It has a latent heat—by equal weight—of 900. Ether, on the other hand, boils at 90 deg. Fah. at atmospheric pressure, has a vapour tension of about 10 lb., while the latent heat is by equal weight 162, and by equal volume 369. Air, of course, is not condensable, and does not enter into the comparison on the same basis. Putting theory, however, on one side, Mr. Jno. Chambers, of New Zealand, states that his machine, which is designed to do the same work as a dry air machine delivering 60,000 cubic feet an hour, will work with about one ton of coal per twenty-four hours, while the air machine will require four tons for the same work. It will keep a storage space of 20,000 cubic feet, enough to hold 7000 carcases of sheep, at a temperature of zero, and occupies an area of 306 square feet, the cubical measurement required being 2295 cubic feet. At a higher temperature, say 15 deg., a larger space can be kept cool.

FOUR men were recently stationed at Fulton-street and Broadway to count the vehicles passing through Broadway at that point from 7 a.m. to 6 p.m. The total number was 22,308 for the period of eleven hours—about 2000 an hour, 33 a minute, or 1 every two seconds. The largest number of any one kind of vehicles was of single and double trucks—7384; the smallest number was 2—these were ambulances. There were 3390 single and double express wagons. The 2310 stages and the 10,022 cabs were next in order of quantity, pedlers' wagons numbering 938, produce wagons 446, rag trucks 375, carriages 354, coal carts 324, and vendors' wagons 300. Then there was a drop to hacks, 288, and butchers' wagons 223. The variety of vehicles was striking, there having been eighty kinds according to the schedule. Every conceivable article of transfer appears to be poured into Broadway. The private carriages were completely engulfed in the 150 ash carts; the two ambulances and three funerals made a melancholy showing amid the seventy-three loads of dead hogs, the sixty-four garbage, and the seventy-three dirt carts. The lager beer wagons and the orange pedlers flourished on an equality; the bone and lumber wagons went neck and neck; the pie and the sugar wagons were half and half, which should give the pies sweetness; the milk were left behind by the swill wagons. The mixture presented was, says the New York *Tribune*, something appalling. Kerosene, milk, old iron, sawdust, rags, sugar, ice, beer, bones, oranges, ashes, pie, hogs, tripe, tin, tallow, tea, tar, and undertakers were commingled in a bewildering confusion. Broadway is certainly a remarkable thoroughfare.

MISCELLANEA.

THE death is announced of M. William Fraisse, a distinguished Swiss civil engineer.

THE Bath and West of England Society's show next year will be held in Bristol. A larger prize vote than usual—£2000—has been passed.

THE Water Supply Committee of the Richmond Vestry last week accepted the tender of Mr. Timmins, amounting to £780, for the works at the well, as suggested by the resident engineer, whose mateesti, as we recently stated, was £800.

A USEFUL little guide for London visitors has just been published by F. E. Longley, Warwick-lane. It contains a clear little map and lists of the names of places to be seen and means of finding them, is as much as many people require, and costs but 1d.

AT a special meeting of the Whitby Harbour Board last week it was determined to apply to the Public Works Loan Commissioners for £10,000 for deepening the harbour. The North Eastern Railway Company will contribute £2000 towards the improvements.

THE more economical system of electric lighting seems to be gaining favour for interior lighting. A recent example is the large temperance restaurant known as Pearce's Coffee Bar lighted by seven Clark-Bowman lamps supplied by a 6-horse Otto gas engine and Gramme dynamo, the installation having been carried out by Mr. C. R. Heap.

THE annual meeting of the Midland Steam Boiler Inspection and Assurance Company was held in Wolverhampton on Wednesday, Mr. Charles Cochrane presiding. Mr. E. B. Marten, C.E., the chief engineer of the company, presented a report which showed that 2917 boilers are under the company, of which 1069 are inspected and 1848 assured.

AT a Town Council meeting of the Corporation of Edinburgh, held on the 19th inst., it was resolved unanimously to purchase the Shand, Mason, and Co.'s small-size steam fire-engine that obtained the gold medal, first award, at the International Inventions Exhibition. Some slight modifications for special use in Edinburgh are required, which are to be carried out under the direction of Mr. Wilkins, the firemaster.

IN this column of our last impression we spoke of the electric light being applied at Varallo, well known to Alpinists who pass it on their way from Italy to Monte Rosa. Mr. J. Boyd writes respecting this, saying, "As you refer to Aosta, it may interest you to hear that for many weeks last winter the Dora, which furnishes the driving power for the Aosta dynamos, was frozen so hard that the town was obliged to have recourse to its old oil lamps."

THERE are some fine specimens of driving belts in the Antwerp Exhibition, amongst which are those for which Messrs. Sampson and Co., of Manchester and Stroud, have been awarded a gold medal. Amongst their exhibits they have a main leather belt, 5ft. wide and 151ft. long, of double thickness, made on their system without cross joints. This belt is one of two of same width they have on order, the other being 173ft. long, for driving direct off a fly-wheel 30ft. in diameter, 10ft. 6in. wide on the face, and for transmitting together 1600 indicated horse-power. They are also makers of the large double belt at work in the Belgian section of the Machinery Hall, driving off the fine Corliss engine exhibited by Mr. Prosper, Vanden Kerchove, of Ghent, for transmitting 400 indicated horse-power.

THE programme of arrangements in connection with the international Exhibition of Navigation, Travelling, Commerce, and Manufacture, to be held in Liverpool in 1886, which is under the patronage of her Majesty the Queen and the presidency of his Royal Highness the Prince of Wales, has been issued. The aim of the Exhibition is at once comprehensive and well defined. It is intended to illustrate the history and development of travelling by land, sea, and air. There will also be shown, as allied to this subject, exhibits representative of the manufacture and commerce of the world, which owe so much to the achievements of modern science in creating and perfecting the means and methods of movement from place to place. We are not told whether the Manchester Ship Canal will be prominently illustrated as a feature in the Exhibition.

EXPERIMENTS have been made at the Royal Gun Factories in the Royal Arsenal, Woolwich, to test the application of a new electric lamp designed for making examinations and photographs of gun interiors. The system of scrutinising the bores of guns by means of electricity has only been a short time in vogue, and has proved of great value, but the want of a dynamo has prevented its adoption at many places, and the authorities have now taken up a portable battery for the purpose of supplying the place of a dynamo in such cases. The battery is chiefly serviceable on account of its constancy, as it can maintain a light for a period of ten hours if requisite, and then enable the examiners to make their inspections with all the leisure they may desire. In future it may be expected that reports of damaged guns sent in from distant stations will be accompanied by photographs, both internal and external.

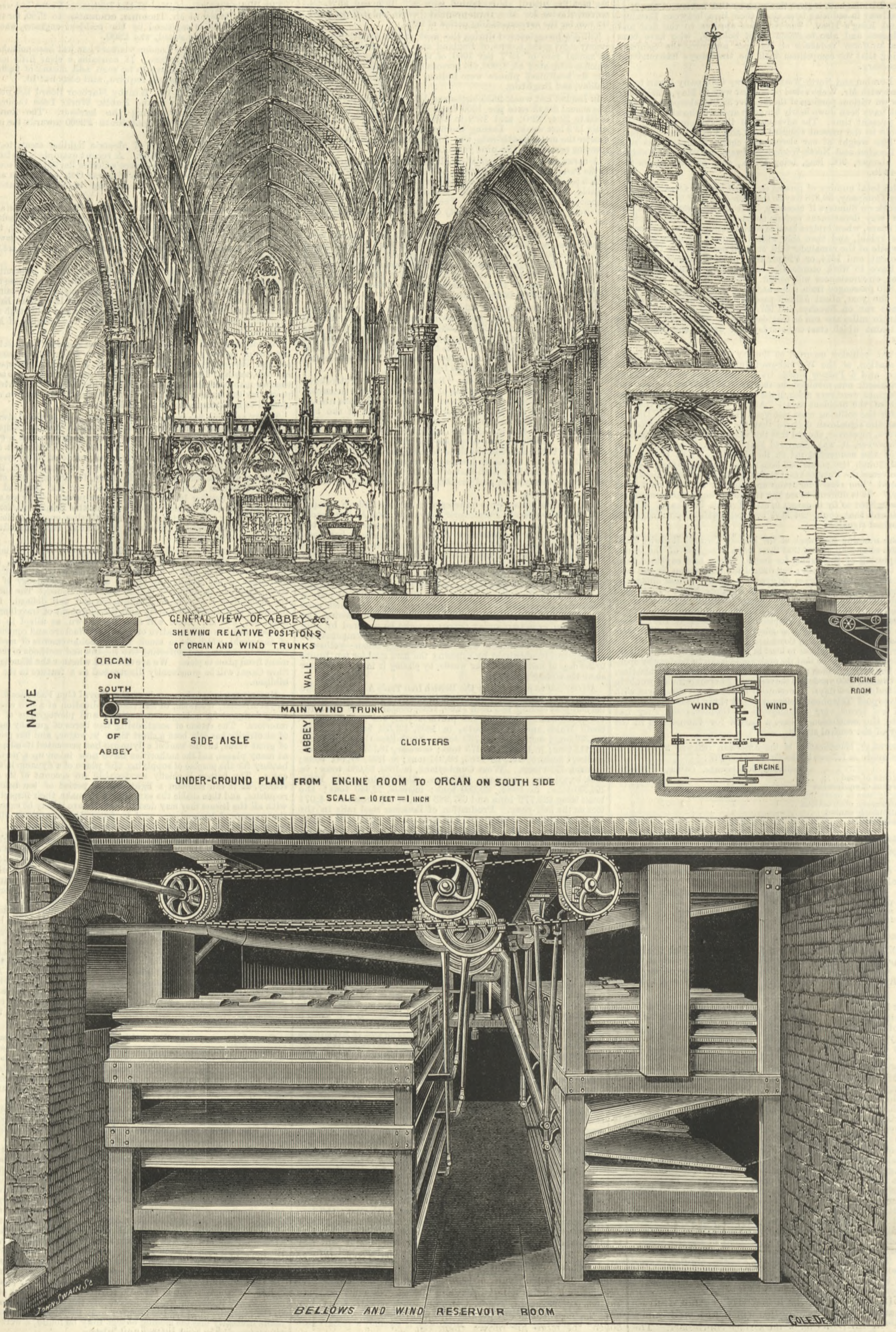
ANALOGOUS to the work done at Hell Gate, near New York, is that now in progress for the removal of Flood Rock. At some date in October next, not yet fixed, the works for removing this rock, in progress for the past ten years, will be exploded, the work of loading the 13,700 holes having just begun. It will be by far the vastest explosion which has ever taken place. The American journals state that 225,000 lb. of "rackarock" powder and 75,000 lb. of No. 1 dynamite will be employed, or over six times as much as was exploded at Hell Gate in 1875 (49,900 lb.) The holes are about 9ft. by 3in. diameter, at an angle of 35 to 40 degrees with the vertical, and chiefly in the roof, instead of—as at Hell Gate—in the pillars of the 21,670ft. of galleries which have been constructed under an area of about nine acres. Making these galleries has involved the removal of 80,160 cubic yards, from which it follows that the average section of the galleries is a little over 4ft. by 8ft. The average thickness of the rock above the galleries is about 13ft., which makes the quantity of rock to be broken up and removed after the explosion, by dredging, fully 200,000 cubic yards.

ONE of the many odd callings which the production and pipe line transportation of petroleum have made necessary is one known as "chasing the scraper." Crude petroleum is run from the oil regions to the refineries at the sea board, a distance of 300 miles, in iron pipes. It is forced over the high hills that intervene by powerful pumps. Much of the way it runs by its own gravity. The pipes are constantly becoming clogged by sediment and paraffine. To clean them out an iron stem, 2½ft. long, to which are attached circular steel scrapers, fitting loosely in the pipes, is placed in the pipe at regular periods. This is forced along the line by the pressure of the oil behind it. It is necessary to keep track of this scraper, in order that its exact location may be constantly known, so that if it is stopped by any obstacle it may be readily discovered, and the obstacle removed. The noise made by the scraper against the iron pipes as it moves along their interior would not be heard by an untrained ear, but certain servants of the Pipe Line Company are able to follow it on its journey by the noise, and never lose its situation. These men are the scraper chasers. They are stationed in relays three or four miles apart along the line. One chaser will follow up and down mountains, across ravines and through streams and swamps until he reaches the end of his section, when another man takes up the chase and follows it until relief is reached, and so on until the course of the scraper is run. The work is one of hardship and danger, owing to the character of the country through which miles of the pipe line is laid. If a chaser by any mishap is thrown off the track of the scraper, and it becomes clogged before he can recover its position in the pipe, the cutting of the pipe for long distances is frequently made necessary that the missing object may be found, a work that is accompanied by much expense and labour.

THE NEW ORGAN, WESTMINSTER ABBEY.

MESSRS. W. HILL AND SON, YORK ROAD, LONDON, N.W., BUILDERS.

(*For description see page* 155.)



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TO CORRESPONDENTS.

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

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

E. C.—*Read "Continuous Brakes," by J. Reynolds, published by Lockwood and Co.*

R. K.—*Pulleys with holes in them to increase the grip of belts have no doubt often been tried. We are not aware that any are in use. Possibly some of our readers may be able to supply further information.*

J. L. (Glasgow).—*We fear that there is not the least chance that any railway company would take up your invention, the general adoption of which would cost at least half a million; probably double that sum.*

MACHINE FOR CUTTING OUT OLD BOILER RIVETS.

(*To the Editor of The Engineer.*)

Sir,—Can any of your correspondents tell me the names of makers of a machine for cutting off the heads of rivets and forcing the rivets out of old boilers? P. B.

London, August 21st.

WIRE ROPE SUSPENSION BRIDGES.

(*To the Editor of The Engineer.*)

Sir,—Can any reader inform me if there are any special books published giving a description of wire rope suspension bridges, such as are much in use in America, viz., the Brooklyn Bridge? Inquirer.

WOOD BEARINGS.

(*To the Editor of The Engineer.*)

Sir,—We have an inquiry from New Zealand with reference to a timber called maire, used for "brasses" where there is a great deal of wear and tear. It is represented to be nearly everlasting, and to improve with oiling, so as to be superior to metal in quick running journals. We shall be glad to know, through your readers, whether it is known in the English markets for the above purpose, and how much it is likely to fetch per lb. B., D., and Co.

London, August 24th.

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

MEETING NEXT WEEK.

The Iron and Steel Institute.—The autumn meeting of the Institute will be held in the Corporation Galleries, Glasgow, on Tuesday and following days of next week. List of papers: "On the Iron Trade of Scotland," by Mr. F. J. Rowan, Glasgow. "On the Rise and Progress of the Scotch Steel Trade," by Mr. J. Riley, Glasgow, member of Council. "On the Present Position and Prospects of Processes for the Recovery of Tar and Ammonia from Blast Furnaces," by Mr W. Jones, Langloan Ironworks, N.B. "On the Structural Features and Working of the South Chicago Blast Furnaces," by Mr. F. W. Gordon, Philadelphia, and Mr. E. C. Potter, Chicago, U.S.A. "On Certain Accessory Products of the Blast Furnace," by Mr. T. Blair, Wingerworth Ironworks, Derbyshire. "On a New Form of Cupola Furnace," by Mr. J. Riley, Glasgow. "On a New Form of Pyrometer," by Mr. A. von Bergen, Middleton Ironworks, Darlington. "On the Ancient and Modern Methods of Manufacturing Tin Plates," by Mr. Philip W. Flower, Melyn Tinworks, Neath. "On the Manufacture of Basic Steel on the Open Hearth," by M. Pourcel, Bilbao, Spain. "On the Forth Bridge," by Mr. Benjamin Baker, M.I.C.E., London. Programme of arrangements: Tuesday, Sept. 1st, at 10.30 a.m., general meeting of members in the Corporation Galleries, Sauchiehall-street, Glasgow; a selection of papers will be read and discussed. At 1 p.m., luncheon at the Corporation Galleries. Afterwards alternative excursions to Hallside Steelworks, Steelworks at Motherwell, Gartsherrie and Summerlee Ironworks, Calder, Mossend and Langloan Ironworks, and Earnock Colliery, near Hamilton. Wednesday, Sept. 2nd, at 10.30 a.m., meeting in the Corporation Galleries; a selection of papers will be read and discussed. At 1 p.m., luncheon. Afterwards alternative excursions to Messrs. Thomson's Shipbuilding and Engineering Works, the Singer Sewing Machine Company's Manufactory, Messrs. Denny's Shipbuilding and Engineering Works, Greenock Docks, Harbour, and Shipbuilding Works, Shipbuilding and Engineering Works of Messrs. R. Napier and Co., and Messrs. John Elder and Co., at Govan, Govan Ironworks, Glasgow Locomotive Works, Blochairn Steelworks, and Caledonian Railway Locomotive Works, St. Rollox. At 7.30 p.m., annual dinner of the Institute at M'Lean's Hotel, St. Vincent-street. Thursday, Sept. 3rd, at 10.30 a.m., general meeting of the members in the Corporation Galleries; a selection of papers will be read and discussed. At 1 p.m., luncheon. Afterwards alternative excursions to Carron Ironworks, near Falkirk, the new Basic Bessemer Steelworks of Messrs. Merry and Cuninghame at Kilbirnie, and to Addie Oilworks. At 8 p.m., *conversazione* in the Corporation Galleries. Friday, Sept. 4th, excursion per special steamer Columba to Inverary, *viâ* the Kyles of Bute, on the invitation of the Local Reception Committee. Saturday, Sept. 5th, excursion to the Forth Bridge Works, South Queensferry.

THE ENGINEER.

AUGUST 28, 1885.

MARINE BOILER FURNACES.

Very little is heard in the present day of that destruction of marine boilers by corrosion which followed immediately on the introduction of the surface condenser. The proper method of working boilers fed with condensed water is now understood, and nostrums for neutralising acids and such-like, no longer find a market. Nothing in the way of protection is required more than a thin coat of scale, not exceeding the thickness of a sixpence, equally deposited all over the interior of the boiler. So long as this remains intact the boiler is safe. In many ships, however, the scale is supplemented by zinc plates hung on the stays, or otherwise secured in metallic contact with the boiler plates, and this expedient no doubt does good. With the adoption of high pressures, however, another evil has been introduced which is already serious and promises to be still more mischievous than it has been. We allude to the partial collapse or coming down of furnace crowns, a matter of almost daily occurrence, and claiming the most serious attention of seagoing engineers. The symptoms are very simple. A boiler is in perfect order, and everything is going well in the engine room; without the least warning a partial collapse takes place in one or more furnaces. The injury may take the form of a pocket, only a small portion of the crown plate being implicated; or a comparatively large portion may be flattened and put out of shape; or the collapse may be nearly complete. The material used in furnace crowns is now so good that the cracking of the plate never seems to take place. At all events, we have never heard of loss of life being caused by the collapse of furnaces. Combustion chambers have given way with disastrous results, but not furnaces. In very many cases the deformation is so slight that the furnace can be set out again by heating the plate and forcing it back with screw jacks. When pocketting has taken place the injured portion must be cut out and a patch put on, and when the collapse is complete a new furnace must go in. In any case risk, delay, and expense are incurred, and no pains or trouble should be spared to prevent furnaces from coming down. Unfortunately, the cause of collapse is more or less obscure, and anomalous phenomena are sometimes present. Some years ago, for example, the coming down of furnace crowns among the ships of a certain line became so frequent and so serious that Lloyd's were applied to for advice. Ships starting with new and perfectly clean boilers, collapsed their furnaces before they reached New York. Mr. Parker, chief engineer surveyor of Lloyd's, carried out a very elaborate investigation, which resulted in the discovery that a particular oil was used to lubricate the cylinders. This found its way into the boilers and formed a thin coating of non-conducting paint, so to speak, on the surface of the flues, which then became overheated and came down. The use of this particular oil was proscribed, and there was no more trouble from that cause. But a new source of trouble is now turning up, and it can only be avoided by the action of captains and owners, for engineers are powerless in the matter. Two new and crack ships on the triple expansion principle, carrying about 150 lb. pressure, have arrived in England each with two furnaces badly collapsed. The cause of the failure in one ship we have not ascertained. The other returned from a long voyage, and it was known that two of the furnaces had manifested some symptoms of weakness, but nothing in any way alarming. The ship reached the Thames, and was delayed for a few hours with fires banked. She then ran up the river at about quarter speed, and both furnaces came down. They were Fox's patent corrugated, and on opening the boilers the cause was soon seen. They were coated with a heavy deposit which had filled up the corrugations, and of course prevented the heat passing through.

It will be said at once that in this case the engineer was to blame. We may take the case as being typical, and derive a great deal of information from it. The fact is that the ship was under steam for eighty-seven days continuously, during which time, of course, the boilers could not be cleaned. The ship had somewhat difficult river navigation, and the captain did not deem it prudent to let steam down while lying at anchor. The fires were banked at these times. Under such circumstances what is an engineer to do? Some loss of water must take place, if it was only in blowing through to warm the engine whenever it was started — an important operation, using a great deal of steam in the case of triple expansion engines. Salt water, or, what was much worse, muddy, brackish river water, was taken in to make up the deficiency. By degrees the water got denser and denser, and the boilers were at last blown down and filled up with sea water. All the eighty-seven days solid matter in one way or another found its way into the boiler, and the result was incrustation. This brings us to the important lesson which we wish to deduce, namely, that it is essential not only to blow boilers down, *but to clean them out*. The philosophy of this deserves further elucidation.

When a boiler is worked continuously scale forms all over the heated surfaces uniformly. Boilers are always filled up with sea water to begin with, on purpose that scale may be formed to protect the iron. There is in a given weight of sea water only a given weight of sulphate of lime and sulphate of magnesia to form scale. This is deposited because the sulphates and carbonates are less soluble in hot than in cold water; but salt is not thrown down save in very small quantity, because the volume of salt and of water remains unchanged. If no water had to be pumped in except that from the surface condenser, all would be well. Some feed has, however, to be got from the sea, and this introduces more sea salt, and more sulphate and carbonate of lime and magnesia, but "nothing to hurt." A port is reached and the boilers are blown out. Now the blowing out of a boiler induces, as is well known, a powerful vibratory action. In other words, the boilers, and sometimes the whole ship, are violently shaken. At the same time the tubes, and, indeed, all the heated surfaces contract as the boiler cools, and the result is that the scale is cracked, shaken off the tubes, and falls loose on the furnace crowns. When the boiler is cool and empty, a man gets in and sweeps out all the loose deposit. In nine cases out of ten no scaling tools will have to be used. The boiler is filled up again, and all goes well until another port is reached, when the process is repeated. If, now, the engineer does not get an opportunity to open his boilers, the more he blows them out and changes the water the worse. On the one hand, if he does not change the water he finds by his salinometer that it is growing denser, and he has every reason to fear that he will have his boiler salted up; on the other hand, if he does blow it down and fill up fresh from the sea, although he avoids Scylla in the shape of salt, he falls into Charybdis in the form of lime deposits. If water is to be changed at all, it is best done at sea through the scum cocks, as much care as possible being taken not to shake the boilers by the operation. By doing it at this time the effect of cooling and contraction does not come into play. If the boiler is not cleaned out, the incoming water finds a great deal of deposit lying loose in the boiler; this is stirred up, and being joined by fresh deposit, a thick coating is soon formed on the furnaces, which constitute a most inviting locality for deposit. The process of blowing out and filling up again without cleaning out the boiler has only to be repeated a few times to secure the overheating of the furnaces and their partial collapse. Let it be borne in mind that the time of danger is when the fires are banked or the boilers are otherwise cooled down. Then there is always set up a strong tendency for the deposit to flake off the tubes and fall on to the furnace crowns; and we need scarcely point out that any little incipient depression makes an admirable receptacle for deposit whose presence aggravates the evil. No doubt this was the reason why the steamer to which we have referred collapsed her furnaces in the river. The fires had been banked, and the boilers allowed to cool a little after about a fortnight's hard steaming; the deposit previously floating in the boiler settled on the furnace crowns, already very dirty, the last straw broke the camel's back. Had she gone straight into dock without delay she would probably not have needed new furnaces.

