THE ANTWERP EXHIBITION.

(*From our Special Commissioner.*)

IN several important branches of engineering, Great Britain is only represented at Antwerp by one exhibitor. For instance, Messrs. Picksley, Sims, and Co. are the only English firm who show agricultural machinery. Their exhibit is neither in the Industrial nor in the Machinery Hall, but they have a little Agricultural Show all to themselves in a building to the right of the principal entrance, in the road leading to "Old Antwerp." It has probably been placed in a separate building to allow them to show the different appliances, and especially the thrashing machine at work. That which they exhibit is driven by a 10-horse power nominal portable engine. At present it is only run slowly, so as to show the movements; but it is intended to thrash with it when the judges desire to see it at work, or on other special occasions.

Messrs. Picksley, Sims, and Co. also show a 6-horse power portable engine, a 4-horse power semi-portable with vertical boiler, an 8-horse power vertical engine, but without boiler, and a 6-horse power horizontal. They have also chaff cutters, bone mills, a machine for flattening maize and barley, a turnip cutter, and cake breakers, as well as a 2-horse power horse-gear, a drill 10ft. wide, a haymaker, and two reapers, one fitted with self-binder. The workmanship of all these machines and implements is very good, so that manufacturers of English agricultural machinery are not inadequately represented by one exhibitor.

In the Machinery Hall, Messrs. De Naeyer and Co., of Willebroeck, occupy a larger floor space than any other exhibitor, viz., 20,000 square feet. This is chiefly required for a complete paper-making plant, capable of turning out 6 cwt. of paper per hour. The installation commences with pulping machines, the work of which may be conveniently observed from the gallery which runs round the Machine Hall. There does not seem to be anything novel about these, or the mixing vats; but the paper machine, 200ft. long by 8ft. wide, is very fine. The paper made in the Exhibition will be of a class suitable for newspapers; but the machine can produce either finer or coarser qualities. They also show printing presses, envelope machines, &c. Another exhibit by the same firm is an ice-making plant, which is shown at work. The system adopted is Pictet's, and the output 24 cwt. per hour.

The steam required for the motive-power of all engines in the Machinery Hall is generated in four 250-horse power boilers, just outside the hall; and these, with the shafting, steam pipes, valves, &c., have also been supplied by Messrs. De Naeyer. These boilers are something like the Babcock and Wilcox; the makers say they are a modification of the Roth boiler. The peculiarity about them is the simple manner in which the ends of the tubes are connected. The joints are made by cast iron caps, each fitting over two tubes, and held down by clamps with one bolt in the middle of each, so that there is one clamp for every two tubes. The usual working pressure is 110 lb. to 120 lb., but they can be kept at 150 lb. when desired. Every steam joint without exception in boilers, or in the transmission to the different machines, is made by wrought iron conical rings. These rings, which are turned very slightly conical at each end, are of all sizes from 1¼in. diameter upwards. They are inserted in the ends of the tubes, which are then screwed up, without red lead or any packing being used. The joints thus made are thoroughly satisfactory, as no leakage of steam can be detected anywhere.

Messrs. John Cockerill and Co., of Seraing, have the most varied set of exhibits in the Machinery Hall. The most conspicuous object at their stand is a triple expansion marine engine, 1600 indicated horse-power, for the s.s. John Cockerill, now in course of construction at their shipbuilding yard, at Hoboken, just above Antwerp. The diameter of the high-pressure cylinder is 2ft. 2½in., that of the intermediate 3ft. 7¼in., and that of the low-pressure 5ft. 9½in.; the length of stroke is 3ft. 7¼in. The steam enters the first cylinder at a pressure of 170 lb. per square inch. The cylinders are steam-jacketed, and are cast separately, copper pipes being used for the steam pipes and intermediary reservoirs. Piston-rods, crossheads, connecting-rods, and the columns supporting the front of the cylinders, are all of forged steel, and the pistons of cast steel. The air-pump is 2ft. 2½in. diameter, and 1ft. 9½in. stroke; it is lined with gun-metal, and the piston is also of gun-metal. The feed pumps are so arranged that they can discharge the water from the condenser either into a Weir's feed-water heater, or direct into the boilers. An auxiliary engine, 6¾in. diameter by 6¾in. stroke, serves to turn the principal engine when it is at rest; and another auxiliary engine with two cylinders, 7⅞in. diameter by 8⅝in. stroke, and making 350 revolutions per minute, drives a centrifugal pump, for circulating the water of the condenser. This centrifugal pump is also used for emptying the water ballast tanks. The diameter of the screw is 17ft. ⅜in., and that of the shaft 12⅞in. The average speed is 66 revolutions per minute.

Messrs. Cockerill also exhibit two "Frikart" engines; a single-cylinder engine, and a triple-expansion. The machine takes its name from the inventor of the valve gear, which may be described as a modification of the Corliss. The single-cylinder engine is not at their stand, being used to drive a dynamo. It is a horizontal 100 indicated horse-power non-condensing engine, 1ft. 7⅞in. diameter by 3ft. 5¼in. stroke, and has a normal speed of 70 revolutions per minute. The triple-expansion engine on this system is also horizontal, the high-pressure and intermediate cylinders being on one side, and arranged as a tandem compound engine, the low-pressure and the air pump for the condenser being on the opposite side. This engine is of 600 indicated horse-power, and has an average speed of 80 revolutions. The diameter of the high-pressure cylinder is 1ft. 3⅜in., that of the intermediate 1ft. 11⅝in., and that of the low-pressure 3ft. 1⅞in. The length of stroke is 3ft. 11¼in. In each of these engines the back cylinder cover, guide bars, and crank-shaft bearings are cast with the bed-plate, the weight of the casting for the low pressure cylinder being about five tons. The cylinders are all steam-jacketed; and under the floor are receptacles—also steam-jacketed—for steam passing from high pressure to intermediate, and from intermediate to low-pressure cylinder. The first of these receptacles supplies steam for the jacket of the intermediate cylinder, and the other for the low pressure. The steam for the jacket of the high-pressure cylinder is taken direct from the boiler. Three separate pumps carry off the condensed water from the steam-jackets and return it to the boiler.

Another exhibit by the same firm is a compound locomotive for the Riazan-Ouralsk Railway in Russia. This engine, one of forty which are being made exactly alike, has several interesting features. It is for a metre gauge, has four wheels coupled, and is to use as fuel the residuum from the distillation of naphtha. Before being accepted, they must satisfy the following test:—On an incline of 42ft. to the mile, and five miles long, they must be able to draw a train weighing 320 tons at a speed of at least eight miles an hour, without letting either the steam pressure in the boiler or the water-level in the gauge glass go down; the trial to be made with the locomotive working as an ordinary and also as a compound engine. The principal dimensions are as follows:—

Diameter of wheels	2ft. 9½in.
Length of wheel base	11ft. 6in.
Diameter of low-pressure cylinder	1ft. 7¼in.
Diameter of high-pressure cylinder	1ft. 1in.
Stroke of piston	1ft. 3¾in.
Boiler pressure	160 lb.
Total heating surface	592 square feet
Weight	21 tons.
Total length over buffers	22ft.
Total width	8ft. 4in.
Tender.	
The tender has six wheels	2ft. 9½in. dia.
Length of wheel base	9ft. 2in.
Total length over buffers	17ft. 9in.
Width	8ft. 4in.
Capacity, water	1430 gallons.
Capacity, naphtha	330 gallons.
Weight in working order, with reservoirs full	16 tons.

The change from simple to compound, and *vice versâ*, can be made instantaneously by the engine-driver without stopping the train.

Besides these different classes of engines, Messrs. Cockerill exhibit a model of their principal coal mine near Seraing, showing the different seams and fissures, with shafts and galleries. In part of the model the overburden is removed, and a very clear idea is given of the strata of the coal. To complete the account I must mention their display of artillery. This consists of light guns of the Nordenfeldt type, the largest being for a projectile 3in. diameter. They are made of Martin-Siemens steel, and beautifully finished. The chief recent improvement consists in the manner in which the recoil is taken up, in one instance by springs, in others by hydraulic pressure. They also show the arrangement by which a gun weighing 3½ cwt. can be transported on three horses or mules, together with twenty-four cartridges, each weighing 5½ lb. Special saddles are made, the first to take the gun, the second the carriage, and the third the wheels and axle, each animal having also to carry eight cartridges. The same size of gun, 1⅞in. internal diameter, is used on the Congo; and in the Congo building a large-sized model of a procession of natives may be seen carrying the different pieces, boxes of ammunition, &c, as well as a section of a steel boat also made by this firm.

THE ENLARGEMENT OF LIVERPOOL-STREET STATION, GREAT EASTERN RAILWAY.

No. I.