Under the existing system of hurry and rush, engines do not get fair play. A ship comes into harbour after ten or twelve days' steaming, and she leaves again in thirty-six hours. It is impossible in such a time to blow down and cool a boiler enough for a man to get into it, clean it, and allow proper time to refill it and get up steam. It should be impressed by owners on captains, especially when the voyages are long, as to India, Australia, or New Zealand, that opportunities must be given to engineers to clean out their boilers; and we would impress on engineers that the cleaning out of boilers is imperative. The changing of the water, and the frequent blowing and scumming, with the notion that deposit will be avoided, is entirely wrong. Cases have been known where the water in a boiler was not changed for six weeks. The water acquired a density of $\frac{4}{33}$, but no evil effects of any kind ensued, and the plates were free from deposit in injurious quantity. When it is impossible to get into a boiler and clean it at frequent intervals, then care should be taken to waste steam as little as possible—the jackets should drain into the hot-well, not into the bilges—and to work with the same water over and over again, it must not be forgotten that what could be done with impunity with steam of 50 lb. or 60 lb. pressure must not be done with steam at three times that pressure. It was thought that Fox's corrugated flues would introduce a new era in boiler construction. So they have, but they will collapse just as freely as the plain flue if they are allowed to become overheated; and a corrugated flue is more likely to collect dirt than a plain flue. If it had not been for Mr. Fox, high pressures could not be carried at all in marine boilers of the existing type; but the corrugated flue will not make up for the neglect which captains too often manifest for the well-being of their machinery.

THE ANNUAL REPORT ON EXPLOSIVES.

The annual report of her Majesty's Inspectors of Explosives is always a very carefully prepared document, and is remarkable for the mass of facts which it records. The use of explosives is a very different matter now compared with what it was before the era of gun-cotton and dynamite commenced. The variety of explosives now in existence, and the extent to which they are employed, make the subject one of a very comprehensive and important character. The surveillance which the State bestows upon the manufacture, storage, and transport of explosives involves enormous labour and vigilance on the part of the officials who have to see that the law is respected. Colonel Majendie, as is well known, holds the post of Chief Inspector of Explosives, and associated with him are two inspectors, Colonel A. Ford and Major J. P. Cundill, R.A. In the annual report just issued these authorities state that they have inspected every factory and magazine on their books at least once during the year, and many of them more frequently. The law, they consider, is working satisfactorily, and the regulations are, upon the whole, more faithfully observed than formerly. One defect remains, and that is the occasional apathy and carelessness of the local authorities. Of course, it is extremely desirable that the use of explosives should not be trammelled by vexatious restrictions. On the other hand, the safety of the public has to be considered, and also the lives of the workpeople. A state of things arose some years ago which exposed London and other towns to perils far greater than any which Fenianism ever contemplated, and the passing of the Explosives Act was simply imperative to prevent disasters in contrast with which the outrages which have recently alarmed the metropolis would be but trifling. Wagon-loads of gunpowder were at one time conveyed through London with no more precaution than if the contents of the barrels had been so much beer. We cannot say that all perils are at an end even now. The importation of explosives is occasionally marked by some curious incidents, as the other day at Liverpool, where there was imminent risk of a vessel being blown up with twenty-five tons of dynamite on board. The small fines inflicted on the offenders offer but small guarantee for future good behaviour. Something worse than the blowing up of the Lottie Sleigh, with her twelve tons of gunpowder, is possible in these days. It is true that dynamite is not so far-reaching as gunpowder in the radius of its mischief; but it has the capability of playing some awkward tricks of which gunpowder would be innocent. When some three months ago a floating magazine, with fifty tons of dynamite on board, sank at her moorings in Hole Haven, it was an unpleasant suggestion that when the dynamite became saturated with water the nitro-glycerine would float to the surface, and collect into masses, which would harden, and when violently struck might explode. There were stated to be as many as nine dynamite ships in the vicinity of Hole Haven, but the inhabitants of Canvey Island and the parts adjacent were said to be under no particular anxiety, either concerning the sunken ship or the others still afloat. In like manner the contiguous population endure the enormous stores of gunpowder at Purfleet. The public generally do not think about these things, and it is, perhaps, well they do not. But somebody must attend to these matters, and it is satisfactory to know that the Imperial authorities are on the watch to see that no harm accrues from the presence of explosives, often stored in large quantities, such as could not be fired without causing great alarm and probably a serious amount of damage.

That the most practised skill is not proof against the possibility of accident, is shown by the mishaps that occur where Government authorities are themselves concerned. A very especial "irony of fate" is supposed to consist in having "the engineer hoist with his own petard." Something of the sort occurred at Lydd early last year. Experiments were being carried on at the instance of the War-office by the Departmental Committee on Laboratories, the object being to ascertain the probable behaviour of a quantity of dry gun-cotton discs, packed in tins as for service, and exposed to the action of fire. As many as 826 tins were put into a wooden hut, the quantity of gun-cotton being one ton. The hut rested on railway bars supported by six brick piers, the space beneath the bars being filled with combustible materials. The pile was set on fire by Sir F. Abel, who immediately retired; but he had only gone as far as thirty or forty yards from the hut, when the mass exploded, only twenty seconds after ignition. According to the War-office report, Sir Frederick was "thrown violently down and considerably hurt by the fall and by pieces of shingle, wood, and metal driven against him, his clothes being at the same time very much torn, and penetrated throughout in many places." The experiment was entirely successful in one sense, and serves as a very "useful illustration" of more than one law which governs the action of explosives. But it was hardly worth while to run the risk of losing the future services of the War-office chemist in order to learn over again what had been learned before, namely, that while small quantities of explosive matter may be burned safely, it may happen otherwise when the same compound is employed in large quantities. Colonel Majendie seems to think that the Lydd experiment was scarcely needed after the experience gained at Eastbourne in 1872, when only 6 cwt. of dry gun-cotton packed in strong wooden cases exploded with great violence under the action of fire. One singular fact made evident by the Lydd experiment was the limited "range of flash." Notwithstanding the violence of the explosion, and the circumstance that Sir F. Abel was close at hand, Sir Frederick suffered no scorching whatever. The intensely local character of the explosion is also shown by the entire immunity from shock experienced by persons 180 yards distant. A still more striking example of the extremely localised nature of these violent explosions is afforded by the disaster which took place near Kimberley, at the Cape of Good Hope, only a fortnight before the affair at Lydd in our own country. In this other instance, more than 30 tons of dynamite exploded *en masse*, together with a considerable quantity of gunpowder. The shock was tremendous. Doors and shutters were burst open within a radius of 1½ miles, windows were broken up to 1¾ miles, and ornaments were shaken from their shelves up to 2½ miles. But the town of Kimberley, distant only about three-quarters of a mile, being screened by the configuration of the ground, escaped structural injury. It is said that the shock was felt at a distance of twenty miles, and yet men who were working at a distance of only 500 yards from the scene of the explosion, and without the slightest protection, escaped unhurt. It is to be hoped that no explosion of this magnitude will occur in the vicinity of an English town. Last September 14 lb. of gun-cotton in process of drying in an experimental oven at the Royal Gunpowder Factory, Waltham Abbey, exploded and caused considerable local damage. Windows were broken up to 300 yards, and *débris* was projected to a distance of 100 yards. The gun-cotton was heated and confined, hence the violence of the explosion. A "carcase" shell burst at Woolwich Arsenal and caused somewhat serious injury to an officer in the Royal Artillery; and in the autumn some gunners were severely injured during experimental practice at Shoeburyness, a shell exploding prematurely. When Colonel Majendie writes the history of 1885 he will have to record the far more terrible disaster which took place at Shoeburyness last spring, when a perfect sweep was made of some of the most eminent artillerists of the day by the explosion of the Lyon shell. Strange and powerful explosives are being handled in unaccustomed ways in these days, and it may be feared that accidents of a serious character will occur from time to time in which even the experts will be taken by surprise. Explosions of another sort have lately plagued the metropolis, a quasi-political conspiracy having made use of dynamite in the execution of its wretched designs. The results, although hurtful enough, have fallen far short of what might have been anticipated, and the public have been by no means panic-stricken at the miserable exploits of the dynamite faction. The most diabolical device seems to have been that of the dynamite bombs seized at Birkenhead when John Daly was apprehended. Experiments showed that these contrivances would have been terribly fatal if employed for the destruction of human life.

The list of explosions enumerated by Colonel Majendie is remarkable for its extent, and for the diversity of the circumstances. To the Chief Inspector it must almost appear as if explosions were the normal condition of things. But he is able to announce some degree of improvement. We have referred to the danger which formerly accompanied the conveyance of explosives. Since the passing of the Act, now ten years ago, there has been only one year, namely, 1883, in which there has been any accident connected with this kind of conveyance. There is one class of casualties over which the Act gives no control. This comprehends the "use" of explosives, and here the accidents show a decided tendency to increase, the number being seventy-five last year, as compared with sixty-four in 1883 and fifty-one in 1881. In the "keeping" of explosives there were only two accidents last year, and in neither case was anybody injured. Concerning the the accidents which arise in the "use" of explosives, it is singular that while there is somewhat of an increase in respect to gunpowder, there is a decrease in the case of dynamite. Possibly the improvement in this latter instance is due to the warnings and instructions issued by Colonel Majendie's department. An interesting chapter in the report has reference to "experiments." Here we are carried into the region of artillery, and an account is given of the investigation conducted at Woolwich Arsenal with a view to test the liability of certain slow burning gunpowders to explode when set fire to, and to communicate explosion to other like powders. A charge of 97 lb. of Waltham Abbey "cocoa" powder was fired at a distance of 4ft. from a similar charge, each being contained in a case composed chiefly of cork and canvas. The result was a "dull explosion" of one cartridge, the adjoining case being not even overturned. The experiment was repeated at a distance of 2ft., and then at as little as 6in. The adjoining cases were overturned by the shock, but in no instance were their contents fired. In the next place a charge of 85 lb. of Rottwell's "cocoa" powder was fired, a similar charge being placed at the distance of 6in. The ignited powder threw up showers of burning prisms, but there was no explosion according to the usual meaning of the term, neither was the contiguous cartridge fired. The general result of the experiments was to show that with all slow-burning cannon powder the risk of communicated explosion, at least up to about 100 lb., is very small, even when the intervening protection is extremely slight. The firing of such powder, when the quantity does not exceed 100 lb., and there is no confinement beyond that of the ordinary cartridge case, simply leads to a rapid deflagration, unaccompanied by any distinct report. It is curious that these sluggish powders ignite under the impact of a rifle bullet. While gunpowder may thus be made to behave with mildness, attention is drawn to the perils connected with the lighter kinds of petroleum. The vapour of benzoline is a fruitful source of peril, of which a painful example has occurred within the last few days at an oil-shop in Bermondsey. Colonel Majendie is of opinion that the law should take cognisance of mineral oils, whether volatile or not. The Petroleum Act is at present limited to oils which flash at and below a certain temperature. But when a petroleum store is in a blaze it is found that explosions sometimes occur with oil which is outside the purview of the Act. The subject has been frequently referred to in these columns, and possibly the law will be amended when some alarming catastrophe comes to pass.

BASIC STEEL.

In the address delivered by the President of the Institution of Mechanical Engineers, at the Lincoln meeting of that body, a point of considerable present importance to both the makers and the users of steel was raised. Touching the relative advantages of iron and steel for the building of ships, Mr. Head pointed out that under present circumstances materials eminently suitable for shipbuilding and far superior to iron are virtually excluded, because they do not coincide with the formula for steel intended to be used in reduced thicknesses. The material specially referred to is the steel made by the Bessemer basic process. Although this process has now been before the public for several years, and has been employed successfully in the manufacture of steel rails and bars, it has not, so far as we know, been used to any appreciable extent for the production of ship-plates in this country; and in the few instances where to our knowledge it has been so employed the results have not been encouraging. The reason of this, according to Mr. Head, is not far to seek. Lloyd's Committee has fixed the strength of steel for shipbuilding at from 28 to 32 tons per square inch for all thicknesses. To this requirement no exception could reasonably be taken by steel makers using the Martin-Siemens open-hearth furnace. Ever since the introduction of mild steel material has continued to be produced within these limits of tenacity with ease. But what is easy of attainment with Martin-Siemens steel is, we are told, difficult, if not impossible with the Bessemer basic metal. That material comes up to, and, indeed, considerably exceeds, Lloyd's requirements with certainty and regularity in every respect but one, and that one is the tensile strength. In this particular it stands at from 24 to 28 tons to the inch, instead of standing at from 28 to 32 tons. Unless, therefore, the method of manufacture of basic steel can be so improved as to render the material capable of withstanding a higher stress, or the present limits of tensile strain demanded by Lloyd's can be reduced so as to admit of the weaker steel being used, the extension of the production of basic steel will be effectually cut off, so far, at least, as concerns shipbuilding. That this result is not one to be accepted by the steel makers and shipbuilders of the country, except under compulsion, none will dispute. We have it upon excellent authority that the basic process is the only means by which five-sixths of the ore of this or any other country can be utilised at all for steel-making. Our own great abundance of native iron ore, which would be suitable for making steel for shipbuilding if the basic process were available, is now being neglected, whilst our makers have to import from Spain and elsewhere the description of material which alone is suited to the Martin-Siemens process. Whatever opinions may be held respecting the conclusions arrived at by Mr. Head, it will be generally admitted that the question which he has so pointedly raised is one demanding the serious consideration of every one interested in the manufacture or in the employment of steel for shipbuilding. Already we are not without evidence of the fact that attention is being devoted to the subject. We observe from the reports which have been appearing in the local daily press of the proceedings of Lloyd's Visiting Committee on the North-east Coast, that the matter has been brought prominently before them by some of the steel makers there; and at the approaching meeting of the Iron and Steel Institute at Glasgow, the centre of the great Scotch iron and steel manufacture, we shall doubtless hear more of the question.

If it be assumed that the manufacture of steel by the Bessemer basic process has arrived at a stage beyond which it cannot advance in the direction of greater uniformity of quality, and if it can be shown, as we believe it can, that the material now produced by that mode of manufacture will comply with all reasonable tests, Lloyd's, we take it, must modify their existing rules to admit of the introduction of basic steel into shipbuilding. That they will do this if the occasion arises we have no doubt. We must admit, however, that to our mind basic steel will be under great disadvantages as a rival to Martin-Siemens steel if it cannot be produced with practical trustworthiness above 28 tons per square inch. Basic steel will not be entitled to the maximum reduction in thickness of 20 per cent. allowed by Lloyd's in the case of steel of higher tenacity. It will indeed be subject to but little, if any, reduction at all from iron. It is well known that the reduction of 20 per cent. is nominal, and can never in any case be maintained throughout the entire scantlings of a vessel. A maximum reduction to the extent of, say, half that amount or less would work out in practice to a very trifling percentage. To all intents and purposes, therefore, a ship built of basic steel will require scantlings of the same thickness as those now prescribed for iron. In the present day, when light ships mean larger profits, and when the whole aim and tendency of shipbuilders have been to produce the lightest and fastest ships consistent with safety and with the economical use of engine power, the introduction of basic steel may be regarded as a step backwards. We should be sorry to see the basic steel of low tensile strength supplanting the Siemens steel of high tenacity. As the dead weight ocean carriers of the world, we cannot afford to give up a material, the great strength and lightness of which in some cases enable a few hundred additional tons of cargo to be carried beyond what would be possible in a sister vessel built of iron. Although basic steel as at present manufactured, however, is inferior as a constructive material to the higher class steel, it can, we believe, be produced at considerably less cost—at no greater cost indeed it is said than iron. That this will tell greatly in favour of basic steel will not be doubted by anyone who is acquainted with the circumstances under which steel has come to be used instead of iron in many cases. At present marine boilers are nearly all made of steel, because steel is obtainable at a lower price than iron of the quality hitherto used for boiler-making. On the other hand, only about 25 per cent. of the vessels built in this country are constructed of steel. Steel is used for shipbuilding, not because, but in spite of the difference in cost of material. In all cases where the advantages of using high strength steel have been sufficient to compensate for the increased price of the material, basic steel of low strength and reduced price is not likely to supersede Siemens steel. Where, however, the enhanced cost of steel has prevented it from taking the place of iron, basic steel may be used with great advantage to all concerned. We cannot altogether share the over-sanguine expectations of the writer of an appreciative article on the subject in a Newcastle contemporary. But that basic steel will entirely replace iron for shipbuilding, and that at no distant date, we have not the slightest doubt.

That being the case, we would put it to the steel makers who are employing this process whether they cannot introduce such modifications of the mode of manufacture as will enable them to produce a material of the highest necessary tensile strength. Steel rails of thirty-five tons and upwards are made by the basic process, and steel plates of twenty-eight tons and downwards; but why steel plates of an intermediate strength and of suitable quality cannot be made we have yet to learn. With the science of metallurgy brought to such a state of perfection that our chemists can tell precisely what will be the effect in the finished plate of a given quantity of any of the constituent elements of the unmade metal, surely it ought not to be a matter of supreme difficulty to determine what alteration in the ingredients would effect the object in view. The opportunity which will be afforded by the meeting of the Iron and Steel Institute next week, of having the whole question in all its bearings fully discussed by the first authorities on the subject, should not be allowed to pass without this being done. Be that as it may, everyone will endorse the opinion of Mr. Head that it is a disgrace to us as an iron and steel producing nation that we import foreign material to build those splendid steel ships which are the pride of the ocean, and neglect our own inheritance of native iron ore. Such a state of matters cannot be allowed to continue, and we must call upon the steel makers and upon Lloyd's to work out between them the solution of what to us appears a by no means insuperably difficult problem.

AMENDMENT OF THE PATENT ACT.

We print elsewhere the text of the Patents, Designs, and Trade Marks Amendments Act, which received the Royal assent on the 14th inst. The "doubts" alluded to in the second section arose immediately after the commencement of Mr. Chamberlain's Act in 1884, when every declaration accompanying an application for a patent was required to bear a half-crown stamp, on the ground that it was made under the Statutory Declarations Act of 1835. This raised a hubbub amongst patentees, who looked upon it as an attempt to add two-and-sixpence to the patent fee. The Office stood firm, and a very large number of papers were returned to be stamped; but at length it dawned upon the official mind that the public might as well have the benefit of the doubt, and sundry half-crowns found their way back to the pockets of the inventors—a fact which deserves to be recorded. The question should never have been raised. It was done, we believe, by some meddling under-strapper, who has by this time probably done mischief enough to justify the addition of C.B. to his name. It is understood that the present formal declaration before a magistrate, or a commissioner for oaths, will shortly be abolished, so that an invention may be stolen with an easy conscience, and without fear of a prosecution for perjury. The power given to the Comptroller under Section 3 is very useful, but the extension of the period for lodging a complete specification is too short. It is difficult to see why a specification which is delayed for a month should therefore require three months longer to accept and four months longer to seal. The acceptance and the sealing are merely official acts, the latter involving nothing more than the filling up of a printed form. Section 4 is a decided improvement, as it annihilates at a blow the entire brood of dropped provisional specifications which have always been a source of trouble. The section would seem to be retrospective in its operation, and to apply to all applications under the Act of 1883. There may, perhaps, be some doubt upon this point, the practice hitherto having been to allow such lapsed applications to be inspected on payment of a fee, but they have not been printed or published. The doubts which Section 5 professes to clear up were invented by the writers of certain text-books. Perhaps it is as well that they should be cleared up, although they are of a purely speculative character. Section 6 corrects an obvious blunder.

We miss from the Act any provisions for remedying the defects in what may be termed the judicial department of the Patent-office, which defects have been pointed out of late in a manner which must be highly unpleasant to those concerned. Steps were taken to introduce a clause into the Bill empowering the Board of Trade to appoint *ad hoc* a properly qualified person to hear oppositions, but it was felt that this did not meet the whole of the case, and that a more drastic remedy was necessary. Although the Act came into operation on the 14th, inventors cannot yet take advantage of it, the necessary rules and scale of fees not having been issued.

FOREIGN COMPETITION.

It is rather suggestive that just at the time when the Royal Commission on Trade is getting into form for the commencement of its labours fresh complaints are to be heard from the Staffordshire and Birmingham manufacturers of the keenness of foreign competition. Recent instances are, too, adduced of the growth of this competition, not only in the Colonies and in neutral markets abroad, but also in the home centres. Staffordshire ironmasters are complaining of the increased severity of the Belgian and the United States competition, and the machinists of Birmingham are complaining of the competition of the Germans in the matter of lifting jacks, drilling machines, crabs, winches, and such like machinery. It is in the Antipodean, South American, and Spanish markets that the competition is particularly met with, and it is mainly on account of their low prices that the Germans are successful. Merchant orders are being placed with German firms which previously came to Birmingham. The wrought iron tube makers of Birmingham and Staffordshire are complaining of the success which is attending the introduction of tubes of German manufacture into the London market. The lock makers have long complained of German competition, and just now enamelled hollow-wares of German manufacture are beginning to get into circulation in consequence of their lower prices. A singular feature of the competition in this last branch is that the Staffordshire enamelled ware manufacturers are themselves carrying round the foreign articles to customers, and the only explanation is that, in times like the present, manufacturers have to make money as best they can. The coach ironwork makers of Wednesbury this week complain of the successful introduction of a French coach clip of superior manufacture. Unlike the English article, which is of wrought iron, the French clip is stamped, and presents a finished and pleasing appearance. Birmingham and other merchants are now ordering the French article in large quantities, instead of sending their orders to Wednesbury. Most of these complaints have the same origin, namely, the refusal or inability on the part of our manufacturers and men to adapt themselves to changes, and to the requirements of the markets. Instead of this they endeavour to make markets suit their manufactures, France, Wednesbury must expect the orders to go abroad. hence their reluctance to change. If the foreign manufacturers produce improved articles, they will have the market, and if Wednesbury cannot produce as good a clip as is obtainable from

STEAMSHIP INSURANCE.