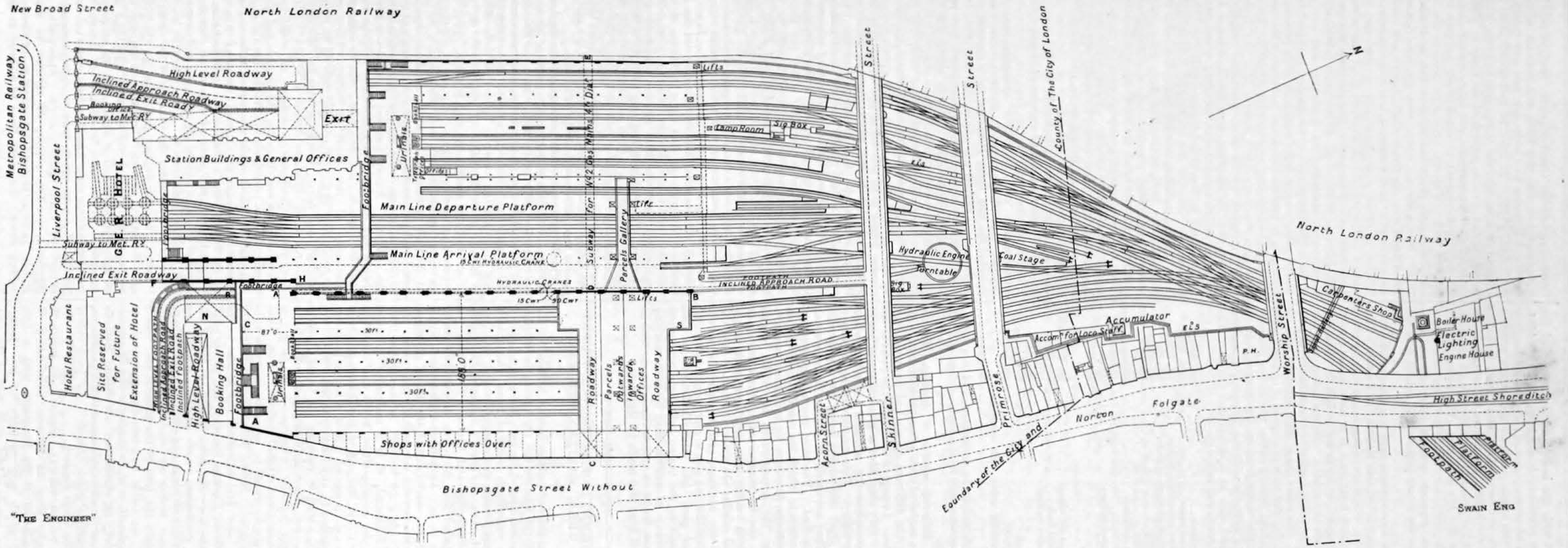
OF all the great lines of railway having termini in the metropolis, the Great Eastern has the advantage of possessing an area or territory of its own, the greater part of which is almost completely secured from the hostile incursions of its neighbours and competitors. If we place a railway map before us, and draw a line from Liverpool-street through Cambridge and Ely to "The Wash," at Lynn, it will be found that the whole of the districts or country, with one or two insignificant exceptions—lying on the right hand, or eastern side of the line of demarcation—belongs to the Great Eastern Railway system. In addition to thus holding the keys of our sea gates from Hunstanton to Southend, it is a matter of universal recognition that the metropolitan, local, and suburban traffic which flows into and out of the Liverpool-street station attains to a daily record, which is not only unsurpassed, but unequalled by any railway in the world. We are not, however, about to eulogise the Great Eastern Railway system, nor draw flattering comparisons—or which some might consider invidious—in its favour, in relation to our other great arterial routes of steam locomotion. Such a course would be as unnecessary as it is foreign to our purpose. Before proceeding farther with our subject, we have first to return our thanks to the directors of the Great Eastern Railway, and to the engineer-in-chief of the line—Mr. John Wilson, M.Inst.C.E. It is to the latter gentleman we are indebted for the use of the numerous valuable plans and drawings, which have enabled us to place before our readers the illustrations necessary to explain the text of the present and future articles. It will, we think, be interesting previously to passing on to the details of the widening of the Liverpool-street station, briefly to sketch out the salient features which mark the incorporation, subsequent amalgamations, and ultimate extensions which chronicle the past career and progress of the Great Eastern.

Early history.—This railway, similarly to the majority of our main lines at present terminating in London, was endowed at its formation with a title different to that which now pertains to it. Referring to the railway annals of the early part of the present century we find that the Eastern Counties Railway Company, now the Great Eastern, may be said to have been formed in the year 1835, and that its original line was from London to Colchester, and was partly opened for traffic in 1839. It may be mentioned that the first London line, namely, the Greenwich railway, commenced to run traffic over a portion of its route in 1836. This proves that the metropolis was by no means altogether to the front with respect to establishing priority in steam communication with the provinces, because the Stockton and Darlington promoted its first Bill in Parliament in 1818. It was thrown out, a very common occurrence in those days, and one from which few of our main lines were exempt. Better fortune, however, attended it in the Session of three years later, and in 1825 the line was opened to the public. A similarly good fate awaited the Liverpool and Manchester line in 1830, though its first Bill, likewise, suffered defeat five years previously. That the expenses attending the formation and incorporation of our original large railway companies, both parliamentary and on other counts, fully sustained their present reputation, may be gathered from the fact that in the case of the Eastern Counties they amounted to £45,000. This modest little sum was completely thrown into the shade by the outlay incurred by its more powerful neighbour, the London and Birmingham, now the London and North-Western, which amounted to £75,000, a sum total in its turn eclipsed by the Broad Gauge—as it should be—with its £88,000. Beyond the opening of further railways in East Anglia, including one in connection with the Cambridge line in 1840, nothing of very great importance occurred until 1844, when an Act of Amalgamation was obtained which included the Northern and Eastern Company, and some smaller systems, under the comprehensive title of the Eastern Counties. Whether it was due to this amalgamation or other cause, it would appear that even at this early stage of its existence, the Eastern Counties evinced unmistakeable indications of material progress, since a couple of years afterwards, an Act was obtained for the enlargement of the terminus at Bishopsgate-street. Two years subsequently to this date, the Eastern Counties amalgamated with, or rather absorbed into its own system, that of the Norfolk Railway, which had constructed the line from Brandon to Yarmouth. In the same year its capital was united with that of the Northern and Eastern Company already mentioned, and reached a joint total of £13,139,156. It was about this time also that arrangements commenced to be entered into with the Harwich Steamship Company, the felicitous results of which are apparent in intercontinental communication at the present day. About this epoch also, anxious glances began to be thrown in the direction of the Great Northern, and "the fear of interference on its part," as the chairman of the Eastern Counties Company remarked at a half-yearly meeting held nearly half a century ago, induced the latter company to purchase the Enfield and Edmonton line, which was a separate undertaking altogether, at a premium of 5s. per share. The number of shares was comparatively small, so that the total extra sum disbursed did not exceed £450. In purchasing the St. Ives, March, and Wisbeach lines, the company was unfortunate, as although the premium per share was not over a couple of pounds, the line acquired, as may be seen from the map, is nearly parallel with another route, the property of the same company. It may not be generally known that the original gauge of the Eastern Counties Railway, as laid upon portions of both its Colchester and Cambridge permanent way was 5ft., subsequently altered in 1844 to the standard gauge of 4ft. 8½in. The rails weighed from 65 lb. to 75 lb. per yard run in 1849, and it is a little amusing to read, that "in the immediate neighbourhood of London the wear and tear of the rails was considerable, owing to the sledge-like action of the engines," the weight of the said engines having been increased from 14 to 25 tons.

Further progress.—After emerging from the fiery ordeal of 1848, though like its neighbours, whether friends or foes, not altogether with unscorched wings, the Eastern Counties pursued its progressive career, with no event of especial importance to interfere with it. It was not until 1856 that the situation began to border on the comical, and, as it may cause a smile of amusement on the face of some of our readers, we may perhaps be pardoned for according a brief notice to it. A series of lampoons, skits, cartoons, squibs, satires, and pasquinades, accompanied by doggrel verses and all kinds of abuse, was launched with ruthless scurrility against this "pariah of railways," as one author—no doubt, somewhat unjustifiably—termed the company. Among the best of these—or perhaps we should say, the least objectionable—may be mentioned the challenge to the directors, real or assumed, of a gentleman of the name of George Hoy, practising professionally as a costermonger, offering to race his own carriage and horse, the proprietor on the box, against some of their business trains over the course from Cheshunt to Waltham—a distance of about two miles. A very diligent search among the records and documents relating to this period has not resulted in the discovery of any evidence which would warrant us in assuming that the gauntlet of defiance so valorously thrown down, was taken up by the company's champion. It is probable that the "potent, grave, and reverend signors" at that time on the board of directors treated the challenge with contemptuous and sublime indifference. At any rate the two illustrations, one representing the triumph of the coster with his "barrer" and his donkey giving the go-bye to the train; and the other, in which the trio are coupled up to the engine and merrily "walking off" with the whole train of passengers, are full of spirit, and by no means badly executed. In the latter the attitude of the engine driver leaning with his arms folded, asleep against the coal, with the air of a man whose toils on earth are over, is not devoid of some artistic merit. Apologising for this digression we now return, *au serieux*, to our subject, and in Table I. give a few particulars of the speed prevailing among the great lines of railway at that time. They are stated to be based on the authorised published time-tables of the period; and although not put forward

LIVERPOOL-STREET STATION

Key Plan.



in any friendly spirit, there is no particularly valid reason for doubting their genuineness. The speeds in Table I. relate to only express and first and second-class trains. In those days the third-class passengers—now the backbone of many of our railways—were of no importance whatever; in fact, to use an Americanism, "they didn't count."

TABLE I.

Speed in Miles per hour of the Trains of the Principal Railways in England, 1856.

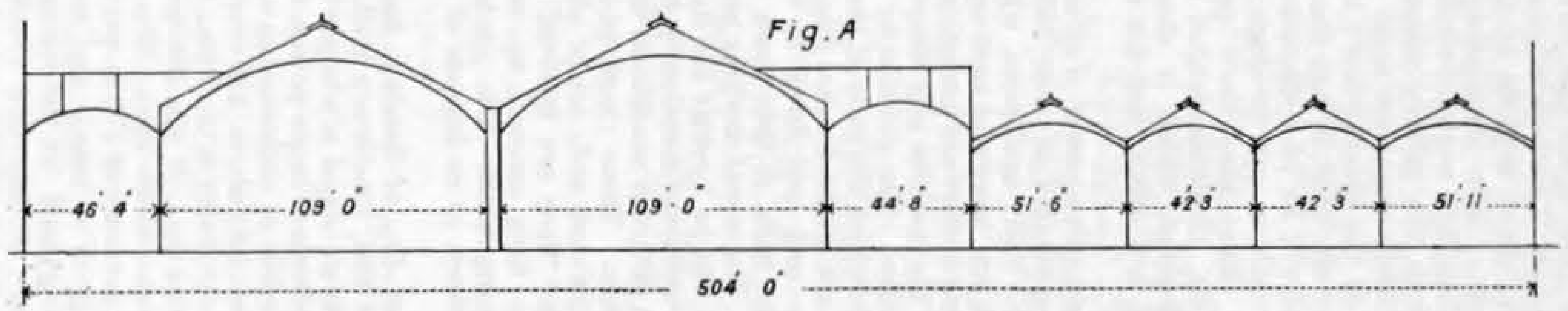
Name of Railway.	Speed in miles per hour. Express trains.	Ordinary trains.
Eastern Counties	31·58	21·77
Great Northern	42·85	33·71
Great Western	38·96	26·78
London and North-Western	36·81	26·55
South Western	33·90	25·86
South Eastern	35·30	25·00
Brighton and South Coast	37·50	25·32

Taking the average speed in miles per hour of all the lines in Table I., that of the express trains amounts to 36·96, and that of the ordinary trains to 26·43. If anyone wished to make the experiment there would be no insuperable difficulty in finding an English railway at the present time capable of running at these velocities.

Adoption of present title.—After "living down" the storm of abuse levelled at it, which railway companies as well as individuals can do, provided they live long enough, and passing through some hard times, the Eastern Counties effected in 1862 a strong amalgamation with all the leading lines in East Anglia, added to its title an epithet of magnitude already adopted by two of our principal railways, and became known to the world in future as the Great Eastern Railway Company.

Two years later when its system embraced 600 miles, it had a fierce parliamentary fight with its powerful rival the Great Northern, in which it was worsted. The Great Eastern petitioned for powers to run a direct line from Cambridge to Peterborough, and thence to Doncaster, and thus avoid the somewhat circuitous route *viâ* Ely and March. As Peterborough is the key of the northern traffic to and from the Great Eastern district, the importance of the proposed route called in the Bill the Great Eastern-Northern Junction, to the Company is obvious. In spite, however, of the most strenuous efforts, the Bill was thrown out in Committee. Notwithstanding that the old station at Bishopsgate was known to be completely inadequate to the increasing requirements of the company, and that the extension into Liverpool-street was already commenced, yet the construction of new lines in other directions was carried on with unremitting perseverance. It will be found on referring to THE ENGINEER, of June 7th, 1872, that under the title of "Great Eastern Railway New Lines," the first section of the Metropolitan Extension of the Great Eastern Railway from Bishopsgate-street to Stoke Newington was opened for traffic on the 3rd of the same month. Other branches and extensions followed, to which we cannot pause to direct attention in detail, but must hasten on to the opening of the new Liverpool station in 1875, a plan and description of which appeared in our columns of June 11th of that year, and respecting this it is necessary, if only as introduction to the immediate subject of our articles, to make some observations.

Fig. A



CROSS SECTION, LIVERPOOL-STREET STATION

Extension to Liverpool-street.—The advent of the Great Eastern Railway into the heart of the city with an exceedingly spacious terminal station of its own, marks a distinct, novel, and most important epoch of progress in its career. Viewed in a general point of view, apart altogether from the particular—and, it must be admitted, well-deserved advantages accruing to the company itself—the actual position is exceptional, and not equalled by any other of our great main lines in London. If the remark be true—and it no doubt is—which was made by the chairman of the company at a Board of directors in 1864, when speaking of the old Bishopsgate station, that "the terminus of the Great Eastern Railway serves a wholly distinct district of the metropolis," then the same remark would be true, considerably stronger, respecting the present terminus. In spite of all efforts to reach the final goal, so ardently sought for by all London railways—that is, to have a terminus of their own in the heart of the metropolis—many still remain outside. The Great Northern, London and North-Western, and the Midland are all in their original locality, jammed together so closely as to bewilder any outsider respecting their separate identity. Junctions and branch lines—over or underground—by which connections are made with City or West-end stations, such as the North London in Broad-street, do not affect our statement. Nine Elms was the first resting place of the South-Western, and it appears to be now stuck pretty fast at Waterloo. One of the stations of the London, Brighton, and South Coast, it is true, is at Victoria; but the other is still on the wrong side of the water. This company might at some future period, if the approaches are widened and otherwise improved, ask Parliament for running powers into Charing Cross and Cannon-street. The South-Eastern certainly have stations in both these localities, but at what a price. The extension from London Bridge was a skilful and able piece of engineering, but it was nevertheless a *tour de force*. Now, a *tour de force*, whether of an engineering or other character, and however brilliantly and successfully it may be executed, is never intended to be of a permanent nature; its cost of maintenance is much too great. It is a temporary achievement, very dear if it eventuates in a failure, but very cheap if in a triumph. The difficulty, delay, and danger—as accidents have more than once proved—of getting into the terminal stations of the South-Eastern are too well recognised to need any comment. Blackfriars was the first home of the London, Chatham, and Dover, which at a great expense crossed the river—a Rubicon which, notwithstanding the somewhat arrogant motto of "Invicta," emblazoned on the escutcheon of the Surrey side shore girders of the bridge, did not, in this instance, lead to victory, but ultimately only to Holborn Viaduct.

People are very apt to imagine that railway termini, with perhaps a difference in the mere size and general appearance of the roof, are very much like one another, whereas, as a matter of fact they are exceedingly unlike, and their arrangements for the arrival and departure of trains and management of the traffic vary in each separate instance. That there are certain guiding principles to be kept prominently in view when laying out the site of a large terminus, is well-known to both railway engineers and their professional colleagues the traffic managers, and it will be seen, as we proceed with our subject, that they have received their proper amount of attention in the planning and disposal of the station, offices, and buildings, and the adjustment of the eighteen lines of track which find shelter within the ample area of the combined old station and its present widening, now practically completed at Liverpool-street. It will be seen from the "Key plan" that the former building and the widening constitute practically a single structure, enclosing within its external walls and boundaries an acreage under cover exceeding that possessed by any similarly situated edifice in England, and possibly, in the whole world. Important engineering works of this character and magnitude, erected in a metropolis of the dimensions and population of our own, are not the result in thought, word, or deed, of the deliberation of a few months, or the mere exercise of the ordinary abilities and experience of duly qualified professional men. They demand both in theory and practice, both in design and execution, inventive and constructive talents of a high order, and in addition, a special fitness for the particular class of work. We fully endorse the remark of the engineer-in-chief that the outside public know little or nothing of the difficulties to be contended with, the obstacles to be overcome, the impediments to be removed, the interests to be guarded, and the innumerable devices, many of a novel character, to be resorted to in order eventually to bring to a successful termination a task of the magnitude before us. It was about ten years ago that it first began to become apparent that the old, or as we prefer to call it, the first half of the Liverpool-street station, big as it was, would be in a very short time inadequate to meet the requirements of the continually increasing traffic, and that speedy measures must be adopted to secure more land, as an additional site would be indispensable for the erection of further station accommodation. To return, however, for a short while to the first part of the building opened in 1875, and to a few of the details pertaining to its setting out and general arrangements.