In the balance-sheet of a large steamship company on the Tyne there is a statement regarding the cost of insurance which is well worth attention. The company in question owns several steamers, estimated to be worth about £117,000. In the past half-year it has paid for insurance a little more than £6600, or at the rate of £13,200 per annum. This is a comparatively high premium, and it is perhaps of all others the one which is the most glaring in the accounts of steamship owners. Indeed, it may be said to be the most costly item in the expenditure on a steamship, and it is one which does not seem to show any fall with the earning power of the vessel. In the case we have named the steamers earn in the six months about £42,000, and thus the amount of the insurance is not much less than one-sixth of the total earnings of the steamers. It is evident that such an enormous cost must, in the present dull state of the shipping trade, handicap it seriously, and must have a reflex action upon the state of the shipbuilding and marine engineering industries. It is of the utmost importance that that heavy cost should be reduced, and now that there is a proof that the figures of the Board of Trade in regard to loss of life at sea were "incomplete" and inaccurate, it is well worth the consideration of the shipowners and of others concerned whether the whole energies of those connected with the Commission should not be devoted to the task of endeavouring to lessen the loss of life and of property at sea, and thus of reducing the heavy drain on the resources of the nation which is going on, and which finds one of its results in the extraordinary cost under the mutual insurance system we have noticed above.

PROSPECTS OF REVIVED TRADE.

Though trade has rarely been in a more disheartening condition than at present throughout the whole of the South Yorkshire district, there is a remarkable unanimity of opinion that the corner has been rounded, and a better day is about to dawn. The chairman of one of the leading industrial concerns in the Sheffield district spoke hopefully last week of the future as regards the businesses carried on by his company in steel and iron production. The head of the greatest cutlery establishment in the world, though admitting that affairs have rarely been worse in the general condition of business, is convinced that the signs of the times are towards more activity in cutlery and hardware, not only for the home markets, but for the United States and the colonies. Other authorities entitled to speak on the point concur in these views, and altogether the situation seems more hopeful than at any period of the year. The beginning of confidence in commerce is usually the end of adversity. There are no fears of any foreign complications to harass our distant markets, and though the general election will unsettle home affairs for a time, it is not, as in America, a general stoppage of business which ensues; and then there is almost the certainty of another abundant harvest to make the prospects brighter in the rural districts, which, in their turn, react favourably on the large centres of manufacturing industries. At the same time, with decreased traffic, there is a significant rise in the value of American railway stocks, while home railroads keep at firm quotations.

LITERATURE.

Die Steuerungen der Dampfmaschinen. By Emil Blaha. Julius Springer, Berlin, 1885.

The subject of this book, as the title indicates, is the valve gears of steam engines. A complete and thorough-going special treatise on this subject in the English language would be very welcome at the present time. Zeuner's "Valve Gears" is to be had in English, but is not what is wanted. As the author of the book now under review says in his preface, there have been few departments of mechanics in which inventive talent has worked so strenuously in recent years as in that of valve gears. The progress in this section of design is so rapid that even the volume before us, whose preface was written at the end of last year, is by no means up to date. For instance, it makes no mention of Marshall's or Joy's gears, nor of Davey's "differential" engine valve gear. It gives a brief description of Brown's gear, which may be said to be the forerunner or parent from which many others have been developed, but which has been now so much improved on that we suppose no one would think of using it anew in its original form. The most recent examples of design which this book contains are the new Sulzer and A. Collmann's, which appeared first at the Paris Exhibition of 1878. The principal motion of the new Sulzer gear is a wonderfully beautiful adaptation of very simple means to attain a final motion which is by no means simple in its character. The drawing of this gear at once suggests further improvement in the direction of simplification of mechanical detail, more especially in the connection between the governor and the cut-off trip gear.

Professor Emil Blaha's book consists of 183 pages of text and thirty plates, containing in all 238 figures. Both text and plates are singularly free from errors in printing. Nothing is more trying to the reader of a book like this than to find discrepancies between the letters as placed in the diagrams and those used in the text. Throughout the whole of the plates we have detected only one or two such misplacements, which says a great deal, not only for the engraver, but also for the painstaking conscientiousness of the author's revision.

The whole subject is divided into slide valve gears, lift valve gears, Corliss gears—Präcisions Steurungen—and rotary valve gears. Among the elementary explanations given at the beginning occurs a very neat diagram, showing the accurate position of the piston for every angle of crank rotation, taking into account the obliquity of the connecting-rod. The diagram is easy to draw, for it consists simply of two circles, whose radii are the connecting-rod length, and this minus the crank radius, the centres being placed distant from each other by the crank radius or half-stroke. This is Müller's diagram, and was given in Müller's translation of Zeuner's work in 1869.

Considerable space is devoted to the construction and uses of Zeuner's well-known slide valve diagram. This diagram is no doubt used more now in England than it used to be, but we question whether it will ever become very popular. It has this inconvenience, that in using it one must imagine the dead points and the direction of rotation of the crank reversed. This is always confusing. What are its advantages? It shows the displacement of the valve for each angular position of the crank, but so does the simple circle representing the path of the excentric circle with quite as great if not greater accuracy. This displacement is shown in Zeuner's diagram in a variable direction, which never coincides with the true direction except at the dead points; the simple circle above referred to shows it always in its true direction. A diagram may easily be drawn on cardboard which will give permanent means of solving all simple slide valve problems without further drawing, and with no calculation beyond adding or subtracting one or two numbers read off the card, and this too taking into account the obliquity of the connecting-rod. It consists simply of a circle with two separate scales marked round its circumference, the diameter of which is divided into, say, 100 parts. The diameter is taken to represent to two different scales the strokes of the piston and of the valve. The writer has used this for many years, and when so simple and accurate a device is at hand he is certainly not likely to take the trouble of drawing out Zeuner diagrams, which after all leave one without any means of taking account of the connecting-rod obliquity. This latter must be dealt with by a separate construction. Any one who has ever attempted the simplest designing in this subject knows that it is inadmissible altogether to neglect the effect of this obliquity.

A very considerable number of different forms of the slide valve is given in Blaha's book. It is curious to note how few of the possible forms are used in common practice. Various forms of expansion slides are also described, and the Zeuner diagram is used to elucidate the motion of the top slide over the under.

This part of the book contains little or nothing that is new. It is followed by analytical investigations of the various slide valve reversing link motions, Gooch, Stephenson, Allan-Trick, Heusinger von Waldegg, Pius Fink, Deprez, Klug, and Brown. All these are solved first for the symmetrical cases mostly met in practice, and then for the general case of the two excentrics having different radii and angular advances. All these solutions are confessedly approximative. There seems to be a fatality hanging over authors on subjects like this that drives them invariably to the algebraic or cartesian methods. The more complicated and difficult the problem is of solution by this method, the more tenaciously do they seem to cling to it. Their pages thus become filled with the longest and dreariest arrays of equations, and at every turn one finds oneself making a new "approximation" in order to get over some new difficulty. At the end one feels quite uncertain whether the sum total of the "approximations" has not led one considerably astray from the truth. We cannot blame our author here much, because he has only faithfully reproduced what others have done before him. But now that modern geometry has advanced so far, and graphic methods are so generally employed, surely it is time that all this should be reformed in our text-books, and that the more powerful and more exact modern methods should be introduced in the teaching of such subjects as this now under consideration. It takes four heavy pages of the above mathematical equations to prove that the motion of the valve obtained from any of the foregoing link motions is approximately the same as would be given by a simple excentric of suitable dimensions. But a simple diagram and three or four lines at most of geometrical explanation are quite sufficient for the purpose. The labour of obtaining the general approximative equation is so great that the author sticks to it and applies it freely, even when a little consideration of the geometry of the case would show that the approximation has become a very rough one indeed, as in the cases of the Brown and the Deprez gears.

In the chapter devoted to "Präcisions" gears our author uses graphic methods to a greater extent. He defines the essential feature of this class of valve mechanisms to be that the cut-off is wholly regulated by the governor. Further, the steam valve, he says, opens gradually and closes suddenly; but we find a slight inconsistency here, because in one of his sub-classes the opening and closing of the valve takes place both nearly at the same rate. He has three sub-classes of "Präcisions" gear, viz., (*a*) the trip mechanism is disconnected by the direct action of the governor; (*b*) one or other of the two teeth or tappets of the trip mechanism is shifted in position by the governor; (*c*) the general configuration of the link work is shifted by the governor. That part of the mechanism extending from the trip arrangement to the valve is called "passive," while the rest of the link work, which is continuously in motion, is called the "active" part. The two teeth or tappets, which engage only during the period of admission, are distinguished as the "passive" and the "active" tappets, and a further sub-classification depends upon whether the governor acts upon the active or the passive part of the mechanism. The need of this somewhat minute subdivision arises from the very large number of patented mechanisms which come under this class, many of which, however, differ not at all in principle and hardly at all in constructive detail. The gears described at length are the old and the new Corliss; those of Inglis and Spencer, of Bede and Farcot, of Welner, the old and new Sulzer, that of Regnier, and those of Collmann and of Brown.

Rotary valves are divided into oscillating and continuously rotating valves. The former hardly needed to be treated separately from ordinary reciprocating slide valves, as their geometry is exactly the same, and they obviously present no points of advantage. The latter may either be flat, as in Brotherhood's three-cylinder engines, or of cylindrical or taper-plug form. The geometry of the motion of both these latter is precisely the same, although, of course, the constructions of the valves are extremely different. These valves, especially the cylindric or slightly conical, present many advantages, chiefly as regards the avoidance of frictional resistance to motion. Their relative disadvantage is that by no ready means can the speed of closing be made great, while that of opening is left gradual. The wear also is not easily taken up, and this is the more important the less perfect the balancing is. Again, it is not this form alone that permits of perfect balancing. An example of a perfectly balanced flat-faced slide valve is seen in Outridge's patent, which deserves to be more known than it is.

We can compliment Herr Blaha upon producing an excellent text-book. If some Englishman would follow his example, and at the same time improve upon his performance by using exact graphic methods in preference to tedious and inaccurate analysis, and also by describing the most recent valve gears as well as the older ones, the British engineering public would be benefitted.

BOOKS RECEIVED.

Practical Treatise on the Construction of Tall Chimney Shafts. By Robt. M. Bancroft and Francis J. Bancroft. Manchester: J. Calvert. 1885.

Memoirs of the Tôkiô Daigaku. University of Tôkiô. No. II.

A System of Iron Railroad Bridges for Japan. By J. A. L. Waddell, C.E., B.A.Sc. Published at the University, Tôkiô, 2545 (Japanese era), A.D. 1885. Text and plates.

Aid to Engineering Solution. By Louis D'A. Jackson, C.E. London: Longmans, Green, and Co. 1885.

The Civil Engineer's Pocket-book. By John C. Trautwine, C.E. Twenty-second thousand. Revised and enlarged by J. C. Trautwine, jun., C.E. London: E. and F. N. Spon. New York: John Wiley and Sons.

Journal of the Society of Telegraph Engineers. No. 58. Vol. xiv. London: E. and F. N. Spon.

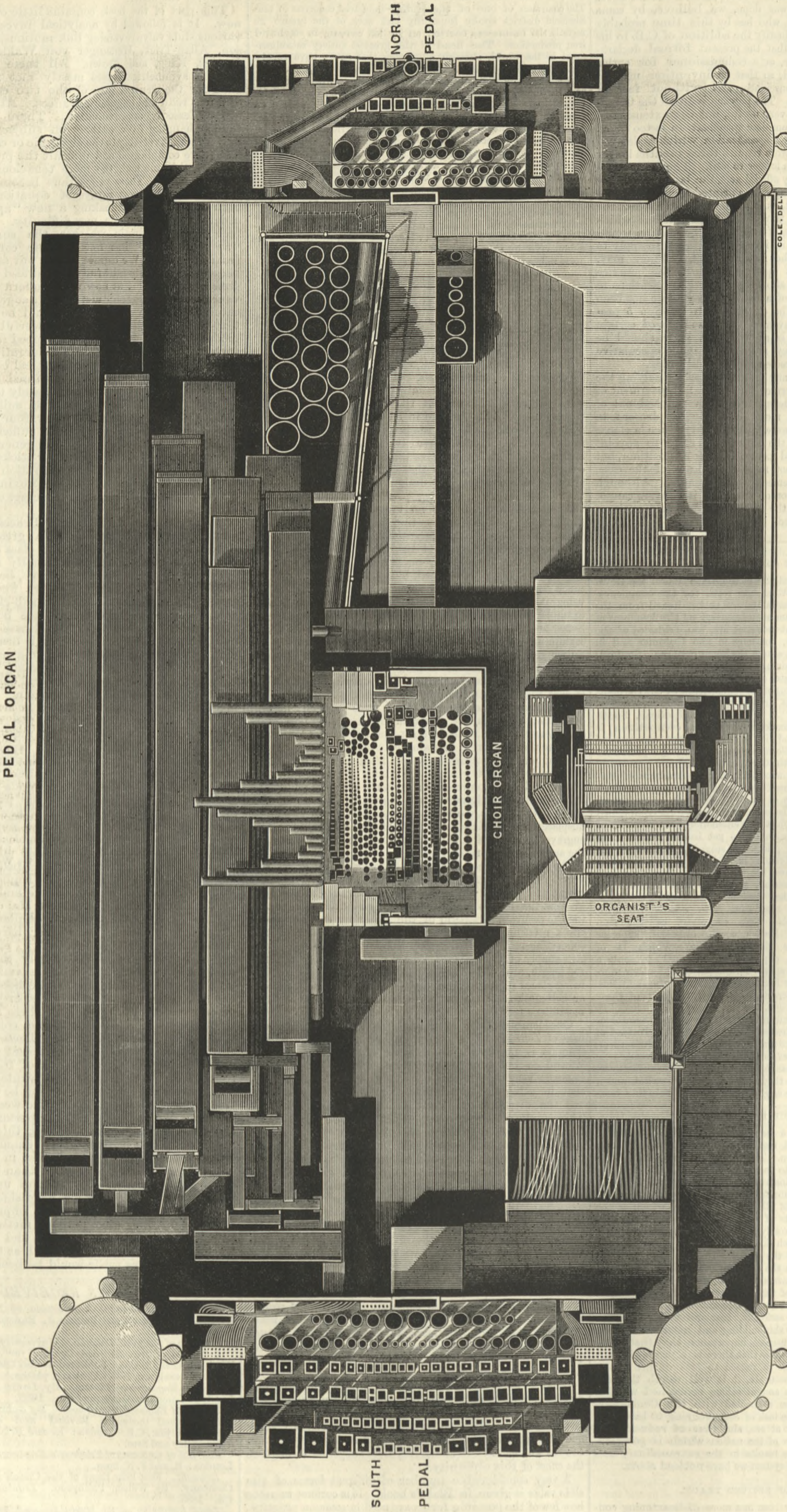
Draught. First Prize Essay of the Coach and Harness Makers Company. By William Phillipson. London: John Kemp and Co. 1885.

Land Surveying on the Meridian and Perpendicular System. By William Penman, C.E. London: E. and F. N. Spon. 1885.

THE NEW ORGAN, WESTMINSTER ABBEY.

MESSRS. W. HILL AND SON, YORK ROAD, LONDON, N.W., BUILDERS.

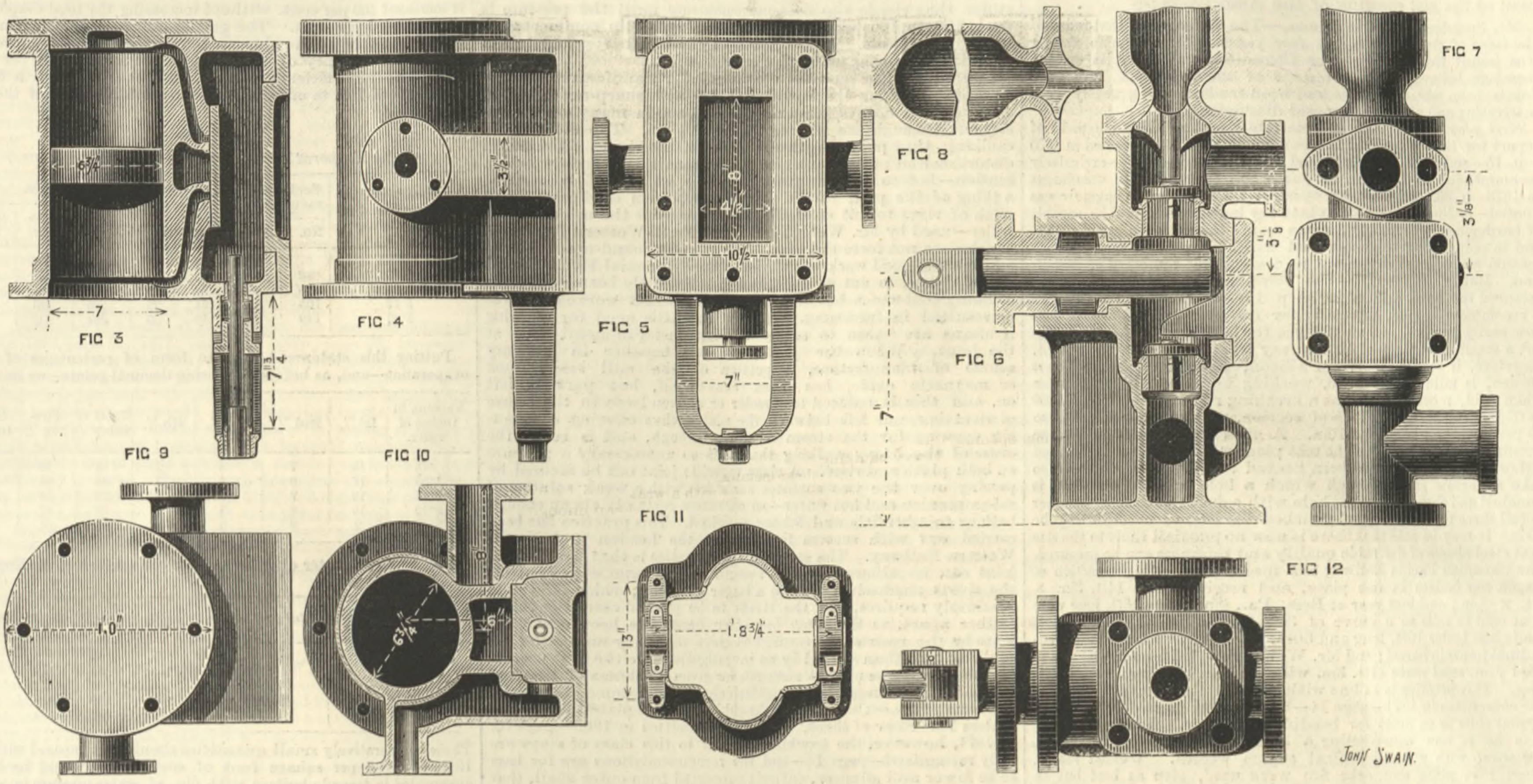
(For description see page 175.)

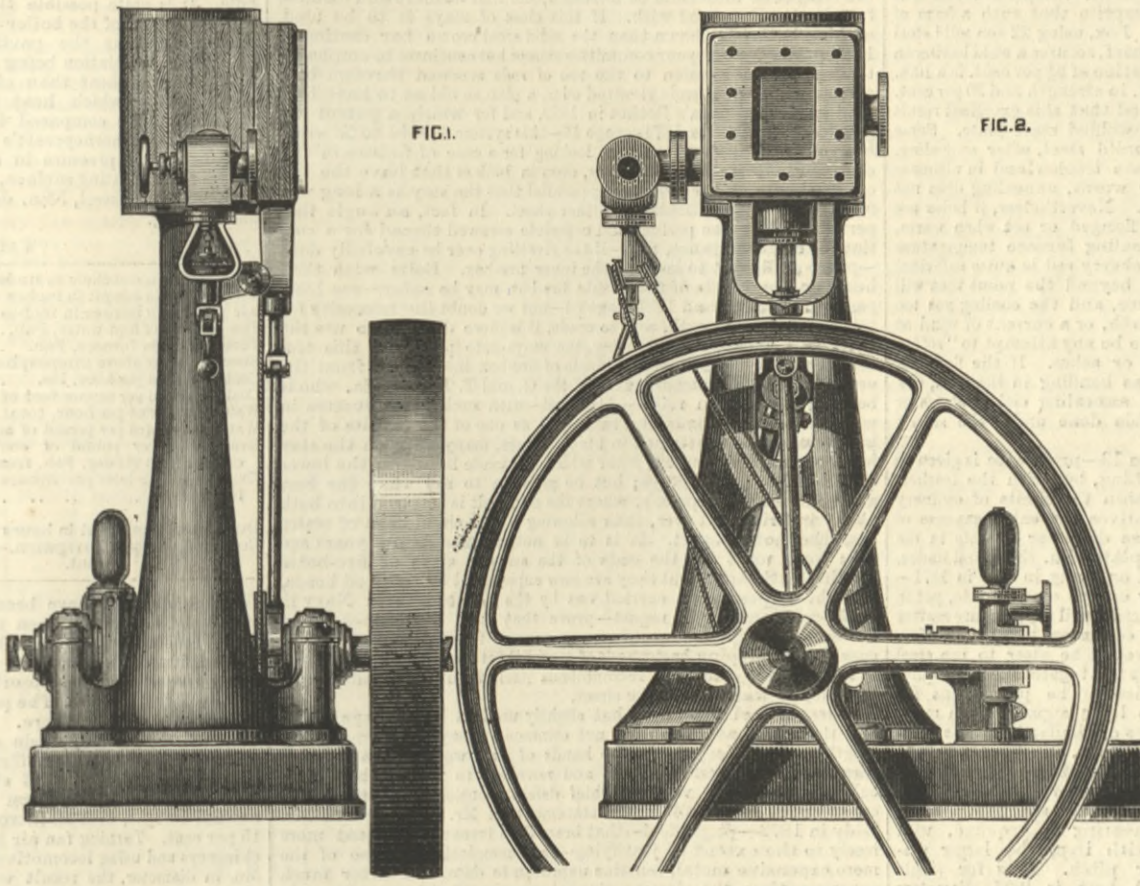


SECTIONAL PLAN AT LEVEL OF GALLERY

THE CLIMAX VERTICAL ENGINE.

THE LONDON AND COLONIAL ENGINEERING COMPANY, ENGINEERS.





THE accompanying engravings represent the type of vertical engines now being made by the London and Colonial Engineering Company, of Lombard-street, E.C., from the designs of Mr. Geo. A. Goodwin, of 2, Victoria Mansions, Westminster. The engines are simple in design and have several features worthy of notice. The engine illustrated is of 4-horse power nominal, the cylinder being 6·75in. diameter, and the stroke 10·75in. They are thus large for the nominal power, and the bed plates, fly-wheel, bearings, and crank shaft are all large. The governors are of a new form of high speed type. The engines are intended to indicate four times their nominal power when working with 60 lb. steam at 168 revolutions per minute. The construction of the engine and of the details is clearly seen from our engravings, and most of the dimensions are given. The crank shaft is 2·75in. diameter, the steam pipe 1·5in., exhaust pipe 2in., suction and delivery of feed pump 1·25. The engines are well designed, and offered at prices which the makers will no doubt have to increase. Their construction is sufficiently obvious from our engravings, though we may observe that the governors, which are shown in their position in Figs. 1 and 2, but not in detail, will be more fully illustrated in connection with another engine in a future impression. It should also be noted that Fig. 11, which is a section through the frame in plan, is on a small scale. The feed pump is shown by Figs. 6, 7, 8, and 12.

PRINCIPLE OF MAXIMUM WORK.—The following abstract is given in the *Journal of the Chemical Society* of a paper by Berthelot —*Bull. Soc. Chim.*, 43, 265-272:—"The principle of maximum work reduces the phenomena of chemical change to two fundamental data—the one, the heat evolved in the reaction taken by itself, the other, the heat change resulting from the dissociation of the reacting substances. Although it cannot at present be definitely stated that an absorption of heat never results from chemical action, yet such an absorption always results from a decrease of energy, brought about by dissociation of the original substances or their derivatives, or from a change of physical state and specific heat. These phenomena of dissociation, fusion, vaporisation, and in general physical changes, result from the temperature required for the chemical action; thus, chemical affinity, in so far as it is measured by the heat disengaged, is expressed by the sum of two terms, the one a constant, or the heat disengaged at 273 deg., the other variable with the absolute temperature. The latter function of the temperature can only acquire a certain value in cases in which dissociation has commenced, whether of the initially reacting substances or of secondary compounds, such as hydrates, acids, or double salts. Although this condition of dissociation is essential for the production of chemical equilibrium, yet it is further necessary that it should give rise to a cycle of reversible changes, such as the double decomposition between the metallic chlorides, bromides, and iodides. Thus the author has shown that whether potassium bromide reacts with silver chloride, or silver bromide with potassium chloride, there is equally an evolution of heat—an observation confirmed by Potilitzin, who has proved that bromine can replace, to a certain degree, its equivalent of chlorine in metallic chlorides. These reversible phenomena are due to the production of metallic perbromides and chlorobromides, the existence of which explains the difficulty experienced in the complete displacement of bromine by chlorine. At low temperatures the action of bromine on chlorides is always accompanied by an evolution of heat."

THE ANTWERP EXHIBITION AWARDS.

THE following is a complete list of the awards. Hors Concours as Jurors:—Easton and Anderson, London; W. J. Bush and Co., London. Diplomas of Honour: Price's Patent Candle Company, Limited, Battersea; J. Brinsmead and Sons, London; Bullivant and Co., London; George Hodgson, Bradford; W. D. and H. O. Wills, Bristol; West Central Sanitary Company, London; T. Jowett and Sons, Sheffield; Kendall and Gent, Manchester; Smith and Coventry, Manchester; Laird Brothers, Birkenhead; Peninsular and Oriental Steam Company, London; Union Steam Company, London; St. John's Ambulance Association, London. Gold Medals: John Smith, Tadcaster; John Corbett, M.P., Bromsgrove; F. C. Calvert and Co., Manchester; Broxbourne Oil Company, Glasgow; Charles Turner and Sons, London; Central Queensland Meat Export Company Limited, Rockhampton; Pitt and Co., London; John Dewhurst and Sons, Skipton; H. C. Stephens, London; Spratt's Patent Biscuit Works, London; London Manure Company, London; Johnson Brothers, Hull; John Moir and Son, London; Smith and Coventry, Manchester; James Taddy and Co., London; J. H. and J. Van Ryn, Cape Town; George Cheavin, Boston; Droitwich Salt Company and London Maltine Manufacturing Company, Limited, London; J. and W. Hodgson, Bradford; Henry Archer and Co., London; British and Foreign Bible Society, London; P. A. Maignen, London; Glenborg Union Fire Clay Company, Limited, Glasgow; Tatham and Ellis, Ilkeston; N. B. Allen and Co., Neath; Eugene Rimmel, London; G. H. Ramsay and Co., Newcastle; Thomas Carr and Co., Scotswood-on-Tyne; W. Benson and Son, Newcastle; Andrew and James Stewart, Glasgow; W. Avery and Sons, Redditch; Kirby, Beard, and Co., London; George Richards and Co., Manchester; Samuel Brooks, Manchester; Vincent Robinson and Co., Limited, London; D. Rudge and Co., London; Saxby and Farmer, London; Berthon Boat Company, Limited, Romsey; R. Hornsby and Co., Grantham; E. Green, Manchester; J. Lee and Sons, Halifax; Sampson and Co., Manchester; S. R. Stewart and Co., Aberdeen. Silver medals: G. Cradock, Wakefield; J. Grayson, Lowood, and Co., Sheffield; W. Harriman and Co., Limited, Blaydon-on-Tyne; Nettlefolds, Limited, Birmingham; Hopkins and Sons, Birmingham; E. Brooke and Co., Huddersfield; J. J. Miller and Co., Bermondsey; Harcourt and Co., Birmingham Davis and Co., Limited, London; Gear Meat Preserving and Freezing Company, New Zealand; P. L. Simmonds, London; *British Trade Journal*, London; Arnold and Co., Wickwar; J. M'Call and Co., London; Morrison, Wood, and Co., London; Carr and Co., Carlisle; Maconochie Brothers, Lowestoft; Thomas Heron, London; Musgrave and Co., Limited, Belfast; Sardou and Co., London; Philip Morris and Co., London; Sissons and Co., Hull; R. Gibbs, Liverpool; Hawthorns and Co., Leith; Procter and Co., London; J. Veitch-Wilson and Co., Glasgow; J. Stott and Co., London; Chamberlain and Smith, Norwich; Francis Falkner, Dublin; Wake and Dean, London; George Cheavin, Boston; Revolving Ball Filter Company, London; Joseph Long, London; Moritz Immisch, London; Fairbank and Co., London; G. West and Son, Gosport; Frank Riley, Tadcaster; Greenhalgh and Sons, Mansfield; Finlay Bros. and Co., Belfast; Rochester Lamp Company, Rochester; F. Selby and Co., Birmingham; Harrington, London; Gustav Mellin, London; T. R. Harding and Sons, Leeds; Tomkinson and Adam, Kidderminster; Thomas Tapling and Co., London; E. Smith and Co., Coalville; D. Rudge and Co., Coventry; Surrey Machinists Company, London; Jones and Co., London; Belfast Rope Company, Limited, Belfast; T. Bradford and Co., Manchester; Charles Thompson and Co., London; C. P. Sandberg, London; Carr and Wonson, London; Shippey Bros., London; Saxby and Farmer, London; Lamb and Wall, Liverpool; Oakeley Slate Quarries Company, Port Madoc; W. Smeaton, London; Macevoy and Holt, London; D. A. Macquordale and Co., Carnoustie; J. Slater, Son, and Slater, two medals, London; John Gordon and Co., London; James Howarth, Farnworth. Bronze Medals.—A. G. Soutter and Co., London; Edward Smith and Co., Coalville; A. Boake and Co., London; Jeyes's Sanitary Company, London; North British Rubber Company, Edinburgh; Walker and Harrison, London; Phospho-Guano Company, Limited, Seacombe; Lambert and Butler, London; John Busch, Oldham; W. G. Clarke and Sons, London; Thomas Farmer and Co., London; Maurice de Leon, London; W. Luks, London; A. Tagliaferro, London; Fal Valley China Clay Company, London; Gwan Cae Gurwen Colliery Company, Limited, Rotherham; Wills and Sons, Birmingham; D. Macpherson and Co., London; B. and S. Massey, Manchester; Joseph Long, London; H. Mase, London; Glenboig Union Fireclay Company, Limited, Glasgow; Scott, Cuthbertson, and Co., London; Henry Smith and Son, Stockport; General Fibre Company, Limited, London; G. Farmiloe and Sons, London; T. Jowitt and Sons, Sheffield; Smith and Paget, Keighley; C. Hills and Sons, Dover; James Howarth, Farnworth; W. Jessop and Sons, Sheffield; Swan and Hunter, Wallsend; Suter, Hartmann, and Co., London; J. Maclean, Pennycross; M. Immisch, London; Birmingham Vinegar Company, Birmingham; A. Smith and Stevens, London; C. Lancaster, London. Honourable mention: Macnaughten Brothers, Glasgow; S. Gulliver, Aylesbury; Voile and Wortley, London; Fullwood and Bland, London; Scottish Central Aërated Water Company; W. Guest and Co., Sheffield; J. G. Stormont, Birmingham; J. Pickering, Stockton-on-Tees; G. Wright and Co., London; British Syphon Manufacturing Company, London; R. Brooksbank, Keighley; Lamb and Watt, Liverpool; Proctor and Co., London J. L. Thompson and Sons, Sunderland; L. Parr, Newcastle.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Harry H. Meades, engineer, to the Nankin, additional, for the Howe; G. V. Cawley, assis. engineer, to the Himalaya; Wm. Whittingham, assis. engineer, to the Nankin, additional, for the Howe; Geo. G. Goodwin, assis. engineer, to the Malabar; Martin Stuart, assis. engineer, to the Himalaya.

LOCOMOTIVE BOILERS.

The American Master Mechanics' Association some time since appointed a committee to report on boilers. The following is the report prepared by the committee and read at the last meeting of the Association :—

Mr. President and Gentlemen,—The slight result that followed the issue of circulars the last few years is the reason no circular was issued this year by your Committee on Boilers, its working members believing that a *résumé* of the past work, rating the points from which progress had been made, would probably prove interesting and elicit free general discussion.

Steel plate.—Steel was reluctantly used in 1869—see p. 10 of report for that year—but 200 boilers of steel are reported in 1875—p. 15—and it is recommended in that year—p. 16—exclusively recommended in 1877—p. 52—and the committee is unanimous in 1878—p. 86. In 1870 an opinion from a French engineer was quoted—p. 18—saying steel plate for boiler use should be capable of hardening; presumably he was using the metal in barrel plates, and to reduce their thickness and weight required a metal of high tension which he would secure in a steel that tempered by immersion. But in 1871—p. 10—the complaint was that it was manufactured too hard, and in 1875—p. 16—steel that will not harden is recommended more especially for fire-box service. The steel we now easily procure, and should use for both sheet and furnace, has but a small percentage of carbon, say from ·15 to ·20 per cent., and, therefore, if fairly free from silicon, phosphorus, &c., will not harden, is mild and ductile, working under the hammer, even when cold, most freely; has a breaking resistance of from 62,000 to 65,000 lb. per square inch of section, with an extension of 24 to 25 per cent. and length of 10in. A good shop test—in addition to bending over at a point in the test piece where it has been punched either cold or after it has been heated and dipped in water—is to take a narrow strip through which a hole one-fifth its width is punched and then enlarge the hole with a drift and flagging hammer to full three times its original punched diameter without splitting the strip. It may be said that there is now no practical limit to the size that steel sheets of desirable quality and thickness can be procured. The Canadian Pacific Railway are making the straight portion of wagon top boilers in one plate, and receive sheets 14ft. 3in. × 8ft. × $\frac{7}{16}$in., and last year at Erie, Pa., ⅝in. plates 16ft. long were bent cold in rolls to a curve of 30in. radius, so that two sheets made one boiler 16ft. long and 60in. diameter, with but two longitudinal joints in barrel; and Mr. Webb has rolled from the ingot and used $\frac{7}{16}$in. steel plate 11ft. 3in. wide by 12ft. 9in. long in one barrel ring. This practice is in line with the strong recommendation of the committee in 1871—page 14—but, as they point out, it requires special rolls to be built for bending the plate. Mr. G. S. Strong says he is now constructing a 56in. straight boiler for 175 lb. pressure, with all longitudinal seams welded. Welded seams, when iron plate and coke fire were used, give at best but an ultimate tension of 14 tons and 6½ per cent. extension for 22 tons iron; therefore, it is not a matter of surprise that such a form of joint was seldom used, but now Mr. S. Fox, using 22 ton mild steel and common gas flame for heating the scarf, secures a weld having an ultimate tension of 21 tons and an elongation of 8½ per cent. in a 10in. length, that is an increase of 50 per cent. in strength and 30 per cent. in ductility; although it should be noted that this excellent result is but one-third the ductility of the unwelded steel plate. Some careful experiments show that very mild steel, after annealing, loses somewhat in its resistance to ultimate tension and in ultimate percentage of extension, or, in other words, annealing does not necessarily improve the natural plate. Nevertheless, if holes are punched in plate, or plate has been flanged or set when warm, mild steel must be annealed, the annealing furnace temperature not being carried too high—a blood of cherry red is quite sufficient—the time in furnace not prolonged beyond the point that will secure thorough and equal temperature, and the cooling not too much hurried by contact with damp earth, or a current of wind at low temperature. Neither should there be any attempt to "soften off" by cooling in a bed of sawdust or ashes. If the flanging, setting, or any other distortion, such as bending in the rolls, can be done cold, there is no necessity for annealing either plates or bars, but all such setting is preferable done under the steady pressure of hydraulic tools.

Drilling v. *punching.*—In 1872—page 19—preference is given to drilling rivet holes rather than to punching, but with the leather-like ductile metal now supplied and within the limits of ordinary thickness of boiler plate used in locomotives the extra expense of drilling is not justified, and the excess diameter of hole in die over punch need not exceed 1-32in. for plates ½in. thick and under.

Rivets.—Steel rivets are not reported as being in use in 1871—page 12—neither are they used to any extent at this date, yet in view of all the conditions of the case, and until the obscure matter of galvanic action and its influence on corrosion, pitting, and furrowing, is more clearly understood, it would be wiser to use steel rivets with steel plates, thus bringing metals together that are quite similar in nature and electric affinities. The proportions for rivetted joints that suited iron plates have apparently in many instances been transferred to steel plates of similar thickness without any serious question as to their similarity, whereas the weight of their evidence—more particularly the elaborate experiments of Professor A. B. W. Kennedy for the Institute of Mechanical Engineers—show that to attain a joint of maximum strength, a larger proportional rivet area to resist shearing is required, with steel rivets and steel plates, than with iron, the larger diameter, however, permitting a wider pitch. Thus for single rivetted lap joints, the pitch found best is 2·25 diameters of rivet hole, and diameter of hole 2·25 thickness of a single plate, the diameter of the rivet being about 1-32in. less than the hole. If this proportion should not divide out well, the pitch should be increased to 2, 3, or 2·4 diameters. This, for a ⅜in. plate, will give a ⅞in. hole and 2in. pitch, a wide departure from average practice in iron plates or in steel plates with iron rivets; and the reason for this altered proportion is found (1) in the fact that in a material so ductile as modern boiler steel the joint is helped materially by the great comparative excess of strength in the plate after holes are cut through; and (2) that while the plate is comparatively so much stronger than before, there is no corresponding increase in the shearing resistance of the rivets over the strength commonly found in iron rivets. The average practice in ⅝in. iron varies from ⅝in. rivets with 1⅞in. pitch and $\frac{11}{16}$in. rivets with 1⅞in. pitch to ⅞in. rivets with 2in. pitch as a maximum. A 2in. pitch is rarely used for any diameter of rivet, and we know of no practice in ⅜in. plate using rivets of larger diameter than ¾in., whereas ⅞in. would make a stronger and better balanced joint for very mild steel, and will secure a single rivetted joint having 60 per cent. of the strength of the unperforated plate. For double rivetted joints, either lap or butt, using a diameter of rivet that is 2¼ times the thickness of the single plate, the pitch should be approximately four times the diameter for the thickness of plate commonly used in locomotive practice, the pitch being proportionately narrowed as the tenacity of the plate is higher than 30—long—tons per square inch. The position of the second row of rivets should be such that the net diagonal area of plate or area along zigzag line should not be less than 30 per cent. in excess of the net area across the joint, and 35 per cent. is better than 30 per cent. The general tendency of present practice—a survival from other days and other conditions—is to put too many small rivets in a double joint, as if afraid the joint would leak, but pitches of 3in. in ⅝in. plate are tight at 120 lb. pressure, and in $\frac{7}{16}$in. plates pitches of 4·14in. are tight at 160 lb.

Power rivetting.—Machine rivetting by a single squeeze was not approved of in 1871—p. 70—but the steam piston rivetter giving several strokes was. This is now practically superseded by the hydraulic piston, having the merits of the single close squeeze and the adjustability of the steam piston, producing work of unequalled solidity, and dispensing with the necessity for caulking, as boilers are now turned out tight under the test pressure of 160 lb. A large amount of boiler patching, and almost the whole of the work on new tender tanks in position, can be done by the portable hydraulic tools of W. R. A. Tweddell—specimens of hydraulic rivetted joints exhibited. A noteworthy point about hydraulic rivetting is that even in those cases where it does not increase the absolute strength of the joint, it makes it so much stiffer that visible slip does not commence until the pressure is from 100 to 125 per cent. higher than when slip commences in hand-made joints. This explains why hydraulic rivetted boilers do so little weeping under high test pressure.

Caulking.—One source of danger in boiler manufacture is excessive joint caulking—both inside and out—with sharp-nosed tool so close to inner edge of plate as to indent, and in many cases actually cut through the skin or the lower plate. The old style of caulking, that put a positive strain upon the rivets commencing distortion and putting excessive stress upon rivets—already in high tension—before boiler commenced work is, we hope, fast becoming a thing of the past. With a proper proportion of diameter and pitch of rivet to suit steel, all that is required is the use of a light fuller—used by Mr. Webb, London and North-Western Railway—which some good work was shown at the Centennial Exhibition at Philadelphia, is not as good, but it is infinitely better than the caulking tool which has often started cracks that worked inwards or resulted in furrowing. There is but little need for caulking if means are taken to secure a clean metal-to-metal face at the joint. When the plates are put together in ordinary course of manufacture, a portion of the mill scale, black or magnetic oxide, has been shaken off, but part is left on, and this is reduced to powder or shaken loose in the course of rivetting and left between the plates, thus offering a tempting opening for the steam to work through, and is really the cause of the heavy caulking that puts so unnecessary a pressure on both plate and rivet. A clean metallic joint can be secured by passing over the two surfaces waste wet with a weak solution of sal-ammoniac and hot water—an operation certainly cheap enough both as to materials and labour required. This practice has been carried out with success for years on the London and North-Western Railway. The result of such practice is that the rivetted joint can be allowed a wider margin beyond outer edge of rivet, the rivets themselves to have a larger diameter, which mild steel absolutely requires, and the rivets to be pitched correspondingly farther apart, as the pitch has often heretofore been controlled more by the resistance required to meet the heavy use of the old caulking tool than settled by an investigation into the best proportion to secure the utmost strength for given thickness of the good material that is now almost exclusively used in locomotive boilers.

Crown stays.—Crown stays should be "double plated transverse girders 1in. clear of sheet," said the committee in 1869—page 10. In 1871, however, the troubles incident to this class of stays are fully recognised—page 15—and the recommendations are for bars to be fewer and stronger, entirely supported from outer shell, that the clearance underside be increased, and that washers and distance ferrules be dispensed with. If this class of stays is to be used, nothing better is shown than the solid steel crown bar castings—1883, page 80—but your committee cannot but continue to emphasise their recommendation to the use of rods screwed through both crowns with their ends rivetted over, a plan so old as to have been used in Stephenson's Rocket in 1829, and for which a patent was granted in 1848. In 1871—page 16—this system is said to be weak, but your committee have been looking for a case of failure in this class of staying without success, even in boilers that have the two crown sheets so far from being parallel that the stay is a long way from being perpendicular to either sheet. In fact, an angle that permits of but one perfect and complete screwed thread for a continuous circumference, will—if the rivetting over be carefully done—prove sufficient to last out the inner fire-box. Bolts with their heads on the inside of the inside fire-box may be safer—see 1880, pages 61, 62, 68, and 1881, page 64—but we doubt the necessity for this excess of strength, and so made, it is more difficult to use the twist drill socket for screwing the stays into plate, as this tool must then be used from the inside of fire-box instead of from the outside. Mr. Urquhart, L.S. of the G. and T. R., Russia, who is burning petroleum refuse—black oil—with such great success in more than 100 locomotives, says that as one of the results of the high temperature attained in his fire-boxes, many nuts on the stay bolts of roof dropped off, after which he made heads on the lower ends of these roof stays; but he goes on to say that the best arrangement is Belpaire's, where the stay bolt is screwed into both plates and rivetted over, thus allowing a free circulation of water over the hottest part. It is to be noticed that many years ago nuts were used on the ends of the screwed stays of fire-boxes burning anthracite, but they are now superseded by rivetted heads, and the experiments carried out by the United States Navy in 1879—see secretary's report—prove that even if snapheaded or button-set they are quite strong enough for their work. The curving and sloping backwards of crown sheet, though not approved of in 1871, page 16, still recommends itself by offering additional facilities in washing off the sheet.

Flues.—Steel flues were but slightly used in 1870—page 105—and their use at present is not common. They are thin, give a lengthened service, and in the hands of good workmen are—with borax as flux—readily pierced and rewelded to iron ends. Difficulty in rewelding was the chief defect mentioned to their discredit in 1873—page 43. The statements of Mr. Robison and Mr. Eddy in 1873—pages 43-4—that brass flues transmitted heat more freely to the extent of justifying—as economical—the use of the more expensive metal, remains unproven to date, and after much experimenting, the almost universal practice of this continent in the use of iron and steel flues contradicts it. The securing of flues is now an almost uniform practice, viz., parallel, expanding with roller expander and beading the ends over, the fire-box end being encircled by a ferrule $\frac{1}{16}$ or less thick of soft iron or copper, preferably brazed to the end of the flue; but the distance flues should be spaced apart varies widely, the best evidence going to show economy in the wider spacing up of ⅞in. water way, and Mr. Fairies in 1875—page 59—and Mr. Adams, on the North London Railway, make a good show for 1in. spaces.

Heating surface.—Mr. Towne in 1872—page 64—said—and it was not disputed—that the flues were acknowledged the most effectual heating surface of the boiler. This view is not held by those who, going to the opposite extreme, say with the gauge commissioners that every square foot of fire-box is capable of evaporating 2 cubic feet of water per hour, experiment having shown that an excellent evaporation for the whole surface—fire-box and tubes combined—per square foot, is one-eighth of a cubic foot per hour, or for 1000ft. of surface 125 cubic feet=940 gallons—U.S. The most common assumption is that the relative values of the flue and fire-box surfaces are as 1 to 3, but Mr. Langridge, in a paper before the Institute of Civil Engineers, analysed the actual work of nineteen locomotives, from which he found the hourly evaporation from the fire-box surface was 11·7 to 1; the total average tube evaporation was 0·1365 × 11·7 = 1·597, or, in other words, with common sizes under ordinary work, and with ordinary blast pressure, the fire-box evaporated one-fifth and the tubes four-fifths of the water, consumption of fuel per square foot of grate varying from 38 to 157 lb., the average being 83 lb. One of his conclusions was that a large increase of heating surface in proportion to the fuel burnt only slightly increases the economical effect. In fact, within the limits of common practice in locomotives, the economic effect is in proportion to about the fourth root of the heating surface. For instance, an increase in heating surface from 915ft. ($\sqrt[4]{}$= 5·5) to 1296ft. ($\sqrt[4]{}$= 6·0), or of 381ft., would only give an increased economy of 1-11, or 9 per cent. for the same consumption of fuel. The case, of course, would be different if both engines were being forced heavily, or a greater amount of coal being burnt per foot of grate; then the greater absorbing surface would give a higher relative economy.

Blast pressure.—Mr. O. Busse analysed some experiments made on the Northern Railway of France, with an old locomotive boiler having 76½ square feet of surface in fire-box and 717½ in 125 tubes 12ft. long, 1⅝in. diameter. The tubes were cut off by bulkheads into four sections of about 3ft. long, and having nearly 180 square feet of surface. The evaporation was as per table, the blast pipe in smoke-box being supplied from a second boiler. One noticeable fact is that the vacuum in smoke-box, measured in inches of water, is increased 400 per cent. without increasing the total evaporation of water 100 per cent. The greater consumption of fuel and the greater speed of smoke due to the highest vacuum improves the evaporative efficiency of the tubes at the outer end 200 per cent.; but at best their efficiency is not high, the last 3ft. length having but from one-fifth to one-sixth the evaporative value of the first length.