Laying out railway termini.—There are three leading principles or methods available, which to a great extent govern the laying out of railway termini. In the first, the booking-offices, waiting-rooms, and other station buildings are disposed alongside or parallel with the departure platform. Examples of this mode are to be found in the Great Western, the Great Northern, and its two immediate neighbours, and in most of the earlier stations. For ordinary through stations it is the only economical plan to adopt. Secondly, the same buildings occupy a space in the rear of the "dead end" of the "tracks." The word "track" will be used in future to signify a single line, or a single pair of rails. It is a good, accurate, and explicit term, which is more than can be said of all the words which our American cousins have taken the liberty to add to the language, and besides, prevents any confusion arising from the indiscriminate employment of the words "line, lines, single or double lines," when they are applied generally to a railway project, or system, and individually to the number of pairs of rails themselves. The Charing Cross Station, Cannon-street, and the London, Brighton, and South Coast Station at Victoria, are among other instances of the class alluded to. A third method consists in the combination of the former two, for which the station of the London, Chatham, and Dover at Victoria may be selected as an example. The booking-offices and other rooms belonging properly to the main line are arranged according to the first plan, parallel to the departure platform, whereas the same buildings for the service of the local and metropolitan traffic are placed at the "dead end" of the tracks. It is obvious that in through stations the dead end principle is inadmissible, unless the station accommodation is placed either under or over the line. There are abundant examples of this fourth method, as it may be termed, on the Metropolitan and other underground railways, but very probably the arrangement is dictated more by necessity than choice. In the instances quoted all the companies are sorely pinched for space, and the employment of either the over or under, or both combined principles, effects a notable economy by utilising to the utmost the ground available for the site. There is yet another plan according to which station buildings may be set out, although it is seldom employed, which consists in disposing the offices within an area situated between the tracks. A disadvantage of this method in case of through stations is that either a subway or footbridge becomes indispensable, unless the usual prohibition against crossing the line is a dead letter. Passengers by the Great Western may be aware that a movable bridge, hauled up from underneath one of the platforms at Paddington, is used to enable them to pass to another departure platform on the other side of a double track.

Liverpool-street terminus.—A reference to the Key plan will point out that the first part of the Liverpool-street terminus was laid out on the compound principle, and that the local lines have their dead ends on the north or outer side of the foot-bridge, the offices belonging to them being located on the southern or inner side of the same bridge. The main arrival and departure tracks Nos. 9 and 10 pass underneath the foot-bridge and have their station buildings and offices arranged alongside, in the space between the foot-bridge mentioned, and a second one at the back of the Great Eastern Railway Hotel which faces Liverpool-street. A somewhat different plan has been followed with respect to the laying out of the extension or widening, which will be described as we proceed. In the Key plan, the letters A D B represent what may be regarded as the line of demarcation between the first and second portions of the station, and also mark the course of the new wall, which extends from the end of the old wall at H, opposite to A, to B, the outside or northern corner of the Parcels Office. It was necessary in order to run this wall perfectly straight, to pull down a portion of the old one and rebuild it in line with the new. As originally constructed, iron semi-arches of the solid web or plate type were supported by the portion of the old wall subsequently demolished, which when rebuilt had been set back a distance sufficient to enable it to range flush with the new wall. The additional space was covered in by the ingenious device of adding semi-arches to those already existing, and thus roofing in the entire extra area. Before the old wall was permitted to be removed, it was stipulated that the whole of the new work should be completed. The portion of the old wall remaining is shown in the Key plan from F to H, and forms one side of the inclined exit roadway. At present, in addition to their vertical support, the arches may be said to be *demi-encastré* at their springings with the new wall, which has a total length from A to B of 550ft. Measuring across the extreme width of the whole station from the frontage in Bishopgate-street Without at the point C to the exterior wall at E along the line of the south roadway of the Parcels Office, and the subway for the gas company's mains, the distance is 540ft., which gives 310ft. to the first part and 230ft. to the second or widening.

A very good idea of the extent of the actual area covered in of the whole station will be obtained from an inspection of Fig. A, which represents a skeleton cross-section of the entire roof. A length of 40ft. must be added to the figured dimensions, to include the space marked on the Key plan, "shops with offices over," which form part of the present extension. The roof over the first part of the terminus consists of four spans, and was designed by the late Mr. Edward Wilson, the uncle of the present engineer-in-chief to the Great Eastern Railway Company. The two central spans measure 109ft. each, and the two side ones 46ft. 6in. and 44ft. 9in. respectively. It will be observed that at the junction of the larger spans, instead of the usual single pillars, double columns are employed spaced 5ft. apart from centres. This mode of construction distributes the total weight evenly on the two supports. The main ribs are connected by three tiers of trussed purlins, and the roof is glazed similarly to the new portion, on the ridge-and-furrow principle; but it is unlike it in one detail, as it dispenses with a screen girder. At the centre of the larger spans the rise is 24ft., and of the smaller 8ft. For the former the principals are of the trussed type, but near the springings the diagonal bars are removed and replaced by a solid plate web. In the side spans the principals are throughout of the plate description.

IN DEFENCE OF THEFT.

OUR United States contemporaries continue to animadvert on the articles which have appeared in our pages concerning the theft of drawings. Obviously the truth is very bitter. Our words have gone home. The various excuses and comments made are at once interesting and amusing. The *Boston Herald*, the original defender of the theft, says:—

We had occasion not long ago to remonstrate with the London ENGINEER for what we regarded as an uncalled-for eruption of abuse, directed at Americans, for the alleged "theft" of plans of the swift British torpedo cruiser Havock. We held that the securing of plans of foreign construction was a recognised line of military or naval activity, and mildly resented the imputation of personal dishonesty on the part of American intelligence officers. THE ENGINEER now retorts, with undisguised ire, by accusing us of defending "theft" in general. While somewhat gratified at our unusually genial contemporary's apparent inability to attack our arguments, we must, nevertheless, call its attention to the fact that even a cursory reading of our words would show that they could not possibly be interpreted by an unbiassed mind as justifying "theft" *in se*. To use the word in this connection would be quite as absurd as to regard a military spy as an eavesdropper. We can see no reason why our attitude on the subject should be changed, and, while regretting THE ENGINEER'S loss of temper, still adhere to the language used in the editorial which has become the target for our contemporary's shafts.

In other words, the *Boston Herald* defends the theft on the principle that all is fair in war, and maintains that in the Intelligence Department of the United States Navy must be sought the thief. We have already stated our belief that the Intelligence Department had nothing to do with the theft, and the same thing has been strenuously asserted in the United States press. The *American Machinist* is quite frank, and a little sarcastic. It says:—

News comes from Washington to the effect that the new battle-ship Texas has developed so many serious defects during the course of building that those responsible for her construction have almost given up hope of ever making the vessel entirely satisfactory. The plans of this vessel were purchased in England, and it is claimed that the delay in her completion—it is now about five years since the vessel's keel was laid—has been caused by the discovery of one weakness and fault after another, which had to be remedied before work could proceed. The latest discovery in this line was made when steam was turned on to the two barring engines, the frames of which immediately broke. Before this, and soon after the launch, the boiler foundations were discovered to be weak, and the vessel had to be put in dry dock to remedy this fault. It seems to have been unnecessary for us to have paid for English naval vessel plans in view of our phenomenal ability to steal them, as set forth in THE ENGINEER; but since all the vessels built here upon plans purchased in England have given trouble, while there has been very little trouble with the others, it will be seen to be the better plan for us to confine ourselves strictly to stealing; the test of construction showing that those English plans which we buy are worthless, while those we steal are fairly good. Seriously, the simple fact is, however, that plans for anything which are transplanted are not likely to turn out successful. We think it is altogether likely that complete plans of our most successful naval vessels sent to England would seem to develope there very serious defects. Plans of complicated structures are always, or should be, adapted to the equipment, methods, and materials of the place in which the work is to be done, and English naval vessel plans can never be reasonably expected to be so successful when executed here by our methods, equipment, and materials as if executed at home, and the same could be said of any other plans made in whatsoever country.

There is a good deal of common sense here; but it is scarcely fair to hold English designers responsible for faults in American workmanship. We never heard before of barring engines in a steamship. We take it for granted, however, that what is meant is the engine employed to turn the main engines while in port. The frames were no doubt designed for the excellent material put into all English naval work. The American founders seem to have used rubbish.

In another place the same journal says:—

The fact that our Philadelphia shipbuilders, the Cramps, have asked of the British Government the privilege of submitting bids upon two of the new vessels which that country proposes to build, would seem to have considerable significance, no matter from what standpoint it is viewed. Upon the surface it looks as though the Cramps expected to be able to compete with the British shipbuilding concerns, a thing which has long been declared on both sides of the water to be impossible, though the Cramps have before declared their ability to do so. To our contemporary, THE ENGINEER, this request coming from American builders will undoubtedly seem nothing more than an attempt to get possession of the plans of an English vessel which could not be stolen.

As a matter of fact nothing of the kind suggested itself to us. Very recently, however, we were told by an American engineer that there was no necessity either to buy or steal English drawings, as they could be had direct from the Admiralty by any big American firm offering to tender. We ventured to assure him that he was mistaken, but he left us unconvinced.