TABLE No. 1.

Total Evaporation in Pounds of Water per hour.

Vacuum in smoke-box, measured in inches of water.	Sections in barrel, commencing at fire-box end.				Totals.		
	No. 1	No. 2	No. 3	No. 4	Tubes.	Fire-box.	Grand total.
·78	57	26	14	8	107	252	360
1·56	82	44	23	15	165	300	465
2·34	118	48	38	25	230	410	641
3·12	105	55	34	25	220	461	681
3·90	149	68	46	30	294	417	712

Putting this statement in the form of percentages of total evaporation—and, as before, ignoring decimal points—we have:—

Vacuum in inches of water.	1st °/ₒ	2nd °/ₒ	3rd °/ₒ	4th °/ₒ	Total of tubes °/ₒ	Fire-box °/ₒ	Grand total °/ₒ
·78	15	7	3	2	30	70	100
1·56	17	9	4	3	35	64	100
2·34	18	7	6	3	36	64	100
3·12	15	8	5	3	32	67	100
3·90	21	9	6	4	41	58	100

The pounds of water evaporated per square foot of heating surface per hour were:—

Vacuum in inches of water.	In fire-box.	No. 1.	No. 2.	No. 3.	No. 4.
·78	3·30	·32	·14	·08	·05
1·56	3·92	·45	·24	·12	·08
2·34	5·36	·65	·26	·21	·14
3·12	6·02	·58	·30	·19	·14
3·90	5·45	·83	·38	·25	·16

These comparatively small quantities should be compared with the 18 lb. of water per square foot of surface—tubes and fire-box—evaporated in torpedo boilers with 6in. of water-pressure in stokehole. It is quite possible that testing the evaporation of independent lengths of the boiler by the use of bulkheads gives a misleading result, as the partitions seriously interfere with the circulation—circulation being a far more important factor in the transmission of heat than either the nature or thickness of the metal through which heat is transmitted. With Mr. Busse's figures should be compared the Government experiments carried out with Mr. Thorneycroft's torpedo boat boilers of locomotive type having air pressure in stokehole. These boilers have 620 square feet of heating surface, of which 56ft. are in fire-box. Grate surface 18·4ft.; barrel, 53in. diameter; tubes, 205 of 1$\frac{3}{4}$in. diameter and 6ft. long.

TABLE No. 2.

Air pressure in stokehole in inches of water ..	2	3	4	6
Air pressure in ash-pit in inches of water ..	1·47	2·29	3·26	5·25
Air pressure in furnace in inches of water ..	1·35	1·87	3·0	4·33
Temperature of feed-water, Fah...	53·5°	57·°	54·°	56·°
Temperature in furnace, Fah.	1,037°	1,192°	1,260°	1,444°
Steam pressure above atmposphere, lbs... ..	117	117	115	115
Coal consumed per hour, lbs.	925	1177	1472	1815
Coal consumed per square foot of grate, lbs. ..	49	62	78	96
Water evaporated per hour, total lbs.	6580	7770	9320	10,840
Water evaporated per pound of coal, lbs... ..	7·06	6·6	6·33	5·97
Evaporation per pound of coal reduced to equivalent at 212 deg. Fah. from 100	7·61	7·08	6·81	6·41
Evaporation per hour per square foot of heating surface	10·8	12·9	15·5	18·
	h. m.	h. m.	h. m.	h. m.
Duration of experiment in hours and minutes	2 0	2 7	1 39	1 27
Coal used, Nixon's Navigation.—Ashes, 9 per cent.				

The results would have been more interesting had lower pressure than 2in. of water been used, as even at half engine power these boilers are overworked, but the influence of pressure on evaporation, combustion, and temperature is clear, and the experiments showed that tubes absorb seven-tenths and fire and grate one-tenth of initial pressure. The pressure in chimney was about equal to the pressure of atmosphere. Additional experiments were made to see if the ordinary mode of combustion with steam blast in chimney approximated in efficiency to pressure in stokehole, with the result of showing that steam jet was very wasteful, usually only increasing consumption on grate 40 to 50 per cent. over natural draught, with an increase of efficient power not exceeding 15 per cent. Turning fan air blast of 12in. pressure and more into chimneys and using locomotive nozzles and split rings from 2in. to 5in. in diameter, the result was poor, the best show being made with a 3½in. nozzle, but even that was not one-half of what was obtained with 2in. pressure in stokehole. This result accords with Mr. Longridge's statement that the blast pipe considered as a motive power is very wasteful, as but from one-eleventh to one-twelfth of the power escaping is utilised in drawing air through the tubes. It should be noted—see Table 2—that an increase of blast pressure from 2in. to 6in., or 200 per cent., did not increase the consumption of coal per square foot of grate quite 100 per cent., and the value of the fuel is reduced 15 per cent.

Hollow stays.—The difficulties in the manufacture of hollow stays and the unvarying supply of air admitted, although the supply should be adjustable to varying demands of the fuel, have not encouraged their use—see 1872, pages 19, 61, 62; 1877, pages 117, 129, 130; 1878, page 16; 1879, page 80—and a fire-hole deflector with adjustable door or diaphragm still proves the better plan for admitting the air requisite above the fuel.

Scale.—After continuous reports of non-success with chemical compounds to remove or prevent formation of scale, the recommendations of former committees—see 1873, page 18, and 1874, page 42—are narrowed down to the use of pure water and providing open surface storage reservoirs to secure it, and washing boilers out when cold with water of heavy pressure to detach all mud and scale; however, in 1869—page 49—there is a report that "Hays battery" will soften scale after formation. Batteries, although perfect in theory, have heretofore been found deficient soon after they have been put to work, through the mechanical difficulties of getting pure zinc and keeping it in clean metallic contact with some point of iron, oxide of zinc rapidly forming at the junction, thus breaking the contact absolutely necessary for a galvanic couple and electric current. The zinc is well hammered at a definite heat, which changes it from a crystalline friable metal to a malleable one, and insures its long existence in an efficient condition. This, in the ocean service of the Canadian mail line, has stopped the further action of corrosion and loosened old scale. We have not to fight against salt or fatty acids in locomotive boilers, but its success in bad marine boilers justifies experiment being made with it on locomotives. The theory explaining its action in detaching scale is that at the surface of the iron plate—the negative pole—water is slowly decomposed, and the hydrogen gathers and forces off the new scale as soon as it is thick enough to offer resistance. Of all boiler plate preservatives used by the Admiralty, zinc has proved to be the most effective. It has been used in rolled slabs 12 × 6 × ⅜in., and one slab per 20 indicated horse-power, on 1ft. square of slab to 2ft. of grate surface.

Pitting.—Pitting can be stopped and the plate brought into a healthy condition by scraping the affected spots and cleansing the surface with a strong solution of soda or petroleum to remove any grease or acidity, and then coating with a thin wash of Portland cement. Even so simple an expedient as filling the cleansed pit-holes with red lead has in marine practice proved quite effectual in preventing any further waste. And as corrosive and pitting action are apparently increased by the partial absence of oxide or scale on the plate, and the whole of it cannot be kept on, due to the handling the steel receives in boiler-making, the better, and certainly the safer, practice is to remove it completely by washing with a very weak acid solution, protecting the raw metallic surface by rubbing over with black oil—still refuse. Such a surface is less liable to obscure galvanic action, and as long as it is kept clean will certainly transmit heat and deliver it to water more freely. See R. Wells' experiment, 1876, page 80. That there was less pitting in steel than iron boilers was Mr. Sedgley's opinion—1877, page 54—and recent experiments and extended experience and observation tend to confirm this statement, except when local galvanic action is started; and galvanic action will not start, or at least will not give any trouble, when like metals are acted upon under similar conditions; therefore iron rivets should not be used with steel plates.

Furrowing at joints.—This subject has been much discussed—see 1872, page 56; 1877, page 61; 1878, page 73, &c.—with the resultant opinion that furrowing was due to chemical or corrosive action on a surface or point at which expansion or alteration of shape was localised. In addition to the cause before given for this localisation, we would call attention to the injury done to barrel plate at the line of rivet holes in passing it through the rolls after drilling or punching, the lessened resistance there permitting the end of plate to make a decided set instead of bending uniformly to curve. Such rough measures are occasionally used by careless workmen in bringing the bent edges back to true curve, so as to make a good opening at this point for acids to work upon.

Recent experiments.—Experiments have been carried out on the Chicago, Rock Island, and Pacific Railway with the Coventry boiler, illustrated by Plate 27 A, p. 42, in the 17th report, and Mr. T. B. Twombly, under date of March 12th, writes the committee as follows:—"In reply to your inquiry regarding the Coventry boiler, will say that this engine ran some 2000 miles on our road. I did not subject her to any scientific tests, but ran her for 600 miles on freight service against our engine No. 291, carefully weighing the coal to each engine and having them pull trains of thirty loaded cars each way, cars of as nearly same weights as possible. The result appears on the small blue print inclosed, which shows that our engine ran 36·98 miles to a ton of coal and the Coventry 33·24 miles. The engine was handled by one of our engineers who knew the road perfectly, and although he might have done somewhat better had he been more acquainted with the engine, yet I consider this a fair practical test. I think it reasonable to presume that no amount of fine handling would cause her to show any decided advantage over our engine. The Coventry boiler is 60in. in diameter, placed on an ordinary 8-wheeled engine with cylinders 17in. by 24in., and weighs something over 40 tons. Our engine No. 291 has a boiler 50in. diameter, cylinders 17in. by 24in., and weighs 36 tons. I made no investigation into her evaporation. A man employed by Mr. Coventry put a pyrometer in her front smoke-box close to the flue sheet, and he reported 900 deg. of heat when engine was working hard, dropping down to 400 deg. when working lightly. Of course I do not know how accurate this is. She ran for a week or two on one of our suburban trains, doing very good work and throwing very few sparks. She is a nearly perfect spark arrester. She ran one trip on one of our heavy express trains—twelve cars—and lost time each way. She is not what would be called a free steamer. It requires considerable more work in the roundhouse to keep her cleaned out than it does with the ordinary boiler, as her back smoke-box fills with cinders which must be shovelled out of a small door, and her flues seem to fill up very fast. The original cost and cost of repairs will be considerably more than on present style of boiler, and altogether I do not think that as at present constructed her advantages will compensate for the increased trouble and expense."

Copy of Blue Print.

C. R. I. and P. Engine, No. 291. 1884.	Lb.	Coventry engine. 1884.	Lb.
Nov. 13, coal taken	9,400	Nov. 13, coal taken	8,100
,, 13, ,, ...	4,000	,, 13, ,, ...	4,000
,, 15, ,, ...	9,150	,, 15, ,, ...	9,700
,, 17, ,, ...	11,150	,, 17, ,, ...	11,300
,, 17, ,, ...	4,000	,, 17, ,, ...	4,000
Total coal taken	37,700	Total coal taken	37,100
Coal left over	5,250	Coal left over	1,000
Coal used	32,450	Coal used	36,100
Miles run	600	Miles run	600
Miles to one ton of coal ..	36·98	Miles to one ton of coal ..	33·24
		Percentage of work performed as compared with engine No. 291	90

In closing this report the committee wish to state that the credit for the labour expended in collecting the material for this review and the working it into shape is entirely due to Mr. J. Davis Barnett, one of the members of the committee. They also desire to return their thanks to Mr. T. B. Twombly, general master mechanic of the Chicago, Rock Island, and Pacific Railway, for his kindness in furnishing the experimental notes on the result of the trial with the Coventry boiler.—Respectfully,

JACOB JOHANN,
J. DAVIS BARNETT, } Committee.
ALLEN COOK,

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, August 14th.

THE Navy Department has made a compromise with the assignees of John Roach, which include the acceptance of the Dolphin. Certain alterations are to be made in it. No definite plan has been announced for the completion of the Atlanta, Chicago, and Boston. An inventory is being taken at the Chester shipyards to ascertain what has been done and what yet remains. This will be completed in two weeks, when work will be begun.

The Western Nail Association met in Chicago on Thursday, and determined to adhere to the terms for nailers offered June 1st.

A meeting of the Associated Bessemer Steel Rail Manufacturers was held at Long Branch, New Jersey, on Thursday, at which the following companies were represented:—The Bethlehem Company, the Pennsylvania Company, Carnegie Brothers, the North Chicago Rolling Mill Company, the Joliet Iron and Steel Company, the Union Steel Company, the Cleveland Rolling Mill Company, the Cambria Iron Company, the Lackawanna Coal and Iron Company, the Renssalaer Iron Company, the Scranton Steel Company, and the Worcester Steel Company. Four of these mills are out of the list of producers—two by bankruptcy, and two which were compelled to shut down for want of orders. An agreement was arrived at to restrict production after January 1st, but details have not as yet been agreed upon.

The Bessemer Steel Company, representing eleven Bessemer mills, met at the same place, and discussed remedies for the present trade depression, but formulated no plan of action.

The general iron trade is dull. The mills are slowly securing orders, but there is much idle capacity in nearly all branches. The structural iron mills, bridge and pipe works, and wire mills are more fully engaged than others. The autumn demands are disappointing. No changes in prices have been made, and buyers have the advantage. The merchant steel mills are booking orders for early delivery. The furnace output in pig iron has been slightly curtailed since August 1st.

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

(*From our own Correspondent.*)

ON 'Change in Birmingham this—Thursday—afternoon, and in Wolverhampton yesterday, the attendance was smaller than usual because of the occurrence of the Birmingham Musical Festival. A rather better feeling, however, prevailed in some trade circles. Indian, South African, and Australian orders were reported more numerous, particularly for sheets and bars, and the mills at certain of the works are being put upon increased time, while at some of the forges there is also less slackness observable.

The Pelsall Coal and Iron Company are among the earliest to benefit by the quickened Indian demand, and this concern is doing more in sheets, bars, and hoops than recently. The price demanded for sheets of 14 to 20 gauge for Indian consumption is £6 7s. 6d. to £6 10s. delivered Birkenhead. Sheets for galvanising are an average of £7 for doubles delivered to consumers' works in the Staffordshire district, and £8 for lattens.

The demand for galvanised corrugated sheets is large, but not all the inquiries made result in business for this district, since the prices at which merchants seek to place the orders are deemed by makers to be unsatisfactory. The inquiries from Australia and from South Africa are brisk, and some good South American orders are also coming forward. Prices are upheld as firmly as the existing competition will allow, and best makers demand £12 per ton for sheets of 24 gauge, bundled, delivered Liverpool. Some other firms will accept £11 or £10 15s., while some merchants assert that they are securing supplies at £10 10s.

Messrs. John Lysaght are so full of work for galvanised sheets on Australian account that they are keeping their large black ironworks at Wolverhampton running full time. The number of mills laid down at this establishment is eleven, which is by far the largest number to be found running at any one works in South Staffordshire at the present time. At some other sheet works six mills and five mills respectively are the largest number going.

Messrs. Lysaght have not yet completed their negotiations for the taking of a new works, but when they have they expect to run seven additional mills, which will give employment to some 400 ironworkers. At their Bristol establishment Messrs. Lysaght are now galvanising 500 tons of sheets a week.

The Gospel Oak Company, at Wolverhampton, who up to about six weeks ago were very slack, are now fully engaged upon galvanised sheets for South Africa and other colonies.

Black sheets of 20 gauge of the Woodford brand stand at £8; Woodford crown, £9 10s.; best, £11; double best, £12 10s.; treble best, £14 10s.; charcoal, £16; and Siemens-Martin steel sheets, £13. An additional 30s. is quoted for 21 to 24 gauge, and a yet further 30s. for 25 and 26 gauge; while 28 gauge is quoted, Woodford, £11 10s.; crown, £13; Woodford, best, £14 10s.; double best, £16; treble best, £18; charcoal, £19 10s.; and steel sheets, £16 10s.

Certain of the Shropshire sheet makers ask higher prices than those in South Staffordshire proper. They quote for singles, £7 5s.; for superior doubles, £8 2s. 6d.; and for superior lattens, £9 2s. 6d. all delivered, Liverpool. Indian, Australian, and Russian inquiries they report as being upon the market in considerable numbers.

Best qualities of bar iron are not sold under £7 10s. by the manufacturers, and as the general run in this branch is for a good medium quality fetching about £6 10s., the belief prevails that the list houses may still have to level down their quotations. There is a fair request for small gauges of bar iron, varying from £5 5s. to £5 10s.

The demand for tube strip is improving with the approach of the gas tube season, and ironmasters are running their mills rather more regularly upon iron of these sections. Common gas strip ranges from £5 5s. upwards at works. Nail strip for Canadian consumption is £5 15s. to £5 17s. 6d., delivered at Liverpool, but Canadian orders are late this season in arriving.

Consumers of pigs are buying for stock in some directions, and there is likewise some extent of speculative buying going on. Prices are, therefore, rather firmer.

Lincolnshire pigs are quoted 41s. 6d. for grey forge delivered. Lonsdale, No. 4, selected forge is 45s.; and No. 3 foundry is quoted 57s. 6d. It is in foundry rather than forge pigs that most vitality is just now observable. For Thorncliffe pigs 50s. is demanded, but the price cannot be got. Native all-mine pigs vary from 55s. up to 60s. for hot blast sorts. Capponfield mild iron is quoted 47s. 6d.; and Capponfield common, 33s. 6d.; Darlaston, Northampton, on pigs, 38s. Staffordshire part-mines mostly vary from 40s., and in some cases even 37s. 6d. up to 45s. Ordinary Northampton pigs are 37s. 6d. upwards, and Derbyshire pigs vary from 38s. 6d. to 40s. delivered to stations in this district. The Westbury brand is quoted 39s. 6d. for No. 4 grey forge, 41s. for No. 3, 42s. 6d. for No. 2, and 44s. for No. 1. The Wingerworth brand is quoted 39s. delivered.

Welsh scrap iron, composed mainly of sheet shearings, is dearer. Vendors are asking 49s. a ton, but only a little business is doing, since buyers are shy of giving any advance upon 46s. 6d. to 47s. 6d., and some will not even give this price.

The day-shift furnacemen, numbering twenty-three, employed at the blast furnaces of Messrs. Roberts and Spurgin, Tipton, are out on strike. The cause of their grievance is a question of beer, and the men state that the firm desire to reduce the beer-money from 6d. to 3½d. a turn. So violent were their efforts to intimidate the night-shift men that a body of constables had to be present. Messrs. Roberts have damped down three of their furnaces, and are keeping one going on at the reduction of 2½d. beer-money to work off the large stocks of minerals. The furnaces, it is expected, will be blown again a few months hence.

Certain of the bridge-building and girder works are employed pretty good time in the completion of some important contracts.

Among the engineering industries no branch is busier than that devoted to electrical engineering. In Wolverhampton valuable repeat orders are constantly arriving under this head. Among the contracts most recently placed are orders for the lighting throughout by electricity of Ingestre Hall, the seat of the Earl of Shrewsbury; the ironworks of John Lysaght, the varnish works of Messrs. Mander Bros., Wolverhampton, &c. The plant at Ingestre will consist of two 250-light dynamo machines, a powerful accumulator containing fifty cells of the company's No. 15 accumulator, and two engines of 11½in. diameter cylinders. Five hundred incandescent lamps will be laid at the hall by Mr. T. Tailor Smith, of London. At Messrs. Lysaght's ironworks four hundred lamps will be laid down, to be supplied by two 12in. dynamos, which will be driven direct from the engines already at the works. At Messrs. Mander's there will be fifty lamps, a four-unit dynamo machine, and twenty cells of the firm's No. 1 accumulator. For the Manchester Art Gallery, which is being lighted by the Edison Company, the Wolverhampton firm are supplying two sixteen-unit dynamos.

Some of the more eminent firms engaged in making pumping and irrigating machinery are well employed on export account.

The demand for hydraulic machinery, force pumps, lifting jacks, planing, sawing, and drilling machines, stocks, dies, and the like, keeps up fairly well with the best Birmingham houses, on account mainly of India and other Eastern markets, and Australia. But the Germans are taking some orders which formerly came to this town. On account of the Admiralty, light marine engines and fittings for torpedo boats are being turned out at certain of the workshops. Messrs. George Bellis and Co. have in hand some valuable contracts of this sort, including several sets of engines of more than 1000-horse power, and developing a speed of at least 20 knots an hour. They have also orders for compressed air reservoirs, built up of nests of steel tubes, for torpedo purposes. Messrs. Jas. Archdale and Co., and one or two of the other Birmingham houses, have Government orders under execution for machine tools and other similar manufactures.

The compact between the masters and men in the nut and bolt trade, to exclude unhealthy competition and to sustain a remunerative rate of wages, has not met with much success. This in much part is the fault of some of the men, who work for masters not members of the Employers' Association at a reduced rate of wages, to the detriment of the whole trade.

In response to a circular signed by six large nail firms, certain of the nail-masters have just met in Birmingham to consider the request of the nailmakers for an advance. Of the forty-five firms to whom circulars were addressed only nine were, however, represented. The chairman said that it was evident that the majority of masters were not willing to subscribe to a resolution in favour of the men's request, and he thought that at present nothing could be done towards advancing the wages. He feared it would end in a strike.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—If trade could be stimulated by an absolute conviction that prices had got to the lowest possible point, certainly the balance-sheets which have recently been presented by some of the principal pig iron making concerns ought to carry conviction to the minds of buyers who may have been holding back for any further possible giving way in the market. One of the largest concerns in Lancashire has in the past six months' sales suffered a loss of no less than £2000, irrespective of stock and plant depreciation, and it is obvious that in the face of such serious losses as this, prices, so far as makers are concerned, must at length have got to something like the bottom. If buyers have simply been waiting for this consummation, any orders they have to give out ought certainly now to be coming forward. Here and there, on this basis, a more hopeful view of the prospects of trade is apparently being entertained, and finds some support in a few inquiries in the market from sources likely to lead to moderate business being done. As to any actually increased requirements, there is, however, no indication of improvement in this direction, the tendency of trade in most of the iron-using branches of industry pointing rather to a lessened than an enlarged consumption; and it cannot be said that there is any really tangible improvement in the condition of the market.

The attendance on the Manchester Iron Exchange on Tuesday was very small for the principal market of the week, and the business done was of a very limited character. For pig iron the quoted prices remained at about 38s. to 38s. 6d. for Lancashire, and 37s. 6d. to 38s. 6d. for district brands, less 2½, delivered equal to Manchester, but only a few small orders are being booked. In the manufactured iron trade the improvement reported last week in the demand for sheets is being maintained, but other descriptions of goods still meet with only a very slow sale at the minimum rates which have been ruling of late. For Lancashire and North Staffordshire bars delivered into the Manchester district, £5 5s. per ton remains the average figure; hoops £5 15s., with local-made sheets about £6 15s. to £6 17s. 6d., and good Staffordshire qualities, £7 to £7 2s. 6d. per ton.

The ironfoundry trades continue in a very depressed condition, and in some classes of small builders' castings the competition is so keen that founders have been compelled to send out reduced lists.