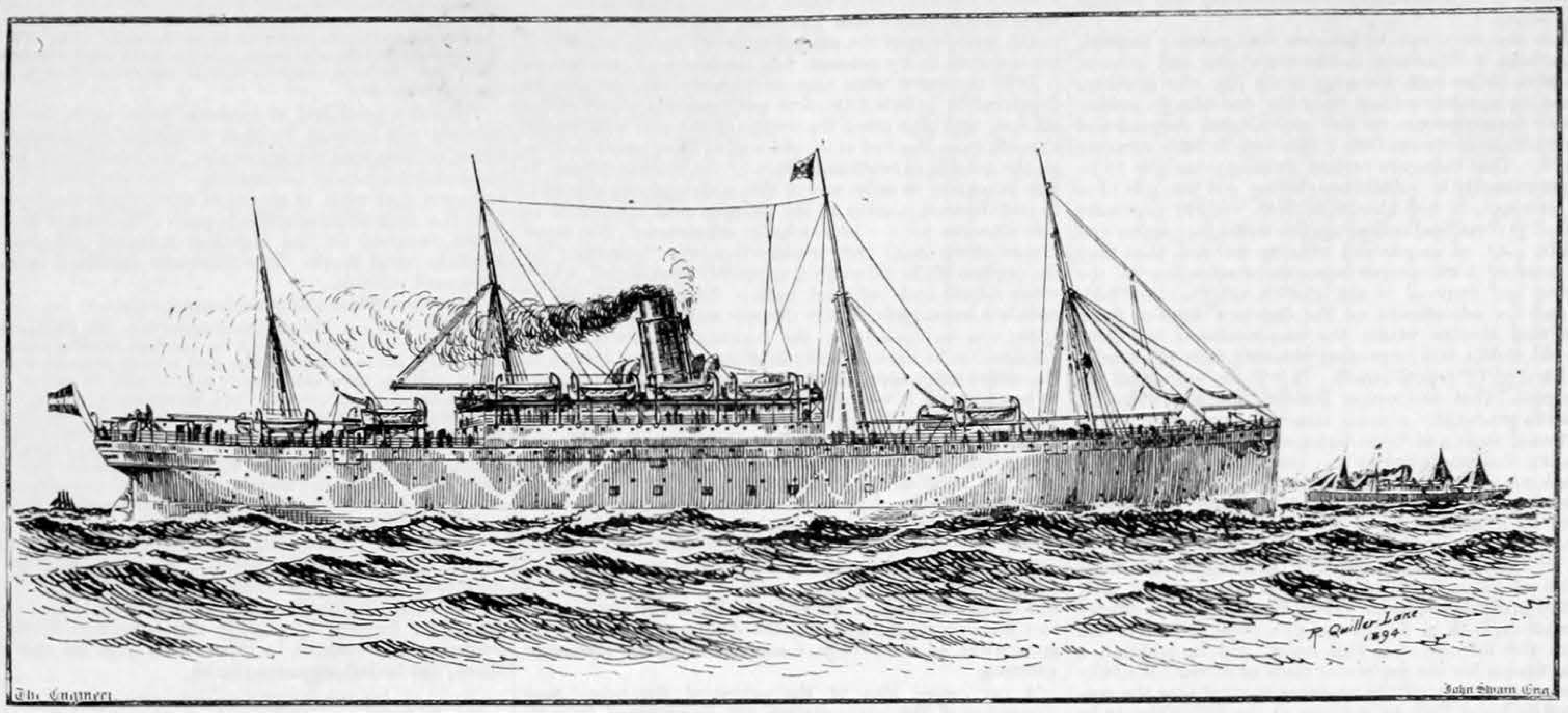
SCOTCH RAILWAY EXTENSIONS.

RAILWAY construction has for several years past been very actively prosecuted in Scotland, especially in the western part of the country. Apart from such large schemes as the West Highland Railway and the Glasgow Central Underground Railway, which have already been dealt with in our columns, quite a number of smaller, but still important, undertakings are at present in progress, or have only recently been completed. The principal of these is the Lanarkshire and Dumbartonshire Railway now making, in the hands of a number of energetic contractors, rapid headway towards completion. This line is being constructed by an independent company, but it will ultimately become part of the Caledonian system, giving that company an important footing in Dumbartonshire. The new line branches off the Glasgow Central Underground Railway at Stobcross, and passes westward in a fairly straight direction along the north bank of the Clyde to Dumbarton, the total distance being about fourteen miles. From an engineering point of view the structural arrangements necessitated by the junction of the two underground lines at Stobcross are of considerable interest. The main feature is a huge bell-mouth of brick in cement, with a length of about 138ft., the span widening from 29ft. to 60ft., and the arch rising 7ft. in the length. This chamber is said to be the largest of the kind in the kingdom, and its construction directly underneath a portion of the North British Railway, over which more than 300 trains pass daily, was a work demanding the utmost circumspection; but it was recently successfully completed without a single mishap. The railway continues underground through Partick—except at the point where it crosses the river Kelvin—till the western extremity of that suburb is reached, when the line comes into the open, and remains so for the rest of its course. The underground way is formed for the most part of rubble-faced concrete side walls, covered by steel cross-girders, the spaces between being filled in with jack-arching of brick. The Kelvin is crossed by a steel-plate girder bridge, with three spans of 60ft. each, the construction of which necessitates the demolition of an ancient stone bridge, which is to be replaced by a steel lattice girder structure, with a single span of 90ft. From Partick the line runs on an embankment of moderate height, through Whiteinch to Clyde-bank, and thence between the Clyde and the Forth and Clyde Canal to a point near Bowling Harbour, where the canal has to be crossed, and also the North British Railway, running immediately alongside the waterway. The works here being carried out are of considerable magnitude, including the complete rearrangement of canal terminal basins, as well as the construction of a concrete viaduct of fourteen arches and a swing bridge of 110ft. span. In these alterations the engineers have had a free hand, as the Forth and Clyde Canal, and the portion of Bowling Harbour connected by locks therewith, are practically the property of the Caledonian Railway Company. The concrete viaduct of seven arches, each of 20ft. span, equally disposed on either side of the canal, is now being erected; but the swing bridge has not yet been commenced. It will, however, be of the hog-backed lattice-girder type supported on a water cushion, and provided with hydraulic slewing gear. The North British Railway will be crossed by a plate girder bridge, and also the turnpike road a few yards to the north. Thereafter the new line passes close along the base of the steep whinstone cliffs behind the village of Bowling, where a large amount of cutting has been necessary. A little to the west of the village the line leaves the cliffs and passes under the road, the level of which has had to be considerably raised to make this possible. A couple of miles further on, the North British Railway is again crossed at Dumbuck, and thereafter the new line runs along the foreshore of the Clyde till near Dumbarton, when it curves inland and joins the older railway about 500 yards east of the existing passenger station. From the foregoing it will be gathered that the new railway runs generally much nearer to the Clyde than the rival line. It will therefore, especially as it is in direct connection with the Lanarkshire coal, iron, and steel centres, be in a better position to deal with the traffic of the large shipbuilding and other works along the north bank of the river, and the number of such establishments is certain to be increased by improved carriage facilities. Mr. Charles Forman, of Messrs. Forman and M'Call, Glasgow, is the engineer for the Lanarkshire and Dumbartonshire Railway, which is expected to be opened for traffic early next year, the total expenditure being estimated at £600,000.

The suburban railway facilities of Edinburgh and Glasgow

THE TWIN-SCREW STEAMSHIP PRUSSIA

MESSRS. HARLAND AND WOLFF, BELFAST, BUILDERS AND ENGINEERS



have recently received important additions by the opening of two short lines of railway operated by the Caledonian Company. The Barnton Railway is 2¾ miles in length, and connects Princes-street Station with Barnton Gates and Cramond Brig. Its construction was commenced about two years ago, and recently completed at a cost of £35,000. The Cathcart District Extension Railway, recently opened for traffic, forms a complete circular connecting railway for the southern suburbs of Glasgow. In 1886 a line was constructed from the Central Station to Cathcart, the distance being about 2¼ miles. This line has now been extended by the formation of a loop line running through a number of villages, and joining the original line at Pollockshields Junction. The new line, which has taken three years to construct, and has cost over £100,000, is about 3¼ miles in length. The Glasgow and South-Western Company's handsome new station at Princes Pier, Greenock, is worth mention as showing the eagerness of the Scotch railways to cater for the coast passenger traffic. An expenditure of £42,000 has been incurred to bring the trains 200 yards nearer to the steamers than formerly, thus saving a few minutes in transference of passengers from rail to steamer and *vice versâ*. At the same time the directors have been enabled to bring the accommodation and appearance of the station into accordance with modern requirements.

TWIN-SCREW STEAMSHIP PRUSSIA, FOR THE HAMBURG-AMERICAN LINE.

THIS fine vessel, just built and engined by Harland and Wolff for the Hamburg-American Packet Co., for its North Atlantic trade, is 445ft. in length, 52ft. beam, and 34ft. deep, with a tonnage of about 5900, constructed to the highest class of the Bureau-veritas, as well as to the requirements of the British and German Boards of Trade.

She has accommodation for about fifty cabin passengers, whose state rooms on the bridge deck will be roomy and comfortable, and heated in cold weather by means of steam pipes. The saloons are also commodious and elegant, and fitted up in a most luxuriant style. In all the rooms, and, in fact, throughout the ship, electric light is provided.

The accommodation for steerage passengers is unusually extensive, provision being made for two thousand two hundred and fifty emigrants. These will be carried on three decks, in separate compartments of twelve each, and a very efficient system of mechanical ventilation will insure a constant circulation of pure air.