In the engineering branches of trade there is a continued quieting down, and the returns as to employment received by the engineering trades union societies show an increasing number of men coming out of work. In exceptional cases some improvement is reported; the shipbuilding trade on the north-east coast is showing a little more activity; from the Blackburn district slightly better prospects are reported amongst engineers. In the Manchester and Salford district trade is, however, only moderate; in Bolton it is slacker than it has been for some time; and in the Wigan, St. Helens, and the colliery districts generally it is extremely bad. In the Liverpool and Birkenhead districts trade is still very quiet, but the returns as to employment show, if anything, a slight improvement. A few of the tool makers are still kept fairly busy, but the general engineering trades are only moderately employed. Cotton machinists in most cases are but indifferently supplied with orders, and locomotive builders, who for the last two or three years have been exceptionally busy, are now discharging hands.

The slackening down in the engineering trades is naturally affecting other allied branches of industry. Brass founders are only getting a small weight of orders for either engineers' or marine fittings, and prices are cut extremely low by the keenness of competition. Nut and bolt makers report trade as extremely depressed, and to meet the underselling in the market the associated firms have decided to suspend the minimum list by which they have previously been bound.

The demand for all descriptions of fuel continues extremely poor, and the slightly increased inquiry which during the last week or two has been coming forward for house fire coals has not yet resulted in any appreciably increased weight of actual business being done. For iron making and steam purposes the requirements of consumers show no improvement whatever, and common round coals are so bad to sell that in many cases colliery proprietors are prepared to accept almost any price to clear away stocks. Engine classes of fuel meet with only a very slow sale, and supplies of slack are much in excess of requirements. Except when prices are cut down to special rates for temporary sales, the current market rates are without material change, and at the pit mouth remain at about 8s. to 8s. 6d. for best coals, 6s. 6d. to 7s. for second qualities, 5s. to 5s. 6d. for steam and forge coals, 4s. 3d. to 4s. 9d. for burgy, 3s. 6d. to 4s. best slack, and 2s. 6d. to 3s. per ton for ordinary qualities.

The shipping trade has been quieting down of late, and although for good qualities of steam coal delivered at the high level, Liverpool, or the Garston Docks, 7s. to 7s. 3d. per ton are still the average quoted figures, stocks are forced for sale at extremely low prices.

The miners appear to be making preparations for another wages agitation, and it is proposed that they should seek an advance of 15 per cent., to secure which end various impracticable methods are proposed. The threatened agitation does not disturb the market, and unless it is a dodge in view of the approaching elections, it is difficult to see how any higher rate of wages can under the present conditions of trade be obtained.

Barrow.—There is a better tone so far as anticipations of a better trade are concerned, and the demand from home, continental, and general foreign sources is giving evidence of growth. The inquiry from all sources is gaining strength, and makers have been entrusted with a greater weight of orders than have fallen to their lot for some time. Prices are easy, but old rates are maintained not only for Bessemer, but for ordinary hematite qualities of pig iron; 42s. 6d. is quoted as the net price for prompt deliveries of mixed parcels of Bessemer iron at makers' works, with forge and foundry iron at 41s. 6d. and 42s. per ton net. The stocks of iron which have accumulated are too large to be judged of no importance, and it is evident that, sooner or later, stocks will have to be reduced, or makers will have to experience a greater demand, or the output of pig iron will have to be reduced. Steel-makers are indifferently supplied with orders, and the mills in the steel rail trade or in the merchant trade are working not more than one-third their time. Shipbuilders are expecting some good orders for Admiralty and general shipping. Iron ore very quiet; coal and coke dull. Shipping brisker than of late, but freights are very low.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THIS week, in the lighter staple industries, rather better prospects are reported. Several establishments which have given three days a week are now working four days, and in one or two instances full time has gratified employer and employed alike.

It is exceedingly gratifying to find these branches beginning to feel brisker, as the prolonged period of depression has been most bravely borne by the artizans. The manufacturers have done all they could to keep their hands together, as well as to find them adequate employment; but it has been impossible in too many instances to accomplish this, and no little suffering has been uncomplainingly endured.

Though one hears of confident expressions regarding the iron and coal trades, it is impossible in this district to report as yet any decided change for the better. With the sharp touch of autumn there is always a little more animation in the demand for house fuel, particularly for the metropolitan markets, as well as for the Eastern Counties. An increased call is also noticeable for the northern ports in view of their being closed during the winter. An advance of 1s. a ton is ordinarily made in household coal about October, and it will no doubt come into effect this year as usual. It is then that the Union officials reopen the wages' question. This season they have already suggested an advance in a circular addressed to the miners at leading pits in this locality, and this has been followed by an announcement that a general conference of miners is to be held to consider a most formidable programme, which includes an advance of 15 per cent. in wages, the laying of the whole mining community idle until the surplus stock of coal is consumed, and afterwards a continued limitation of the output by working shorter hours or fewer days per week. Every district is requested to send delegates with power to state clearly and distinctly what the men can and will both adopt and carry into effect. This movement will have serious results if persisted in. No industry so much needs "rest" as coal. Here it is suffering severely from the ill-advised demand for 15 per cent. two years ago, and the equally ill-advised attempt to compel the employers to keep their collieries going at a loss this season. As the outcome of both movements, large orders which were formerly placed in Yorkshire have gone into other coalfields, with the inevitable issue of lessened employment for the men and increased losses for the coalowners.

The Midland Railway Company has recently placed several heavy orders for tires and axles with different Sheffield manufacturers, the whole making up a goodly weight. The Bombay, Baroda, and Central India Railway Company has placed a considerable order for tires with Messrs. Charles Cammell and Co., the Cyclops Steel and Ironworks, and for axles with Messrs. John Brown and Co., Atlas Works. In the other branches of the heavy trades I cannot find any change for the better. Both armour-plating firms are busy on the plates for the belted cruisers which have to be got out of hand by March.

The Sheffield Chamber of Commerce appear disposed to re-open a question of great interest to manufacturing firms—the rating of machinery. A Bill to amend the law relating to this subject has already been before them and considered. Ultimately it was decided to defer consideration of the subject until a meeting to be held at the commencement of next year, but in time to take the opinion of the Chamber before the annual meeting of the Associated Chambers of Commerce.

Another attempt has been made to bring the miners' strike at Ilkeston to an end. The men agreed to resume work at a reduction of one penny per ton; the masters responded by lowering their demand to twopence per ton. The men declined to go below their penny, and the strike therefore continues, with its attendant distress.

During the last ten days three leading Sheffield men—manufacturers and borough magistrates—have died. Mr. T. Sorby (Messrs. Robert Sorby and Sons, Carver-street), Alderman Hallam (Messrs. Worrall and Hallam, Attercliffe), and Mr. S. Roberts, formerly of the firm of Roberts and Belk, electro-platers, Furnival Works, Sheffield. Mr. Belk is Master Cutler-elect this year. By a singular coincidence, Mr. R. H. Sorby, who had dissolved partnership with the Carver-street firm only a few days before, has died of sunstroke on board ship on his way to America.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

The iron market held at Middlesbrough on Tuesday last is pronounced by several regular frequenters to have been the firmest which has taken place this year. The attendance was much larger than usual, several merchants from distant towns being present. One and all seemed impressed with the idea that a turn for the better has come, or is imminent. The only solid ground for this conclusion which anyone can point to is the rise in value of stocks and shares, originating in America, but which has already spread to this country. That North-Eastern Railway consols should have risen from 150 to 156 in a fortnight, and without any change whatever in traffic returns, must mean something. And if increased confidence pervades the business world, that of itself is a force the value of which it is impossible to over-estimate. It is quite clear that the change of feeling is not the product, so far, of any increased consumption of iron or steel. Ships are not yet in increased demand, nor are their earning powers better than they were. There is no more activity in shipbuilding, nor in railway travelling, nor in the employment of labour, nor in the demand for finished iron, or steel, or castings, or machinery. The improvement has come from none of these sources. On the other hand, if pig iron continues to rise it will affect local industries detrimentally, or force them proportionately to higher values.

There is no doubt that a number of outside investors have entered the market during the last fortnight, and have bought up pig iron to a considerable value for the purpose of stocking and holding it for a rise. Provided these investors are men of means, able to give solid money in return for what they buy, they come most opportunely to the relief of the trade. The total stocks of pig iron in the district are now worth about £700,000. It is manifest that so much money locked up must be a serious inconvenience to the producers unless they can find buyers to relieve them. Not only so, but they must take into account the loss of interest, and, if in public stores, the loss of rent continually accruing, and amounting to about 2s. 6d. per ton per annum. Ironmasters have of necessity enormous capitals buried in their plant and machinery, and cannot be expected to provide the needful for unlimited stocks also. Therefore it is difficult to exaggerate the importance of the relief which, at a crisis like the present, is afforded by the introduction of outside capitalists willing to buy from producers their stocks, and hold them till they become saleable at better prices.

Into Connal's store alone nearly 5000 tons have been sent within seven days, and other public stores have received similar additions. During the last two months 20,000 tons have been added to Connal's stock.

Shipments also are increasing, 60,794 tons having been sent away so far this month against 55,243 tons during the corresponding portion of July.

The price of No. 3 g.m.b. is now firm at 32s. per ton f.o.b.; and forge pig readily commands 31s. to 31s. 3d. Warrants are 32s. 6d., but few holders will sell at all.

In the finished iron trade there is as yet no improvement whatever to report. Ship plates are sold at £4 15s., and girder plates at £5 per ton. Boiler plates command £5 15s.; angles, £4 10s. to £4 15s.; and bars, £4 17s. 6d., all free on trucks at makers' works, less 2½ per cent. discount for cash. The steel trade remains fairly active at previous prices.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

The pig iron market has been strong this week, with a good business in warrants at an advance in price. Reports with reference to a revival of trade in the United States have had some effect on the market, although the demand for pig iron on American account has not in the least degree improved. There is also some anticipation of a number of furnaces being put out in the course of next month, and some speculative business has been passing on the strength of this impression. The shipments of Scotch pigs in the past week amounted to 8942 tons, as compared with 9839 in the preceding week, and 9320 in the corresponding week of 1884. The quantity despatched to Germany gives some promise of a better demand, but the failure of the ironmasters there to agree about reducing the production will not be favourable to the chances of a greater export of Scotch iron. Since last report one furnace has been put out at Gartsherrie and one at Wishaw, and there are now 90 in blast, against 94 twelve months ago. The increase of stocks in Messrs. Connal and Co.'s stores continues, the addition in the past week being upwards of 1200 tons.

Business was done in the warrant market on Friday last at 41s. 4½d. cash. There was a fair amount of transactions on Monday at 41s. 5d. to 41s. 7d. cash. Tuesday's market was active at 41s. 7½d. to 41s. 5½d. cash. Business was done on Wednesday at 41s. 5d. to 41s. 6d. cash. To-day—Thursday—the market was firm at 41s. 6½d. cash, closing with sellers at that figure, and buyers ½d. less.

A considerable quantity of makers' pigs has changed hands in course of the week without much alteration in quotations. Free on board at Glasgow, Gartsherrie, No. 1, is quoted at 46s. 6d. a ton; No. 3, 44s.; Coltness, 48s. 6d. and 45s. 6d.; Langloan, 47s. 6d. and 45s. 6d.; Summerlee, 46s. 6d. and 44s.; Calder, No. 3, 44s.; Carnbroe, 45s. 6d. and 43s. 6d.; Clyde, 46s. and 42s.; Monkland, 41s. 6d. and 39s. 6d.; Quarter, 41s. and 39s.; Govan, at Broomielaw, 41s. 6d. and 39s. 6d.; Shotts, at Leith, 48s. and 47s.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 46s. and 41s. 6d.; Eglinton, 41s. 3d. and 38s. 3d.; Dalmellington, 43s. and 39s. 6d. The total shipments to date are 292,733 tons, against 365,229 tons at this time last year. Imports from Cleveland show an increase to date of 70,592 tons.

The malleable iron trade is quiet, but there is a fair business at firmer prices.

The shipments of iron and steel goods from Glasgow in the past week embraced six locomotives valued at £17,430 for Sydney, five at £14,830 for Kurrachee, four at £9200 for Japan, and three at £6150 for Madras; a small stern-wheel steamer, worth £2340, for Singapore; £10,000 worth of machinery, £1662 sewing machines, £2800 steel goods, and £26,000 iron manufactures.

In the coal trade there has been a good business, but the inquiry for succeeding weeks appears to have materially slackened. The orders that have been given out recently, however, are of considerable amount, and the probability is that by the time these are implemented the inquiry for domestic coals will be on the increase. The past week's coal shipments embraced 20,353 tons at Glasgow, 2589 at Greenock; 3818 at Irvine, 8551 at Ayr, 15,898 at Grangemouth, and 5880 at Leith. The prices of coals are not quite so firm, although they are quoted nominally as without alteration.

The agitation among the miners for an increase of wages has, in a manner, broken down. At the last weekly meeting at Hamilton the attendance was so small that it was deemed advisable to discontinue the idle day for several weeks. In the meantime the leaders are to endeavour to improve the organisation of the men, with the view of renewing the agitation in a more influential form.

The arrangements for the meeting of the Iron and Steel Institute, which takes place in Glasgow next week, are now completed, and they promise to be quite successful. Interest will be added to the meeting by the Exhibition of Mining Machinery and Appliances, which also opens in Glasgow next week, and to which all the members of the Institute will have free tickets.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The general course of things taken by recorders of the state of the iron and steel trade in Wales is to represent a condition only next door to total stoppage; but it is evident from our shipments that some business is being done. For instance, last week 1364 tons of manufactured iron went to Messina, 1370 tons to Ahus, and a fine cargo of 2672 tons to Madras.

I cannot think that ironmasters, such as Mr. Crawshay, would so persistently make for stock without some tolerably sound prospects ahead, and taking the improving condition of things in America with the known necessities of our Colonies into account, my conclusion is that though trade is depressed enough, a better state of things is at hand.

I traversed a wide district this week of country lying between the "hills" and Newport, and could not but be struck with the stagnancy of the house coal, coke, and minor iron industries which capitalists have started in such places as Crumlin, Bargoed, and Machen. In coke ovens especially the picture of dilapidation was complete, but I fancy a good deal of this is due to the superior coke turned out at the larger works at Rhondda, Dinas Main, Ebbw Vale, and elsewhere.

House coal keeps remarkably dull, and steam is very little better. The only kind of coal for which there is anything like a brisk demand is small steam, which keeps very steady and firm in price.

In the Cardiff district, which is served principally by the Rhondda, Aberdare, and Merthyr Valleys, the falling off in coal is very marked. Instead of the old average of 150,000 tons, the total shipment last week was only 122,755 tons. In fuel there was a slight improvement, 5646 tons being despatched, and 1330 tons of iron. At Newport I find a somewhat better tone, though coalowners and shippers are complaining bitterly of trade. Last week the coal clearances amounted to 45,903 tons, against 34,534 tons of the previous week. The signs of progress at Newport are well marked, extensions, improvements are clearly defined, and the brick and mortar competition with Cardiff is unmistakeable. The patent fuel trade is getting into form. I note that last week 510 tons were sent to Algiers, and a cargo of 50 tons to Bordeaux; but this industry is, of course, in its infancy.

I am sorry to say that the stoppage at Llanlwit Colliery continues. The Merthyr Vale has not recovered from its mishap, though strenuous efforts are being made to do so.

A few days ago there was a good deal of feeling aroused at Pontypridd by the rumour that coal had not proven in the fine new sinking at Ynysybwl, which is being carried on by Mr. Beith, but I hope every day to have this disproved. They had certainly gone below the estimated depth, but probably it is only a small local fault. Mr. Beith's success is proverbial, and, besides, those well conversant with the ground are quite content to wait, knowing that coal must be found. With regard to the sinking on the sewage farm on the eastern side of the Taff, critics differ. As a rule, that side is not so true a one.

The Taff Vale is ordering extensive bridge-work. In connection with Cyfarthfa, the company has been very fortunate in getting in the foundation without the slightest flood, and has thus saved thousands of pounds. In Cardiff two new bridges are being placed, Mr. H. O. Fisher is superintending.

There has been a rumour of late that the day men at the Bute Docks are only to work three-quarter time for five days in the week henceforth, but this is incorrect. In the face of a good deal of depression, the large number of men employed there are maintained with only a trifling stoppage on Saturday.

The hopeful note I sounded with regard to the Naval Colliery at Penygraig died away prematurely. The men are out, and in consequence of the action of some doctors, as unquiet spirits are called amongst the men, the strike is maintained.

In tin plate, being stop week last week, there was not much done. This week I was glad to see some little life at Rhiwderin. This place is well situated near Newport, and the township developed by the trade is a model one.

Buyers are stiff in holding back, and makers quite as determined, so trade is by no means brisk. I find, too, that the facts of small parcels of seconds, or supply of old contracts, have been magnified into importance with a view of weakening the combination, but so far it is intact, and prices are firm.

Present quotations I.C. coke, 13s. 9½d. to 14s. 6d.; ruling prices obtained have been from 14s. to 14s. 3d.

Steel coke sheets, 14s. to 14s. 6d. and up to 15s. Wasters are lower in figure.

LAUNCHES AND TRIAL TRIPS.

On the 24th inst. Messrs. Earle's Shipbuilding and Engineering Company launched from their yard at Hull an iron screw tug named the Alexandra, built to the order of the Hull, Barnsley, and West Riding Junction Railway and Dock Company. The vessel, which is intended for working in the new—Alexandra—dock at Hull and for general towage purposes, is 72ft. long by 16ft. 6in. beam by 8ft. 6in. depth, is classed 100 A at Lloyd's, and is fitted with all the modern appliances of a powerful tug. She has a cast steel rudder of large area made by Messrs. W. Jessop and Sons, of Sheffield, and a large steam fire engine and salvage pump fitted in the engine-room with suitable connections on deck. A small cabin is provided amidships which will be available as shelter for passengers, and the crew will be housed in cabin aft. She will be fitted by the builders with their triple compound three-crank engines, having cylinders 11½in., 17in., and 30in. diameter and 21in. stroke, which will be supplied with steam of 150 lb. pressure from a steel boiler having two Fox's corrugated furnaces.

With reference to the trial trip of the ss. Algoma we are informed that she is fitted with S. Baxter and Co.'s system of anchor gear, by which the expensive and cumbersome appliances for catting and fishing are dispensed with, the anchors, which are stockless, being hove direct into the patent hawse pipe on seatings. The trial was carried out under the superintendence of Mr. F. Pilcher, of Liverpool, who has expressed himself highly pleased with the satisfactory working of the whole arrangement. The windlass is one of Messrs. Baxter's vertical type, with an independent steam engine and capstan on forecastle fitted with wheel for working wire ropes. H.M. Scout is also fitted with S. Baxter and Co.'s capstan, the capstan being similar to H.M.S. Benbow, &c., for veering cable and protection to the men at the bars while working it.

The steel screw steamer Shieldrake, built by Mr. W. B. Thompson, of Dundee and Glasgow, for the Cork Steamship Company, has been launched from the Caledon Shipyard. The Shieldrake is the second vessel Mr. Thompson has built for the Cork Steamship Company—the first ship, the Avocet, completed a short time ago, being now on the passage between Cork and London. The new vessel is about 1100 tons gross, to carry about 1400 tons, and has been built of the highest class at Lloyd's. Her dimensions are: Length, 250ft.; breadth, 32ft.; depth of hold, 15ft. 8in.; her poop deck is 106ft.; bridge deck, 28ft.; and forecastle deck, 47ft. Like the other vessels belonging to the company, the Shieldrake has been constructed on the cellular bottom principle. The engines and boilers are placed well aft. In the wheel-house is placed Higginson's patent steam quartermaster, by which the vessel can be steered either by hand or steam. The crew are berthed forward under the forecastle deck. On this deck is placed Clarke, Chapman, and Co.'s patent steam windlass for working the anchor. At the after end of this deck are two iron lighthouses, in which the ship's side lights are fixed—an arrangement which places the lights beyond any risk of extinction in the heaviest weather. The poop, bridge, and forecastle decks are connected by fore and aft gangways, railed on both sides, thus obviating a descent to the main deck when passing from one end of the vessel to the other. The appliances for loading and discharging cargo comprise four powerful steam cranes on the main deck, and two steam winches, placed conveniently to the hatchways. The engines, compound surface condensing, are 160 nominal horse-power, with cylinders 29in. and 57in., with 48in. stroke, and are expected to drive the vessel at a high rate of speed. Steam is supplied from one steel double-ended boiler at a pressure of 90 lb.—that for the cranes, winches, &c., being from a donkey boiler placed on the main deck.

Colonial and Indian Exhibition, 1886.—It is probable that a great success will be secured for the Colonial and Indian Exhibition of 1886, by the proposed practical illustration of the handicrafts of India, which will be given in the form of a royal "Karkhana," or series of palace workshops. Although of remote antiquity, this is still the principal feature of Eastern Courts, where visitors are surprised to find within the palace precincts a colony of merchants and artificers carrying on their several trades in open shops similar to those in the bazaars outside. Circumstances favourable to the production of high-class work raise these men above the level of the hand-to-mouth daily toilers of the town, and, working for the palace (usually on royal presents), masterpieces are produced which it would otherwise be impossible to obtain in the ordinary course of business. Arrangements are now being made to fulfil the conditions of such a palace workshop, and for the representation of a palace court-yard, the entrance to which will be the magnificent gateway presented by his Highness the Maharajah Scindia, K.C.S.L., to the South Kensington Museum.

The British Society of Mining Students.—The members of the above Society held their annual meeting on Tuesday, August 18th, at Tyne Dock. By the kindness and liberality of Mr. George May, of Simonside Hall, general manager of the Harton, St Hilda, and Boldon Collieries, a room was placed at the disposal of the members for the transaction of the annual business of the Society. The past president, Mr. H. F. Bulman, Rainton Collieries, Durham, delivered an address, in the course of which he laid particular stress on the recent experiments with coal dust in fiery mines. The secretary, Mr. C. H. Cobbold, Plumbley Colliery, Derbyshire, read his report on the past year, which showed a satisfactory increase in the number of members. After the election of Mr. E. F. Melly, Griff Colliery, Nuneaton, as president for the present year, and the selection of the vice-presidents for the various mining districts, and the formation of a working committee, luncheon was served, for which the members were again indebted to the kind forethought and liberality of Mr. May. The members were now divided into three groups, and by the kind permission of the following gentlemen their respective works were open for inspection under personal guidance, viz.:—Mr. T. M. Hicks, superintendent of the Tyne Docks; the River Tyne Commissioners, through their engineer, Mr. Philip J. Messent; Mr. C. A. Shute, manager of the Hebburn Collieries; Mr. W. T. Warner, manager of the South Shields Gasworks; Mr. John Price, general manager of Palmer's Shipbuilding and Ironworks; Mr. J. J. Hopper, North-Eastern Wire Rope Works; Mr. Lindsay Wood, managing owner, and Mr. George May, manager of the Harton, St. Hilda, and Boldon Collieries. Group No. 1: Harton Colliery, Wire Rope Works, Tyne Docks, St. Hilda Colliery, South Shields Gasworks, Pier Works. Group No. 2: Harton Colliery, Wire Rope Works, Tyne Docks, Boldon Colliery. Group No. 3: Harton Colliery, Wire Rope Works, Tyne Docks, Jarrow Gasworks, Palmer's Shipbuilding and Ironworks, Hebburn Collieries. The following members were present at the meeting, and enjoyed the privilege of joining one of the three groups, viz.:—Messrs. F. G. L. Simpson, W. T. Curry, T. Douglas, H. W. Hughes, C. H. Dodd, W. Douglas, G. S. Corbett, R. A. Redmayne, Cyril Gipps, F. G. Hooper, H. Bramwell, J. J. Turnbull, S. W. Linsley, G. Rhodes, R. Laverick, C. J. Murton, C. F. E. Griffiths, G. May, J. Hopper, H. F. Bulman, C. H. Cobbold, C. W. James, W. Badger, S. R. Anderson, J. H. Young, H. Pratt, C. H. Steavenson, R. B. Smith, T. Scowcroft, J. H. W. Laverick, T. E. Crone, T. Thompson, E. P. Bainbridge, C. Cole, W. Nichol, and W. Brown.