In addition to the passenger accommodation, the Prussia has very large cargo capacity, and will be provided with every mechanical device for its rapid loading and discharge.

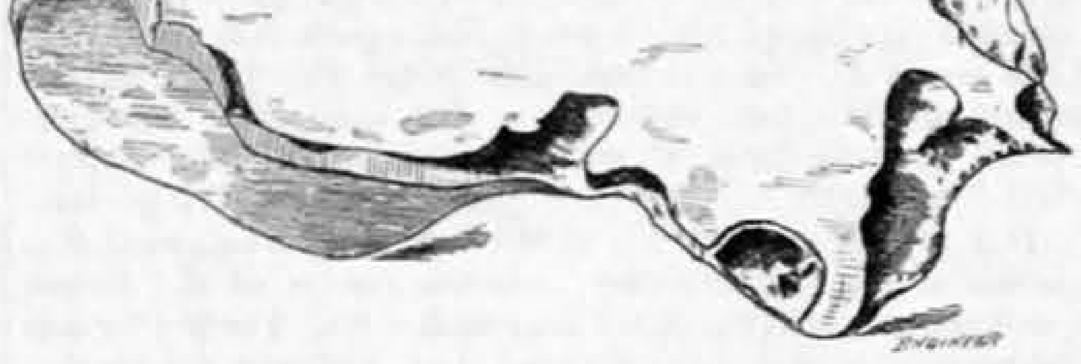
Elaborate arrangements have been made for the carrying of fresh meat from the United States, and refrigerating machinery of the most approved type has been fitted on board to preserve it in a frozen condition during transit. In addition, the ship has also provision for carrying 380 head of cattle.

The ship is propelled by twin-screws, of manganese bronze, bolted to a cast steel boss, and placed extremely close together and overlapping—this feature being facilitated by the adoption of Harland's patent hanging stern post.

The engines, of which she has two complete sets, in separate water-tight engine-rooms, are of the makers' well known and tried triple-expansion type, supplied with steam at a working pressure of 175 lb. per square inch.

THE CORROSION OF CAST IRON WATER MAINS.

A SOMEWHAT peculiar case of external corrosion of two cast iron water mains has recently come under our notice, and will no doubt interest a number of our readers. It is a case in which results very similar to those which are now so frequently ascribed to wandering electric currents, that it receives additional interest in this respect. The pipes thus affected formed part of private service mains in the neighbourhood of the Strand, and consisted of two separate 4in. main pipes in 9ft. lengths, running side by side, and placed at a depth of some 3ft. below the level of the ground. The mains, which were laid some twelve years ago, were surrounded chiefly by gravel and clay; but the portions at which the corrosive actions took place exclusively were embedded in cinders. The annexed sketch portrays the character of the wasting or pitting, and it will be observed that the holes would almost appear to have been gouged out. This, however, is disproved by the number of lengths affected, namely, six. The defective portions were discovered owing to the pipes having in some cases become so much reduced in thickness as to be unable to withstand the pressure within them. We have ascertained that there are no electric mains in the neighbourhood of the pipes, so that this phenomenon cannot have been produced by short circuiting or earthing. The crown plates of steam boilers, upon which ashes have been employed as a non-conducting material, have been known to



Corrosion of Cast Iron Water Pipe

suffer in a very similar manner where any moisture has been allowed to collect. Numerous experiences of this kind might be mentioned, and the partial conversion of the affected parts into plumbago have been also known, and it is quite possible some of those now ascribed to electrolytic action may be due to similar causes.

THE PORTSMOUTH ELECTRIC LIGHTING STATION.

THE new station of the Portsmouth Corporation Electric Lighting Committee was, with due form and ceremony, opened for the public supply of electric power and lighting on Wednesday, June 6th, when at 4 o'clock upon that day the Mayoress of the ancient borough of Portsmouth, started the several engines, which at once began, without hitch or halt, to provide that light and power which is the object of their existence.

This is probably the most important provincial station for the supply of electricity, whether for light or power, in England. It has begun a career which will be watched with jealousy by some, with envy by others, with admiration by many, and with keen interest by all engineers.

The committee appointed by the Portsmouth Town Council —over which Mr. Alderman Ellis has presided with such advantage to his town, and to which was relegated the consideration of the electric lighting proposition about five years ago—must be congratulated upon the success which has attended its labours, and particularly upon the system which it has adopted, through the advice of its engineers. At one moment it seemed as though Portsmouth was about to follow so many other corporations into an effete, low-tension (possibly accumulator) system; but, fortunately for the old town, Mr. Alderman Ellis, at the right moment, decided against one adviser, and, relying upon those who now advise him, adopted high-tension alternating current. The generation of electricity is effected in this station by the most modern means, and, indeed, at every stage may be noticed advances upon previous practice.

The plant as at present constituted consists of two Ferranti alternators of a type not hitherto associated with his name, and of one turbo alternator and condenser by Messrs. C. A. Parsons and Co., of Newcastle-on-Tyne, as generators. The Ferranti alternators, which are each fixed directly on the crank-shaft of a pair of compound horizontal Corliss engines, built by Messrs. Yates and Thom, of Blackburn, have a revolving field which may be said to act as the fly-wheel of the engines, and which is embraced in a mechanical fashion by the armature ring. The winding of the armature bobbins is parallel to the axis of the shaft, and is enclosed in a series of boxes which afford perfect protection against mechanical injury, and indeed most of the ills to which alternators have until now been heir. The machines are designed for an output of 212 kilowatts, but it is anticipated that they will readily give an output much larger than this should they be required to do so. The periodicity of these machines is fifty, and the whole thing may be very fairly described as essentially a first-class electrical mechanical engineering job, and one with which we must deal in detail at a later date. The Parsons turbo alternator, which has been erected beside one of the Ferranti machines, is capable of a separate output of 150 kilowatts at the same periodicity, though it may also be assumed that, like the larger dynamo, it will be able to give a considerably larger output after it has been at work for some little time. It is similar to the machines already working in the Cambridge electric lighting station with such success, and large and important stations at Scarborough, Newcastle-on-tyne, and elsewhere have also been fitted by the same firm. The two Ferranti alternators have been run in parallel with much success from time to time, but after the experience of Deptford, where machines designed by Mr. Ferranti, generating at different potentials, and of such difference of size as 300-horse power and 1500-horse power, are daily run in parallel without a moment's trouble or anxiety, we might reasonably have expected this, but we are very pleased to report that the two Ferranti dynamos and the Parsons turbo alternator can be put into parallel, and so worked at Portsmouth quite successfully.

The current, which is generated at a pressure of 2000 volts, is transmitted to the street transformers at that electromotive force, and in these street transformers it is converted to 100 volts, and passed into a low tension system to do the lighting for a radius of 300 yards or thereabouts round the transformer pit.

The arc lighting of the tower, which is extensive and remarkably perfect, is done by means of current from the same dynamos, which has been commuted at the station by means of a Ferranti rectifier. No more perfect arc lighting can be seen than that at Portsmouth, and figures which we have before us now show that not only can arc lighting be brought very near to perfection by means of this system, but that it can be done much more cheaply than by any purely continuous or alternating system.

The new station is remarkable for three distinctive departures from previous practice, which place it in the race of progress. (1) Slow-speed direct-driven high-tension alternators. (2) Street transformation by efficient automatic transformers. (3) Arc lighting by means of an interrupted or rectified current. A detailed account of these we must leave to future impressions.

THE DANUBE REGULATION WORKS.

By BELA VON GONDA.

(*Continued from page* 474.)

THE road of Trajan was begun by the Emperor Tiberius, and the Emperor Trajan continued and finished it in A.D. 103 with the aid of the Fourth Scythian and the Fifth Macedonian legions. The parts of the road cut in the rocks are the existing evidences of the great determination of the Emperor Trajan.

The performance of this magnificent technical work was eternalised by the Romans with three commemorative tables. These are cut into the wall on the shore, in frames adorned with fine relievos, of which some parts are still quite visible on the Table of Trajan—see page 502—in the Straits of Kazán.

With the decay of the Roman Empire the Lower Danube lost for a long time its former importance. The migration of people caused the decay of the great creations of the Latines; and after long centuries the Lower Danube became the scene of heavy struggles against the Turks, and many fortifications having been built there in order to impede the hostile army to advance.

When the Turks were finally repulsed to the Balkan peninsula, and the reign of Napoleon came to an end, and the war alarm ceased, and peaceful times came again, the attention of the Governments and Statesmen was directed again to the question of the improvement of waterways. The Government Council of Hungary had defined in 1816 the topographical and hydrographical plan of the Danube, with reference to the frontier of the country to Cserneez in Roumania, and with this object a special bureau was soon established under the supervision of the Board of Public Works. But the surveys were begun only in 1823, and finished in 1838. These surveys embraced the study of all circumstances referring to the channel of the river and the current, and were executed so precisely and conscientiously, that they are still now the pride of the Hungarian hydrotechnics. On the basis of these surveys particular plans were elaborated for the uniform regulation of the Danube; but these plans were not carried out.

To be continued.

RAILWAY MATTERS.

THE Kolar Railway has recently been inspected by the Indian deputy consulting engineer for railways, with a view to finding out if it is safe for the running of night trains.

TRACKLAYING at the rapid rate of 10,000ft. in ten hours was, according to *Engineering News*, done on the Southern Pacific Company's line to San Luis Obispo, Cal., on May 3rd, in order to keep its agreement to have trains running by May 5th.

THE *Indian Engineer* says that the old bridges on the Karachi to Kotri section of the North-Western Railway are being renewed, and the bridges are made to carry double line; also that the Government intend doubling the line on this section as soon as funds are available.

THE Western Railway Company of France is erecting a new station in place of the old building at Montretout at Saint Cloud, which is no longer adequate for the increasing traffic. Access will be gained to the new station, which will have a façade of 100ft., by a handsome stone bridge, 90ft. in span. Three months more will see the completion of the works, at a total cost of £12,000.

THE Glasgow and South-Western Railway exhibit a weather report at the St. Enoch Station, Glasgow, which enables pleasure-seekers to decide on their day's programme before booking. The weather, including direction of wind, is given for a dozen most important places on the system, the information being transmitted by telegraph each morning between seven and eight o'clock.

THE scheme of railway construction upon which the Swedish Government has been engaged since the year 1855, was completed at the end of last year, and there is now unbroken communication between Malmö in the south and Gellivaara in Swedish Lapland. The mileage of the State Railway was increased by 44$\frac{3}{4}$ miles, bringing up the total to 1748$\frac{1}{2}$ miles. The revenue steadily increases, having amounted for the year to £1,271,509, an increase of £27,777, or 2·43 per cent. over the previous year.

THE Brighton Line is probably in a better position than any other to express an opinion on the electric lighting of trains. They have sanctioned the equipment of eight new trains with electric lighting plant. It seems that the company is engaged in thoroughly overhauling its train-lighting arrangements, as they have decided to erect oil-gas works under the Pintsch system both at New Cross and at Brighton. So far, a preference for any particular system does not appear to have been formed.

AT the Crewe Engineering Works of the London and North-Western Company notices have been posted stating that the works will be put on full time, commencing immediately. The notices are limited, however, to only one month, but it is hoped that it will be continued permanently. The workmen have been on short time about twelve months, for a portion of which period they were working less than four days a week. There is more activity now in the workshops than at any time this year, and the prospect indicated by the largely-increased traffic receipts is more encouraging.

IN reporting on the collision which took place on the 12th March at Castle Cary on the North British Railway, when the 11 a.m. up express passenger train from Glasgow to Edinburgh—consisting of engine and tender, two third-class, two first-class, and one third-class carriages, and guard's brake van, fitted throughout with the Westinghouse brake—overran the up home signal at Castle Cary at about 11.23 a.m., and came into violent collision with a train of fifteen goods wagons, which were being shunted back into an up siding, Major Marindin says:—"The occurrence of such an accident as this, where, in broad daylight, upon a fine day, a light express train, fitted with a first-class continuous brake, runs at high speed into a shunting train, upon a line nearly straight and level, should be well nigh impossible, and can be brought about only by breaches of the rules, and carelessness, on the part of more than one servant of the company, most discreditable to those concerned."

A NEW light railway just over three miles in length, which puts the pleasant and rising watering-place of Lee-on-the Solent in direct communication with the general railway system of the country, was on Thursday formally opened by the Countess of Clanwilliam. "Four years ago a certificate of the Board of Trade, possessing the force of an Act of Parliament, was obtained by an independent company for the construction of a new light railway line to Lee, under the Railways Construction Facilities Acts, and in 1893 this contract was entrusted to the firm of Pauling and Elliott, of 28, Victoria-street, Westminster, who in a few months have successfully completed the line, which is laid with 60 lb. rails. It commences with a junction with the London and South-Western Railway at Fort Brockhurst station, on the line to Stokes Bay and Ryde, and terminates at a station almost on the beach at Lee, and close to the pier. The engineer is Mr. P. W. Meik, C.E. The chairman of directors is Mr. James Willing, jun., and Mr. E. B. Ivatts has been appointed manager."

MR. G. W. HAWKSLEY, Brightside Boiler and Engine Works, Sheffield, whose plea for traction engines was noticed in last week's ENGINEER, again returns to the charge against the Highway Committee of that city That body, he says, is trying to prevent the removal by road of all loads of 15 tons and upwards. Mr. Hawksley says that since writing his last letter he had occasion to deliver a boiler 18 tons weight in the city. He did not send it by traction engine, but by horses, and on a broad-wheeled wagon. Nothing unusual, he says, occurred *en route*, yet the owner of the horses has been served with a notice of law for damaging the roads all along the way. Mr. Hawksley states that in Leeds, Manchester, and other large towns weights of 30 or 40 tons are regularly passed over the roads, and he contends that the policy of the Highway Committee is a deliberate blow at the Sheffield heavy trades. If Sheffield is to maintain her place in the manufacturing world, means must be found of keeping down working expenses, and Mr. Hawksley attaches great importance to the adoption of high-pressure steam as one means to that end. Thirty years ago, he adds, boilers were working generally at 30 to 60 lb. pressure; now it is from 100 to 200 lb. working pressure. At the former period double-flued boilers were usually about 10 or 12 tons; now 20 tons is an ordinary weight.

THE statement concerning the Congo railway, which was communicated on Wednesday to the Chamber by M. de Smet de Nayer as an additional inducement to it to pass the measure by which, under M. Beernaert's Administration, a subsidy of 10,000,000f. was promised by the Belgian Government towards the undertaking, has, the *Times* says, caused great Radical outcry. It appears that, instead of the million sterling at which the cost of construction was estimated at the outset, the railway will absorb two millions and a-quarter, and that its maintenance will require an annual outlay of £73,080, without putting aside anything towards the liquidation of the debt. The annual expenditure will thus exceed by £12,000 the receipts anticipated by the company, even at the somewhat prohibitive rate of £40 per ton and £20 per passenger for a distance of 248 miles—400 kilometres. The company maintains, however, that when the line for a distance of 175 kilometres is in working order the railway can be profitably opened. So far, however, it has cost some £8000 per kilometre to construct and £100,000 for preliminary surveys, which have still to be carried on. The main obstacles to progress have been the climate, the soil, the conformation of the country, and the impossibility of finding capable workmen. Begun in 1890, it was only at the end of three years of almost superhuman effort that the work of laying the line from Matadi to Kenge, representing the first section of 40 kilometres, was accomplished.

NOTES AND MEMORANDA.

WHEN a mixture of sodium dioxide and aluminium powder is exposed to damp air, spontaneous combustion ensues. If the mixture is moistened, a very high temperature is produced.

AT a recent meeting of the French Academy of Sciences M. A. d'Arsonval read a paper on "Apparent Death Produced by Alternating Currents and Restoration to Life by Means of Artificial Respiration." In the cases where death has apparently been caused by direct action of the current on the nerve centres, without lesion or destruction of the tissues, it is found possible to revive the patient by the treatment adopted with apparently drowned persons.

AT a recent meeting of the Teign Naturalists' Field Club Mr. Alfred Chandler, F.R. Met. Soc., read a paper on "Sunshine Recording Instruments and their Uses," and, amongst other things, exhibited one of the original sun-bowls used in Campbell's first instrument. The date of this sunburnt bowl is for the half-year June 21st to December 21st, 1869, or from the summer to the winter solstices of that year, and it is one of those burnt by the solid glass lens. It is interesting to note that when the sun acted through the lens upon this bowl it was a period just before the sun spot maxima around 1870.

THE recent earthquakes in Greece and Venezuela have been unusually severe, and the discussion of them has led *Engineering News* to publish the following statistics of great earthquakes and approximate loss of life:—1158, Syria, 20,000; 1268, Cilicia, 60,000; 1456, Naples, 40,000; 1531, Lisbon, 30,000; 1626, Naples, 70,000; 1667, Schamaki, 80,000; 1693, Sicily, Catania, &c., 100,000; 1703, Jeddo, Japan, 200,000; 1706, Abruzzi, 15,000; 1716, Algiers, 20,000; 1731, China, 100,000; 1746, Lima and Callao, 18,000; 1755, Lisbon, 50,000; 1759, Baalbec, &c., 20,000; 1797, Panama, &c., 40,000; 1822, Aleppo, 20,000; 1851, Milfi, Italy, 14,000; 1857, Callabria, &c., 10,000; 1867, Peru and Ecuador, 25,000; 1875, Colombia, 14,000; 1883, Krakatoa, 100,000.

AT the general meeting of the Compagnie Parisienne d'Eclairage et de Chauffage par le Gaz the report stated that the volume of gas consumed in Paris and neighbourhood during 1893 was 303,496,850 cubic metres—70,979,625 thousand cubic feet—less by 5,404,088 cubic metres—190,818 thousand cubic feet—than the quantity consumed in 1892, which had one day more, being leap year. Allowing for this fact, the diminution in the consumption is not nearly so great as that noticed in London, and bore chiefly on the second half of the year when there were so many fine and hot evenings. While the use of Auer incandescent burners increased the number of subscribers, it brought about a diminution in consumption. The use of gas for cooking, heating, and motive power is greatly extending, the ratio of day consumption to the total consumption having increased from 27·35 per cent. in 1892 to 28·71 per cent. in 1893.