NEW COMPANIES.

THE following companies have just been registered:—

Otway Engine Company, Limited.

Upon terms of an agreement of the 10th inst., this company proposes to purchase from Mr. Harold Otway, of 37, South Lambeth-road, British and foreign patent rights for certain inventions relating to improvements in steam engines, the number of the British patent being 12,415, dated 15th September, 1884. It was registered on the 18th inst., with a capital of £100,000, in £1 shares. The purchase consideration is £14,000, one-half of which is to be paid in fully-paid shares. The subscribers are:—

	Shares.
R. Kelly, 26, Suffolk-street, S.W., chemical agent	1
A. J. Thorman, 6, St. Benet-place, ship and insurance agent	1
W. F. Tritton, 37, South Lambeth-road	1
W. Shepherd, 16, Elms-road, Dulwich, secretary to a company	1
A. Weigel, 3, Pall Mall, chemical agent	1
H. Straborne, 51, Imperial-buildings, Ludgate-circus, solicitor	1
R. J. Burns, 4, Ludgate-circus	1

The number of directors is not to be less than two, nor more than seven; the subscribers are to appoint the first; qualification for subsequent directors, £500 in shares or stock. The chairman will be entitled for remuneration to not less than £300, nor more than £500 per annum, and the directors will be entitled to £150 per annum each, but upon payment of 10 per cent. dividend upon the ordinary shares, the rates of remuneration will be doubled.

Piranga Gold Dredging Association, Limited.

In Brazil and elsewhere, this company proposes to carry on the business of dredgers for gold and other precious metals and gems, and will take over the interest of a concession made to the late Dr. Witt Clintol Van Tuyl by the Brazilian Government, dated 3rd of May, 1879, so far as the same applies to the River Piranga, its tributaries and banks. The company was registered on the 17th inst., with a capital of £25,000, in £100 shares. The subscribers are:—

	Shares.
*J. F. Harrison, 41, Ovington-square	5
*Lieut.-Col. H. R. Eyre, 10, Berkeley-square	3
*C. T. Molyneux-Montgomerie, J.P., East Harling, Norfolk	4
*General, the Hon. St. George G. Foley, C.B., 24, Bolton-street	5
*The Rev. Sir G. L. Wilmot Horton, Bart, Burton-on-Trent	5
Mrs. E. F. Molyneux-Montgomerie, East Harling, Norfolk	1
*F. Hambro Dutton, Palace Hotel, Buckingham-gate	7

The number of directors is not to be less than three; the first are the subscribers denoted by an asterisk; remuneration, a sum equal to 10 per cent. of the net profits.

Breckenridge Company, Limited.

Upon terms of an agreement of 23rd ult., this company proposes to purchase from Mr. David Maitland Yeomans, described as of the Hotel Metropole, the capital stock of the Cloverport Oil and Colliery Company, a corporation incorporated in Kentucky, U.S.A., with a capital of 500,000 dollars, in 5 dollar shares, fully-paid up, to acquire and work the property of the Breckenridge Canal Coal Company, and other lands or property situate in the counties of Breckenridge and Hancock, Kentucky, U.S.A., consisting in the aggregate of 6500 acres. The company was registered on the 13th inst., with a capital of £500,000, in £10 shares, the whole of the shares to be issued as fully-paid up as consideration for the purchase. The subscribers, who take one share each, are:—

	Shares.
D. M. Yeomans, Hotel Metropole, engineer	1
J. Nield, 1, Ashburn-place, South Kensington	1
*J. Pickering, 110, Lexham-gardens	1
*T. Cory, Sketty House, Swansea, colliery proprietor	1
*Tudor Crawshay, J.P., Cardiff, colliery owner	1
J. Nield, jun., 1, Ashburn-place, S.W.	1
J. Marmont, 60, Jermyn-street, E.C.	1

The number of directors is not to be less than three, nor more than seven; qualification, one share, and subsequently 50 shares; the first are the subscribers denoted by an asterisk. Remuneration, £500 per annum to the chairman and £250 to each other director.

British Emery Company, Limited.

This company was registered on the 17th inst., with a capital of £10,000, in £1 shares, to acquire and work the letters patent for an improved manufacture of polishing material, for which provisional protection, dated April 14th, 1885, has been granted to Messrs. Frederic Cooper and John Hall. The subscribers are:—

	Shares.
G. Chapman, 52, Bread-street, manufacturer	1
F. Thirkell, 76, Wood-street, manufacturer	1
T. A. Wheatley, 130, Great Suffolk-street, S.E.	1
P. McKinlay, 23, Upper Thames-street, warehouseman	1
G. P. Thirkell, Clapham Park, merchant	1
H. G. Thompson, Penola, Sydenham, Kent, warehouseman	1
S. Cheesman, The Hall, Dulwich	1

Registered without special articles.

Liverpool and Isle of Man Steamship Company, Limited.

On the 17th inst. this company was registered with a capital of £500,000, in £10 shares, to acquire steamships suitable for communication between the Isle of Man and any ports or places in the United Kingdom. The subscribers are:—

	Shares.
J. Herbert Slater, 3, Plowden-buildings, Temple, barrister	1
H. J. Newman Harrison, Southampton, master mariner	1
E. Hampson, 60A, Market-street, Manchester, accountant	1
J. Halliday, Water-street, Newtown, Manchester, engineer	1
J. R. Lawton, John Dalton-street, Manchester, accountant	1
E. Slater, 7, Sinclair-gardens, Kensington	1
J. A. Hinton, Castle Mona Hotel, Douglas, Isle of Man	1

The number of directors is not to be less than three, nor more than ten; the subscribers are to appoint the first and act *ad interim*; qualification, £250 in ordinary shares; remuneration, £1000 per annum. Mr. Marcus Percy Shorrock is appointed first manager.

Swedish Ice Company, Limited.

This company was registered on the 19th inst., with a capital of £40,000, in £1 shares, to construct and carry on ice works and stores, and refrigeration and meat preserving works. The subscribers are:—

	Shares.
Walter Hunt, C.E., 1, Fern Villas, Croydon	1
G. Lowthian, C.E., 58, Blenheim-crescent, Notting-hill	1
E. P. Binet, C.E., 3, Lynscott-road, Lower Clapton	1
W. Steele, 35, Great Percy-street, W.C., clerk	1
J. Langley, 51, Princes-road, Bermondsey, clerk	1
G. Stewart Anderson, 46, Warwick-gardens, Kensington, merchant	1
F. T. Watts, 27, Lordship-road, Stoke Newington, clerk	1

Registered without special articles.

THE BRITISH ASSOCIATION.

ARRANGEMENTS for the visit of the British Association to Aberdeen—commencing in the second week of September—are now considered complete, and the local committee seem to have succeeded in overcoming what at one time seemed to threaten the Association with a very small visitors' list, namely, exorbitant charges for lodgings and general accommodation. At all events, fairly reasonable rates are now said to be offered as compared with those which ruled two weeks' ago. The programme is a very attractive one, and there is some probability of some rather more exciting enunciations than have characterised the proceedings—that is to say the addresses, papers, or lectures—during the past few years, since the Belfast meeting.

The sections are all under men prominent in the branches of science they represent. Mr. Benjamin Baker, M.I.C.E., will preside over the Engineering or Mechanical Section. The excursions will be of an interesting character, and the Geological Section will have its papers illustrated by local examples.

Professor Bonney will retire after this meeting, and Mr. A. T. Atchison, who has long taken an active part in the work of the meetings, and especially in the Mechanical Section, will, we are glad to see, succeed him.

Our readers are aware that at the approaching meeting of the Association it has been arranged to have discussions in Section A on kinetic theories of gases, and on standards of white light. Prof. Crum Brown has consented to open the discussion on kinetic theories, and has drawn up the following short abstract of points to which he proposes to allude. It would be convenient if persons desiring to take part in the discussion would forward their names, with, if possible, a short abstract, to the recorder, Prof. W. M. Hicks, Firth College, Sheffield.

Difficulties connected with the dynamical theory of gases.—Professor Crum Brown.—The dynamical theory of gases appears at first sight to furnish a very complete explanation of all the properties of gases, both physical and chemical. When, however, we come to details, difficulties and apparent contradictions make their appearance. These difficulties have been pointed out from time to time, and some attempts have been made to show that they are not really fatal to the theory as usually stated; but it may be useful that some of them should be brought at this time before the section and regularly discussed. I shall here merely mention some of these difficulties, as the explanations which have been given of them will be better supplied by others in the discussion.

(1) *The difficulties connected with the doctrine, that energy communicated from without to a gas is equally shared among the whole of the degrees of freedom of the molecules.*—This leads to a relation between the numbers of degrees of freedom and the ratio of the specific heat at constant pressure to that at constant volume. This ratio is for mercury gas almost exactly 5 : 3, from which it would appear that the molecules of mercury gas have not more than three degrees of freedom—in other words, that the whole energy of mercury gas is kinetic energy of translation of the molecules. But even if we assume that the molecules of mercury are spheres, perfectly smooth and perfectly rigid, the fact that mercury vapour has a spectrum points to some form of energy of a vibratory kind. Again, the gases, the molecules of which are supposed to consist of two atoms, have the ratio of the specific heats nearly equal to 7 : 5—it seems always to be a little greater than this, which increases the difficulty. This points to five degrees of freedom of the molecule, which would be consistent with the hypothesis that these molecules consist of two smooth, undeformable spheres at a constant distance from each other, the five degrees of freedom being three of translation and two of rotation about two axes, any two at right angles to each other and at right angles to the axis of the molecule, that is, the line joining the centres of the two atoms. But here also we have spectra, and in addition the phenomena of dissociation lead to a belief that the firmness of the union of the two atoms diminishes as temperature rises, and it is difficult to reconcile this with a constant distance of the two atoms from one another in the molecule. Any variation in this distance would be a new degree of freedom in addition to the five allowed by the theory. All attempts to reconcile chemical action and chemical equilibrium with dynamical conceptions seem to require the assumption of vibrations of the atoms in the molecule, under the influence of forces depending on the distances of the atoms from each other, and perhaps in addition to these vibrations of the atoms as parts of the molecule, vibrations of the atoms themselves. In molecules even of a comparatively simple kind, such considerations imply many degrees of freedom, certainly far more than the dynamical theory of gases as usually understood will admit.

(2) *Difficulties connected with the doctrine that energy of each kind is distributed among the molecules according to some form of the law of probability.*—This implies that in a gas at any temperature there are molecules in the condition as to energy which is the average condition of the gas at any other temperature. That, for instance, at the ordinary atmospheric temperature there are molecules in the condition which is the average condition at a red heat. This seems inconsistent with what is usually regarded as true, viz., that there are limiting conditions of temperature and pressures, on the one side of which certain chemical changes occur, while they do not occur at all on the other side. Thus at ordinary atmospheric temperatures and pressures, hydrogen and oxygen show no tendency to combine. At a red heat they combine almost completely. At ordinary temperatures phosphorus combines slowly with oxygen if the pressure of the oxygen is below a certain limit—dependent on the temperature—but apparently not at all if the pressure of the oxygen is above that limit. Many other cases might be mentioned, but these may suffice as instances. It is difficult to understand the existence of such definite sharp limits, if the energy is distributed among the molecules according to any asymptotic law. In such a case the rate of chemical action might be expected to diminish, but not to become zero. I have brought forward these instances of apparent contradiction between the conclusions of the dynamical theory as usually stated and observed facts, in the hope that they may be cleared up. This may conceivably be done in two ways—either by showing that the facts have not been accurately observed, or that the conclusions have not been legitimately drawn from the theory.

A NEW EXPLOSIVE.

A NEW explosive, known as Hellhoffite, which has been invented by Hellhoff and Gruson, has been subjected to comparative trials at St. Petersburg, together with nitro-glycerine and ordinary gunpowder. It is described in the *Times* as a solution of a nitrated organic combination—naphthaline, phenol, benzene, &c.—in fuming nitric acid. In preparing the Hellhoffite tried in the experiments, binitro-benzene, a solid, inexplosive, and badly burning body, was used. At the first trial glass bottles of 20 cubic centimetres contents each were filled with 20 grammes of the respective explosive substances, and corked down. A tube filled with fulminate of mercury was passed through the corks, a slow match being attached to the outer end of the tube for the purpose of ignition. Each of the bottles thus prepared was placed on a truncated cone of lead, the upper diameter of which was 3·5 cm., its lower 4·5, and its height 6. The cone itself stood on a cast iron plate 2·5 centimetres thick. The deformation of the leaden cone by the action of the explosives could consequently be taken as a measure of their respective destructive power. The explosion of the gunpowder, as was anticipated, caused no changes. By the explosion of the nitro-glycerine the cone was compressed about a quarter of its height; its surface had assumed the appearance of a well-worn hammer; the diameter of the surface had been increased to 5·5 centimetres. The explosion of the Hellhoffite caused much greater changes. The surface of the cone was completely torn; pieces 5 centimetres long and 2 centimetres thick were torn off and thrown about for several paces; only half of the cone was still a compact but entirely defaced mass. At the second experiment, bottles of 25 grammes each, filled with the various explosive substances, were let into corresponding cavities bored into the face of fir blocks of similar dimensions. In exploding the gunpowder, the block was torn into four pieces as if split with a hatchet, the several pieces were thrown about for 18, 12, 11, and 10 paces. In exploding the nitro-glycerine, the block was split into several pieces. The upper portion of the block, as far as the bottle was let into it, was torn off perpendicularly in the direction of the fibre in such a manner that a smooth cut was formed. The explosion of the Hellhoffite likewise tore the portion of the block surrounding the bottle perpendicularly in the direction of the fibre, and splintered the remainder of the block into a large number of thin fibres. The following experiments were also made with Hellhoffite alone:—A slow match was passed through the tube in the cork which was without fulminate of mercury, as far as the surface of the Hellhoffite in the glass bottle; no explosion followed on igniting the slow match. A quantity of Hellhoffite poured into a bowl could not be exploded by a lighted match. Finally, a few drops of Hellhoffite were poured on an anvil, and exposed to heavy blows with a hammer, and no explosion followed. The Hellhoffite, consequently, possesses the following advantages:—(1) In igniting it with fulminate of mercury it acts more powerfully than nitro-glycerine; (2) it may be stored and transported with perfect safety as regards concussion, as it cannot be exploded either by a blow or a shock, nor by an open flame. On the other hand, it has the following disadvantages:—(1) Hellhoffite is a liquid; (2) the fuming nitric acid contained in Hellhoffite is of such a volatile nature that it can be stored only in perfectly closed vessels; (3) Hellhoffite is rendered completely inexplosive by being mixed with water, and can consequently not be employed for works under water.

THE MASON SCIENCE COLLEGE.—The syllabus of day and evening classes for session 1885-6 of this College has been issued. The engineering section naturally forms a large one, and is under Professor R. H. Smith, whose plan of instruction is, "firstly, to describe the facts of engineering practice—that is, the tools, machinery, and methods used by engineers; secondly, to develope theoretical engineering science as based on these facts; and thirdly, to apply the scientific knowledge of facts and theory to practical problems in engineering design; no theory being introduced except such as has a direct bearing upon the problems of professional practice, and no theories being taught until the facts upon which they are based have been fully explained."

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

18th August, 1885.

9769. RING-SPINNING MACHINERY, J. Tatham, Manchester.
9770. TRICYCLES, G. Tolson, Dewsbury.
9771. HARROWS, T. J. Williams, London.
9772. TINTOGRAPHS, &c., E. H. Brown, London.
9773. GENERATING HYDROGEN GAS, H. J. Allison.—(*C. C. Yeaton, United States.*)
9774. BUTTON-HOLE STITCH SEWING MACHINES, G. Browning, Glasgow.
9775. PITCH-CHAINS, J. S. Orton, Birmingham.
9776. ENABLING PERSONS DISABLED in the HAND to WRITE, &c., W. Macgill, Fraserburgh, N.B.
9777. MARKING the GAME of LAWN-TENNIS, F. Perry, Margate.
9778. CUTTING WATER WEEDS, R. Smith, Wokingham.
9779. CAMERA METAL FITTINGS, S. D. McKellen, Manchester.
9780. ARTIFICIAL STONE, W. P. Thompson.—(*G. Lilienthal, Melbourne.*)
9781. OBTAINING ALUMINIUM and other METALS from their ORES, W. P. Thompson.—(*E. H. and A. H. Cowles, United States.*)
9782. BLOCKS or TYPE for PRINTING POSTERS, S. Jones, Liverpool.
9783. SHIRTS or SHIRT FRONTS, R. Ripley, Liverpool.
9784. BOTTLE STOPPERS, F. McIlvenna and W. Thompson, Liverpool.
9785. SCREENING and BAGGING COAL, R. W. Roulston and W. Armstrong, Liverpool.
9786. BOTTLE WASHING WHEEL, J. Murrell, Ipswich.
9787. TUBES and TUBE PLATES of STEAM GENERATORS, H. Turner, Liverpool.
9788. BINNACLE ADJUSTABLE PEDESTALS for ROTATING SHAFTS, W. H. Poole, London.
9789. ROLLER SKATES, B. Rebeschke, Halifax.
9790. FLAT ROPES, C. J. Banks, London.
9791. CLIPPING DEVICES, W. H. Underwood, London.
9792. VENT PEGS, A. T. Hughes, London.
9793. BEE-HIVES, F. Lyon, London.
9794. DEVICES for TRANSMITTING POWER, A. J. Boult.—(*E. Winans, United States.*)
9795. TELEGRAPHING, F. H. Brown, London.
9796. GAS REGULATORS or GOVERNORS, H. F. Bromhead, London.
9797. PURIFYING GAS, H. F. Bromhead, London.
9798. PRESSURE REGULATORS, A. J. Boult.—(*A. S. Bigelow, United States.*)
9799. DOUBLE CASE or HUNTING CHRONOGRAPH WATCHES, C. Haseler, London.
9800. GAS STOVES, C. G. Saunders, London.
9801. GAS ENGINE, E. G. Coulton.—(*H. Hartig, United States.*)
9802. TELEPHONE RECEIVERS, C. A. Tesk, New Wandsworth.
9803. CONSTRUCTION, &c., of VELOCIPEDES, C. E. Read, London.
9804. WHEEL-HOES, S. Fuller, London.
9805. POCKET KNIVES, H. J. Haddan.—(*G. Hassler, Germany.*)
9806. FILTERING SMOKE, H. Fisher, London.
9807. PIANOFORTE ACTIONS, E. Bishop, London.
9808. MIDDLINGS PURIFIERS, H Simon, London.
9809. PREPARING COPPER for CASTING, W. R. Walton, London.
9810. VENTILATING GLASS STRUCTURES, J. McK. Jeffrey, Uxbridge.
9811. YARNS and WOVEN and FELTED GOODS, M. Raabe A. C. G. Skynner, and S. Henning, London.
9812. GLAZING, P. Sorel, London.
9813. HERMETICAL SILOS, C. Engrand, Marseilles.
9814. SOWING SEEDS, G. Baker, London.
9815. LOOM SHUTTLES, J. Magee, London.
9816. FLUID METERS, H. H. Lake—(*C. H. and F. C. Hersey, United States.*)

19th August, 1885.

9817. INCANDESCENCE ELECTRIC LAMPS for BURNING UNDER WATER, F. Wynne, London.
9818. TESTING SAFETY LAMPS, W. Clifford, Sheffield.
9819. BOOT MAKING, S. F. Scott, Glasgow.
9820. LOCKS for RAILWAY CARRIAGE DOORS, &c., J. M. Matthews, London.
9821. SAFETY VALVES, G. Wilson and I. A. Timmis, London.
9822. JOINERS' and other BEVELS, A. Gamble, Sheffield.
9823. PRODUCING a CRAPE in WOVEN FABRICS, E. and G. W. Wilson and J. Fell, Manchester.
9824. MACHINES for PRINTING ENVELOPES, &c., in Two or more COLOURS, R. F. Sproule, Liverpool.
9825. CAPSULES for BOTTLE STOPPERS, H. Aylesbury, Bristol.
9826. ILLUMINATING ADVERTISEMENTS to fix upon TRICYCLES, &c., E. Marriott, London.
9827. ELECTRIC BELLS, P. Jolin and T. Ballard, Bristol.
9828. DOUBLE-BARRELLED PISTOLS, T. Thacker, Birmingham.
9829. WATER-EMITTING APEXES, P. H. Clague, Liverpool.
9830. OIL COAL, G. W. Errington, Newcastle-on-Tyne.
9831. DECOMPOSING by MAGNESIA the MOTHER LIQUID of the AMMONIA SODA PROCESS, W. Weldon.—(*A. R. Pechiney et Cie., France.*)
9832. BRAKING VEHICLES by HORSE-POWER down INCLINES, C. H. Nassau and G. Butler, Sheffield.
9833. GALVANO-ELECTRIC MEDICAL BELT or BAND, A. Chadwick, Manchester.
9834. FRICTION BALL BEARINGS, A. Cordier, London.
9835. DUPLEX AUTOMATIC JIGGING MACHINE, J. Kitto, A. Paul, and J. H. Webb, Llanidloes.
9836. HOT-AIR STOVES for HEATING ROOMS, &c., J. Kay, Chapeltown, near Sheffield.
9837. MUSICAL COMPASS, J. Hannah, Glasgow.
9838. SPRING KNIVES, A. J. Beal, London.
9839. LOCK NUTS, R. F. Drury.—(*E. Dieuaide, Paris.*)
9840. SHEEP SHEARS, &c., A. Amber, London.
9841. ROPES OF METAL, D. H. and G. A. Haggie, London.
9842. FIRE-EXTINGUISHING APPARATUS, H. H. Perry, London.
9843. PORTABLE FURNITURE, J. T. Cooke and J. L. Bottomley, London.
9844. RECIPROCATING ROTARY ENGINES, L. Mills, London.
9845. ARC LAMPS, C. E. L. Brown, London.
9846. FASTENING WINDOW SASHES when either SHUT or partially OPEN, C. Thornett, London.
9847. BEER, P. M. Justice.—(*A. W. Billings, United States.*)
9848. GAS PRODUCERS, &c., as applied to STEAM BOILERS, J. Hill, Glasgow.
9849. MARINER'S COMPASS, F. A. Paget, London.
9850. FORMING the BOTTOMS of RUBBER BOOTS, &c., M. W. Whitney, London.
9851. HAIR CRIMPERS, J. M. Kelley.—(*W. Stimpson, United States.*)
9852. FEED-WATER HEATERS, J. Kirkaldy, London.
9853. CARBON ALUM, T. H. Cobley, Dunstable.
9854. FORMING and COMPOSING TYPE, E. Codignola, London.
9855. SUN-AND-PLANET WHEEL DRIVING GEAR for LATHES, C. D. Abel.—(*P. P. Huri, France.*)
9856. CARRIAGE LAMPS, W. Burley and J. Grimley, London.
9857. INDICATING the VARIATIONS of a BAROMETER, H. H. Lake.—(*R. R. von Walcher-Uysdal, Austria.*)
9858. YELLOW and ORANGE COLOURING MATTERS, J. H. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
9859. MACHINE GUNS, C. W. Worrell and F. Podger, London.

9860. Clinical, &c., Thermometers, E. T. Perken, London.

20th August, 1885.

9861. Preventing the Driving Wheels of Locomotives from Slipping, J. Gresham, London.
9862. Valve Cock, T. Murphy, London.
9863. Bicycle and Tricycle Bells, J. Harrison, Birmingham.
9864. Street Boxes for Protecting Gas Meters, &c., J. Dewsnap, Manchester.
9865. Raising and Lowering the Healds in Looms, &c., C. Bedford, Halifax.
9866. Preventing Suction of Gases into Water Service Pipes, H. Swete, Worcester.
9867. Obtaining Multiple Copies of Writings and Designs, A. Paget, Loughborough.
9868. Tricycle for Three Riders, H. Morehen, London.
9869. Maturing of Spirits, W. W. Crawford, Glasgow.
9870. Apparatus for Railway, &c., Cars, J. B. Fondu-Bloemendal, Liverpool.
9871. Valve Ports, &c., of Steam Cylinders, J. Clyne, Aberdeen.
9872. Securing Handles to Broom-heads, &c., S. H. Sutton, Birmingham.
9873. Saddle Bars, J. Cottrell, sen., Bristol.
9874. Glasses for Bicycle and other Lamps, S. Snell, Birmingham.
9875. Lighting, &c., Lamps, J. J. Butcher and J. H. Wüster, Newcastle-on-Tyne.
9876. Generating Vapour, J. Murrie, Glasgow.
9877. Close-tight Casement Fastener, J. Ellis, Walsall.
9878. Revolving Tips for Heels of Boots, &c., W. J. Murgatroyd, Bradford.
9879. Velocipede and other Saddles, J. B. Brooks, Birmingham.
9880. Umbrellas, G. M. Cruikshank.—(*R. Grumbach, Germany.*)
9881. Stucco Objects, &c., F. Shorten.—(*A. Rachner, Germany.*)
9882. Hook, C. Hawxwell, Birmingham.
9883. Tin and Terne Plates, G. Leyshon, London.
9884. Blasting Cartridges, S. H. Emmens, London.
9885. Boring Apparatus, S. H. Emmens, London.
9886. Excavating, S. H. Emmens, London.
9887. Treatment of Aluminous Minerals, S. H. Emmens, London.
9888. Weft Forks for Looms, S. Cook, jun.—(*C. Dupire, France.*)
9889. Steam and other Engines, W. Cameron, London.
9890. Aerial Toy, J. Newsom, London.
9891. Artificial Birds, &c., J. Newsom.—(*J. Hirayama, Japan.*)
9892. Hats and Bonnets, E. C. Vickers, London.
9893. Bottle Stoppers, A. Childs, London.
9894. Making Purple Ores into Bricks, J. G. Williams, London.
9895. Lubricating Compound, A. Lovell, London.
9896. Galvanic Element or Battery, H. J. Haddan.—(*K. Pollak and G. Wehr, Germany.*)
9897. Bearings or Axle-boxes, C. D. Abel.—(*J. E. Marchant, France.*)
9898. Congratulation Cards, &c., A. J. Boult.—(*N. L. Chrestensen, Germany.*)
9899. Numbering Machines, A. J. Boult.—(*J. R. Carter, U.S.*)
9900. Ornamenting Metal, &c., Articles, A. J. Boult.—(*G. Gehring, Bavaria.*)
9901. Embroidering Hats, &c., P. Jensen.—(*E. Loth, Poland.*)
9902. Apparatus for Bottles, &c., for the Delivery of Measured Quantities, W. Bartholomen and E. B. Baker, London.
9903. Electric Targets, G. Arnoult, London.
9904. Flower-holders, E. Ure, London.
9905. Supporting the Body in a Straight or Upright Position when Sitting, H. H. Lake.—(*Wirth and Co., Russia.*)
9906. Devices for use with Rifles, &c., J. Richards, London.

21st August, 1885.

9907. Trouser Suspenders, &c., G. Walker, Birmingham.
9908. Dynamo-electric Machines, F. H. Royce, Manchester.
9909. Corkscrews, F. R. Baker, Birmingham.
9910. Brass-headed Nails and Pins, &c., G. F. Hall, Birmingham.
9911. Tricycles, H. J. Lawson, Coventry.
9912. "Crinoleum," W. Richardson, Birkenhead.
9913. Gas, &c., Motors, M. Milburn and R. Hannan, Glasgow.
9914. Securing Coverings to Ricks, B. P. Cartwright, Wolverhampton.
9915. Tricycles, I. Rix, Norwich.
9916. Checking Shuttles, T. Wade and J. T. Brown, Bradford.
9917. Securing Door Knobs, &c., C. Longbottom, Bradford.
9918. Looms, M. Leach, J. Heaton, and J. Bentley, Bradford.
9919. Safes, D. R. Ratcliff, London.
9920. Automatic Steam, &c., Steering Gear, J. Lyle, Paisley.
9921. Joint Chair for Permanent Way, P. Rickard, Derby.
9922. Stripping Hops from Poles, W. Gardner, Canterbury.
9923. Raising, &c., Seats of Music Stools, L. C. Niebour, Kingston-on-Thames.
9924. Making Electrical Conductors, E. Fox, London.
9925. Spoon Brakes for Velocipedes, W. H. Knowles, London.
9926. Compressing Air, &c., F. Jewell and E. C. Garnham, London.
9927. Safety Pins, &c., S. Bott and W. E. Cooke, London.
9928. Engine Governors, W. L. Collamore and W. Ackroyd, London.
9929. Holder for Chalk for Games, K. Beresford, London.
9930. Refrigerating Apparatus, W. Hutchinson, London.
9931. Preparing Fibrous Substances, J. V. Eves, London.
9932. Preserving Articles of Food, W. Powell, Liverpool.
9933. Type Writers, S. Sykes and J. Tester, London.
9934. Slates, O. J. Owen, Liverpool.
9935. Lavatory Basins, P. Winn, London.
9936. Bells and Gongs, E. Tonks and R. T. Powell, London.
9937. Brush or Damper for Damping Paper, G. J. Pedley, London.
9938. Water Filtering Apparatus, R. G. Chipperfield, London.
9939. Life-saving Sheet, A. M. Clark.—(*A. Chauvel, France.*)
9940. Railway Chairs, R. Symons, London.
9941. Combination of an Adjustable Perpetual Calendar with a Purse Fastener, M. Krumm.—(*L. Krumm, Germany.*)
9942. Doors, &c., G. Beadon, London.
9943. Joints for Perambulator Hoods, W. Evans and C. J. Harcourt, Birmingham.
9944. Reaping Machines, S. Pitt.—(*Palmcrantz and Co., Sweden.*)
9945. Wheels for Knitting Machines, L. Woodward, London.
9946. Feed-water Apparatus, A. M. Clark.—(*J. E. E. Fromentin, France.*)
9947. Luggage Labels, C. E. Gowan, London.
9948. Securing the Lids of Baskets, &c., C. E. Gowan, London.
9949. Striking Plates, &c., for Locks and Latches, N. Fellows and H. Winkley, London.
9950. Manufacturing Syrup and Beer from Maize, &c., H. H. Lake.—(*A. E. Fewe, United States.*)
9951. Inking Apparatus for Printing Machinery, H. H. Lake.—(*Maschinenfabrik Augsburg, Germany.*)
9952. Bottles and Bottle Stoppers, W. H. Frank, London.
9953. Oil Cans, J. M. Bunting and J. T. Findlay, London.
9954. Ball Cock, R. W. Thomas, London.
9955. Surface Air Condensers for Traction Engines, W. Wilkinson, London.

22nd August, 1885.

9956. Testing Brewing Materials, C. R. Bonne, Manchester.
9957. Carding Engines, W. Taylor and R. Taylor, jun., Manchester.
9958. Hooks and Crooks, W. Richards, Sheffield.
9959. Filters, A. Bell, Manchester.
9960. Marine Steam Generators, S. W. Wiles, Liverpool.
9961. Increasing the Speed of Screw Propellers, J. Waddington, Barrow-in-Furness.
9962. Telephones, A. M. Rosebrugh, London.
9963. Filters, S. Robertson, Dundee.
9964. Match-box, C. F. H. Heckford, Birmingham.
9965. Pens, W. P. Thompson.—(*T. Foulds, Gibraltar.*)
9966. Portable Stand for Cameras, H. C. Braun, London.
9967. Tube Beaders, C. Wicksteed, Kettering.
9968. Feeding Steam Boilers, J. C. Bauer, London.
9969. Taking Hydrographic Soundings, J. Dillon, London.
9970. Laces for Boots and Shoes, &c., H. C. Heard, London.
9971. Apparatus for Heating Water, J. J. Royle, London.
9972. Suspended Gas Lights, J. J. Royle, London.
9973. Revolving Small-arms, H. Dimancea, London.
9974. Drop-down Small-arms, J. F. Swinburne, London.
9975. Gun Wads, J. C. Scott.—(*V. T. Sherbrooke-Houghton, New South Wales.*)
9976. Connecting the Traces of Horses to Vehicles, R. M. Saulez, London.
9977. Letter Files, J. Sturrock, Dundee.
9978. Pianofortes, F. and H. Collins and G. Wheeler, London.
9979. Sewing Machines, O. Robinson, London.
9980. Controlling Gear and Speed Indicator for Tramway Engines, B. C. Browne, London.
9981. Breaking Down Rock, C. D. Abel.—(*W. Köhler, Austria.*)
9982. Protective Material for Iron and Steel, C. D. Abel.—(*W. J. Wisse, Holland.*)
9983. Automatically Controlling the Speed of Tramway Engines, R. C. Parsons, London.
9984. Bread, J. C. Pooley, London.
9985. Rock Drilling Apparatus, T. H. Bell, A. L. Steavenson, and R. Clough, London.
9986. Miniature Ammunition for Rifles, J. Richards, London.
9987. Jointing Leaden Pipes, J. Costelle, Glasgow.
9988. Pen Wipers, W. Abbott, London.
9989. Inkstands, R. G. Chipperfield, London.
9990. Non-vibrating Handle-bar for Velocipedes, J. R. Trigwell, London.

24th August, 1885.

9991. Pianoforte Sounding Boards, E. Bishop, London.
9992. Purifying Sewage, &c., J. C. Thresh, Buxton, and M. Hilton, Prestwich.
9993. Treating Galvanised Iron or Steel, H. Grimshaw, Manchester.
9994. Portable Music Stands, T. Wright and J. D. Davidson, Glasgow.
9995. Driving Mechanism for Velocipedes, C. S. Snell, London.
9996. Preventing the Unwinding of Thread from Bobbins, R. W. Kenyon and B. Baron, Halifax.
9997. Aerated Water Bottle Openers, N. S. Heeley, Birmingham.
9998. Self-acting Window Sash Fasteners, C. H. M. Wharton, Manchester.
9999. Tablet for Holding Printed Matter, &c., J. Hicken, Portsmouth.
10,000. Parallel Duplex Rulers, H. Salsbury, London.
10,001. Showing the Time by Turret Clocks, J. Bennett, London.
10,002. Dust Collectors, J. Clayton, London.
10,003. Clips for Fastening Papers, &c., A. C. Henderson.—(*F. E. Girard and A. Rigault, France.*)
10,004. Bats for Games, C. Malings, London.
10,005. Cabs, T. D. Gilbert, Westminster.
10,006. Combination Stud, M. J. Alexander, London.
10,007. Low-water Alarms for Steam Boilers, H. Wilson, London
10,008. Centrifugal Pumps, C. D. Abel.—(*A. C. Nagel, R. H. Kaemp, and A. Linnenbrügge, Germany.*)
10,009. Cleaning the Grooves of Tram Rails, W. H. Hall and F. R. Hanson, London.
10,010. Billiard Table Light, G. Henderson and D. McNiel, London.
10,011. Compound Galvanic Batteries, S. H. Emmens, London.
10,012. Guiding Fabrics into Beaming Machines, D. P. Smith, Glasgow.
10,013. Knitted Fabrics, J. H. Nussey, London.
10,014. Boots, V. Thomas, London.
10,015. Flour Dressing Machines, W. White and J. F. Milner, London.
10,016. Ploughs, A. Simpson, W. Law, and D. Arnot, London.
10,017. Cans, W. A. Barlow.—(*A. Steen, Germany.*)
10,018. Separation of Tin from Tin-plate, H. H. Lake.—(*Wirth and Co., Germany.*)
10,019. Indicating Apparatus for Navigable Vessels, J. S. Raworth, London.
10,020. Steam Boilers, W. Malam, London.
10,021. Revolving Shutters, W. R. Lake.—(*A. Dufrène, France.*)
10,022. Caps for Gas Globes, W. Clark.—(*P. Costes and A. Vervin, France.*)
10,023. Straightening Wire, S. H. Byrne, London.
10,024. Treatment of Ores, R. Oxland and C. Oxland, London.

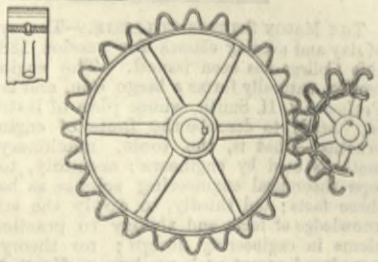
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.)

322,667. Gear Wheel, *John C. Wilson, sen., New York, N.Y.—Filed December 27th*, 1884.

Claim.—(1) The gear wheel composed of a band of metal forming the rim, arms and a hub sustaining said rim, and a corrugated strip of metal surrounding and attached to said rim and forming the teeth, substantially as set forth. (2) The combination, in a gear

322,667

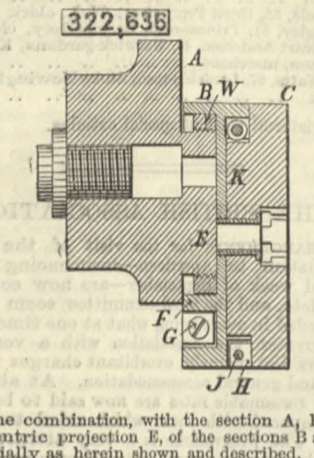


wheel, of a rim, a teeth band around such rim, and a winding of wire around the teeth strip and rim to connect them together, substantially as set forth. (3) The combination, in a gear wheel, of a teeth band of corrugated sheet metal and a covering to the surface of leather or similar material, and a pulley to which the teeth band is attached, substantially as set forth.

322,636. Lathe Chuck, *Edward Pement, Esmond, Dak.—Filed April 14th*, 1885.

Claim.—(1) In a face plate and chuck attachment, the combination, with the section A, having a projection E, which is screw-threaded on its rim, of a screw collar W screwed on the said projection, and the section B, which is clamped on the collar W, substantially as herein shown and described. (2) In a face plate and chuck attachment, the combination, with the section A, having the excentric projection E, the rim of which is screw-threaded, of the screw collar W and the section B, the said section B and the screw collar being provided with apertures for receiving screws, and implements for turning the said collar, substantially as herein shown and described. (3) In a face plate and chuck attachment, the sections A, B, and C, combined substantially as herein shown and described. (4) In a face plate and chuck attach-

322,636

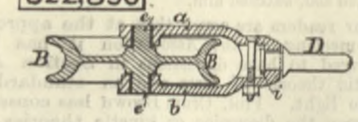


ment, the combination, with the section A, having the excentric projection E, of the sections B and C, substantially as herein shown and described. (5) In a face plate and chuck attachment, the combination, with the section A, having the excentric projection E, of the section B, having the split collar F, and of the screw G, substantially as herein shown and described. (6) In a face plate and chuck attachment, the combination, with the section B, having the split collar H, of the screw J, the section C, having the projection K, and of the worm M on the spindle N, substantially as herein shown and described. (7) In a face plate and chuck attachment, the combination, with the section A, having the excentric projection E, of the section B, having the split collars F and H, the screws G and J, and of the section C, substantially as described.

322,890. Pulley Block, *Huntington Beard, Fayetteville, N.Y.—Filed February 23rd*, 1884.

Claim.—A pulley block constructed with a bipartite frame *a b*, having corrugations *h*, and corresponding

322,890

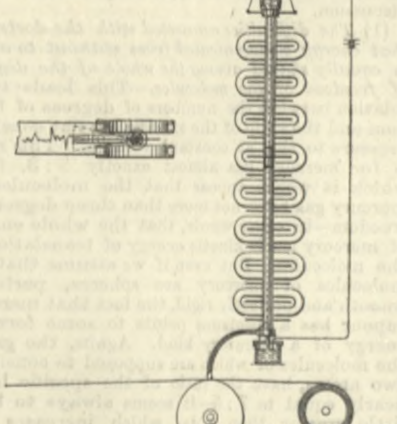


indentations *s* in the meeting edges, a swivel seat *i*, and swivel ring D and wheel B, having chilled bearings *e*, all held together by a single bolt, substantially as shown and described.

322,918. Cable Recorder, *Moses G. Farmer, Newport, R.I.—Filed December 4th*, 1884.

Claim.—(1) An electrical recorder consisting of the combination, with insulated coils and armatures, of a platinum wire arranged to be heated by an electric current and attached to the armature support so as to move therewith, and a band or strip of coloured tissue paper, adapted to be moved past the platinum wire, as and for the purpose set forth. (2) The combination, with a series of insulated coils, armatures, or magnetised bars, and a support for the same capable of being moved by the action of currents in the coils upon the armatures or bars, of a platinum wire arranged to be electrically heated attached to the support, so as to move therewith, and a band or strip of coloured tissue paper adapted to be moved past the platinum wire, all substantially as described. (3) The combination,

322,918

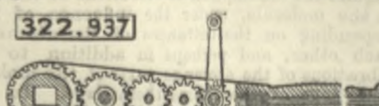


with a series of insulated coils, magnetised needles or bars, and a vertically suspended support by which said bars are carried, of copper or similar wires connected with an electric circuit and projecting from the armature support, a short length of platinum wire united to the copper wires, and a band or strip of coloured tissue paper adapted to be moved past said platinum wire, as set forth. (4) The combination, with a series of stationary galvanometer coils, magnetised bars in position to be moved by currents in the coils, and a vertically suspended tube carrying said bars, of copper wires extending from said tube, a platinum wire connected to the copper wires, an electric battery for heating the platinum wire, mercury cups for connecting the wire with the battery, and a band or strip of coloured tissue paper adapted to be moved past the platinum wire, as herein set forth.

322,937. Wrench, *Edward M. Hungerford, Utica, N.Y.—Filed January 26th*, 1885.

Claim.—(1) The combination, in a rotary wrench having side bars and handle, with a succession of spur

322,937

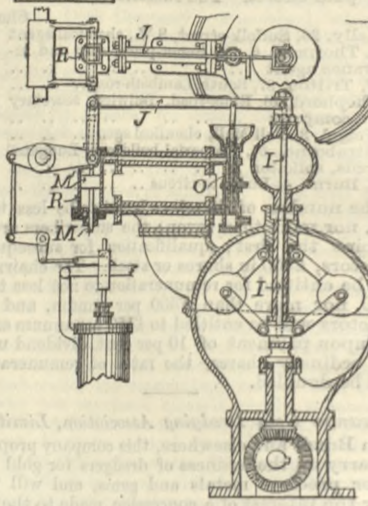


gears between the side bars operated by a crank, as described, of the circular wrench head, with the eye in the central bearing of the wrench head journalled between the side bars, substantially as described. (2) The combination, with a rotary wrench head constructed and mounted to be rotated in either direction through a succession of spur gears moved by crank, substantially as described, of a movable stop for engaging the cogs, whereby the wrench heads and connecting gear may be held stationary.

322,956. Governor for Steam Engines, *Joseph Moore, San Francisco, Cal.—Filed August 27th*, 1884.

Claim.—The combination, with a suitable centrifugal governor, of the hydraulic cylinder R, having inlet and outlet passages, as shown, piston M^1, and rod M, valve O, moving in suitable chamber to control the action of said piston and rod, and the differ-

322,956

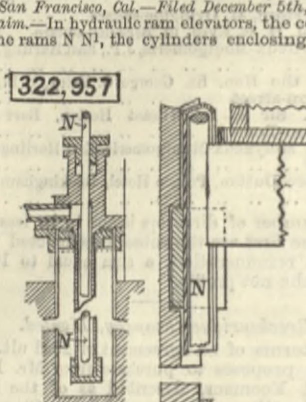


ential valve mover consisting of the valve J, connected, first, at one end with the end of piston-rod M; second, at the other end with the governor spindle I, and intermediately with the stem of the valve O, arranged and operating, substantially as and for the purpose herein described.

322,957. Hydraulic Ram Elevator, *Joseph Moore, San Francisco, Cal.—Filed December 5th*, 1884.

Claim.—In hydraulic ram elevators, the combination of the rams N N^1, the cylinders enclosing the rams

322,957

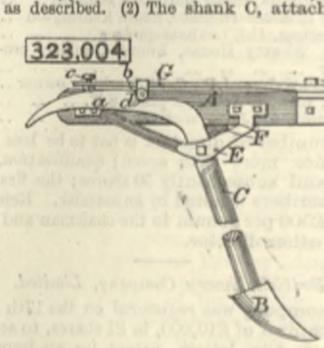


and the cylindrical guides P, secured to the sides of the elevator shaft, constructed and operating substantially as and for the purpose described.

323,004. Tooth Holder for Cultivators, *Joseph F Wheeler, Wyocena, Wis.—Filed September 24th*, 1884

Claim.—(1) The combination with the draw-bar A of the spring G secured upon the top thereof, the antifriction wheel *b* attached to said spring, and the arm *a* of shank C, provided with the shoulder *d*, substantially as described. (2) The shank C, attached to the

323,004

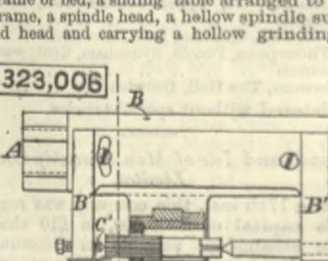


draw-bar A by being pivotted below the bar in bracket E and arm F, both rigid to said bar and provided with arm *a*, having shoulder *d*, in combination with bar A and spring G, having anti-friction wheel *b*, as set forth.

323,006. Reamer Relieving Machine, *Amos Whitney, Hartford, Conn.—Filed March 10th*, 1884.

Claim.—(1) In a relieving machine, the combination of a frame or bed, a sliding table arranged to slide on said frame, a spindle head, a hollow spindle supported in said head and carrying a hollow grinding wheel,

323,006



and a tool-holding bracket, substantially as described, on said slide, for holding a tool against the inner surface of said wheel, substantially as described. (2) In a relieving machine, the combination of bed A, a table B, a bracket B^1, pivotally secured to that table, and having centres C and C^1 for supporting a tool, a sliding head A^1, a spindle S, and a ring-shaped wheel W, substantially as described.