IRREGULAR subsidence of the ground in which stoneware pipes are laid, even when well surrounded by concrete, often causes failure of the stoneware sewer. It would be safer in such a case to employ cast iron pipes. A contemporary remarks that they have this conspicuous advantage over a square mass of concrete—that they present a much smaller surface to receive the weight of earth above. The chief difficulty arises from the additional cost. A 12in. diameter stoneware pipe sewer could be provided and laid in most localities for 3s. to 4s. per yard, exclusive of digging. It would require half a cubic yard of concrete to enclose one lineal yard of such a sewer to a thickness of 6in. from the top, bottom, and sides; and this would cost another 5s. or thereabouts per lineal yard. A 12in. cast iron pipe, $\frac{3}{8}$in. thick, would weigh 94 lb. per foot, and could not be provided for much less than 18s. per lineal yard. There being fewer joints than in stoneware pipes, the cost of laying would be less. It might be done for 1s. to 1s. 6d., so that the cost would be more than double that of stoneware pipes surrounded with concrete. There are, however, many cases in which the use of steel or wrought iron pipes would be far the cheapest in the end.

AT the last meeting of the Physical Society, Professor W. Ramsay, F.R.S., read a paper on "The Passage of Hydrogen Through a Palladium Septum, and the Pressure which it Produces." After referring to the analogy between asmotic pressure of solution, and the behaviour of hydrogen and palladium, the author described the apparatus he had used in his experiments, and showed it in operation. A vertical platinum tube provided with a palladium cap is enclosed within a glass vessel, through which hydrogen or other gases may be passed, and outside the glass vessel is a vapour jacket, by means of which a constant temperature can be maintained. The lower end of the platinum tube communicates through a graduated capillary tube with an adjustable manometer, which enables the volume of the enclosed gas to be kept constant. Great precautions were taken for insuring purity and dryness of the gases used. After filling the palladium and platinum tube with dry nitrogen at atmospheric pressure and the desired temperature, hydrogen was passed through the glass vessel. Some of the hydrogen permeated the palladium walls, thus increasing the pressure inside. After some time—usually an hour or so—the pressure attained a steady value, and the total increase was then observed. Experiments were made with air, nitrogen, nitric oxides, nitrous oxide, carbon dioxide, carbon monoxide, and cyanogen in the palladium tubes, and in some cases the hydrogen was diluted with nitrogen. In all cases the maximum pressure of the hydrogen within the tube was less than that of the hydrogen outside the tube.

CONCERNING the number of flour mills in the United States and Canada, the *Minneapolis Record* says it places the number in Canada at about 1000. There are probably, all told, about 1200 mills in this country. In the States the number is placed at beyond 15,000. Pennsylvania leads all other States in the number of mills, there being 2200; New York follows next with above 1300; Ohio, 975; Missouri, 810; Indiana, 750; Illinois, 700; Michigan, 600; Wisconsin, 575; Iowa, 500; Tennessee, 490; Virginia, 460; Texas, 450; North Carolina, 405; Minnesota, 390; Georgia, 340; West Virginia, 335; Kansas, 320, running down from that to three for the district of Columbia. While Minnesota is fourteenth in the list, according to number, the capacity is beyond the capacity of any other State, owing to the larger size of the mills. The daily milling capacity of Minneapolis is about 47,000 barrels, if run up to the highest possible limit. This, however, is impracticable; and, during the last year, the average production in this city was 67·8 per cent. of the total capacity. The average production of Duluth and Superior was 56·3 per cent. of the total capacity. The average production of St. Louis was 48·8 per cent.; of Buffalo, 55·9; Milwaukee, 60·9 per cent. The average daily capacity of Duluth and Superior during 1883 was rated at 12,361 barrels. The year began with less than that; but several mills were completed in West Superior during the season, and at the beginning of this year Superior had a capacity of 12,000 barrels daily, and Duluth 6300 barrels daily; St. Louis a daily capacity of 21,000 barrels; Buffalo, 11,000; Milwaukee, 10,200. Baltimore has some 3300 barrels total capacity; Philadelphia about half as much; Detroit about 2000; Chicago some 4000; Kansas City above 2000; Cincinnati about 2000; Cleveland 4000, and Indianapolis about 5000. Minneapolis in 1892 manufactured 9,750,470 barrels of flour; in 1893, 9,377,635 barrels. The product of Minneapolis exceeded in both these years all the flour-producing cities separately. The production of this city was greater than that of St. Louis, Baltimore, Philadelphia, Buffalo, Milwaukee, Toledo, Detroit, Chicago, Duluth and Superior, Kansas City, Cincinnati, Cleveland, and Indianapolis combined, and they are the leading flour cities outside of Minneapolis. The production of flour, to capacity, in Minneapolis in 1892 was 71·6 per cent. of capacity; St. Louis, 51·1; Buffalo, 64; Duluth and Superior together, 51; and Milwaukee, 71·3 per cent.

MISCELLANEA.

AN Admiralty order has been issued directing her Majesty's torpedo vessel Landrail to be despatched from Sheerness to London on June 29th to represent the Royal Navy at the opening of the new Tower Bridge.

WE are informed that Mr. George Pinkert, of Hamburg, the inventor of the "Land and Water Tricycle," intends going on his machine across the channel from Cape Gris Nez, near Calais, to Folkestone, probably at the end of this month.

ON Wednesday the South Staffordshire Institute of Iron and Steel Works Managers held their annual excursion, and visited the Manchester Ship Canal and the Liverpool Overhead Electric Railway. The party, together with their friends, numbered some 560.

THE Westinghouse Electric and Manufacturing Company, in their recently-issued annual report, express great expectations of their long-distance power transmission business when the three 5000-horse power generators are in operation at Niagara Falls.

THE Maldon Union Rural Sanitary Authority, Essex, at their meeting on May 29th, appointed Mr. H. G. Keywood, assistant in the Borough Engineer's Office, Nottingham, as the surveyor and inspector of nuisances, at a salary of £200 per annum. There were 74 applications.

THE death is announced of Colonel Haywood, the chief engineer to the City Commission of Sewers, which office he had held for nearly fifty years. The special committee appointed to consider the filling up of the vacancy has appointed Mr. D. J. Ross, the assistant engineer, to the office.

ON the 31st ult. the annual conversazione of the Institution of Electrical Engineers was held in the Galleries of the Royal Institute of Painters in Water Colours, as on former occasions. Mr. Alexander Siemens, President of the Institution, received the guests, and so brought to a conclusion his term of office.

ON June 1st another new ironclad was successfully launched from the Admiralty-yard on the Neva, in the presence of the Tsar and an enormous concourse of people. The *Times* says the new battleship, which is called the Sissoi the Great, after an orthodox saint, has already been three years under construction, and will not be completed for another year at least.

IT is satisfactory to know that the Simla water supply is now in a condition to remove all apprehensions of water famine. The pumping engines at the waterworks are now delivering nearly 130,000 gallons daily, while from the old catchment area 94,000 gallons a day are reaching the reservoirs by gravitation. This gives a total supply of over 240,000 gallons, so that the station has water in abundance.

THE Anderlues Mining Company of Belgium is now putting down a new shaft not far from that in which the terrible accident occurred in March, 1892. On account of an underground fire at Height 670 N, in pit No. 7, of the Bellevue Colliery, owned by the Société de l'Ouest de Mons, it is feared that the workings must be definitely abandoned, and that fresh exploring works must be undertaken in order to maintain the output.

ONE of the boreholes of the Lens Colliery Company was reported to have struck a diamond mine—not one of black diamonds merely, but real gems. It is only sufficient to add that the report appeared in a local paper, which was appropriately dated 1st of April. The news, however, made sufficient impression in Paris for the editor of the *Echo des Mines* to telegraph to M. Reumaux, general manager of the Lens Colliery, "Est-ce un canard?" To which the reply came, "Oui, à plusieurs becs."

THE alterations to the Bombay Dockyard, begun about three years ago, have been completed. The additions made are a wet dock capable of accommodating eight vessels of the largest tonnage, a dry dock for the reception of three torpedo boats and light craft, and a tidal basin with a depth of 6ft. at lowest spring tide, with a wharfage area of 600ft. in length by 50ft. in breadth. The dock throughout has been deepened by about 7ft., and an additional length of 60ft. by 48ft. wide has been added. *Indian Engineering* says the total cost of these works amounted to about 17 lakhs of rupees.

THE Technical Education Board of the London County Council has organised a series of trade conferences to discuss the subject of technical education in its relation to the various London industries. They will be held at the County Hall, Spring-gardens, S.W., during the months of June and July. The chair will be taken at 8 p. m. by Mr. Sidney Webb, Chairman of the Technical Education Board. The dates of meeting and the particular groups of trades to which the conferences will be devoted are as follows:—June 7th: The building and furniture trades. June 20th: The engineering, shipbuilding and metal trades. July 4th: The book, paper and printing trades. July 18th: The clothing, leather, chemical and miscellaneous trades.

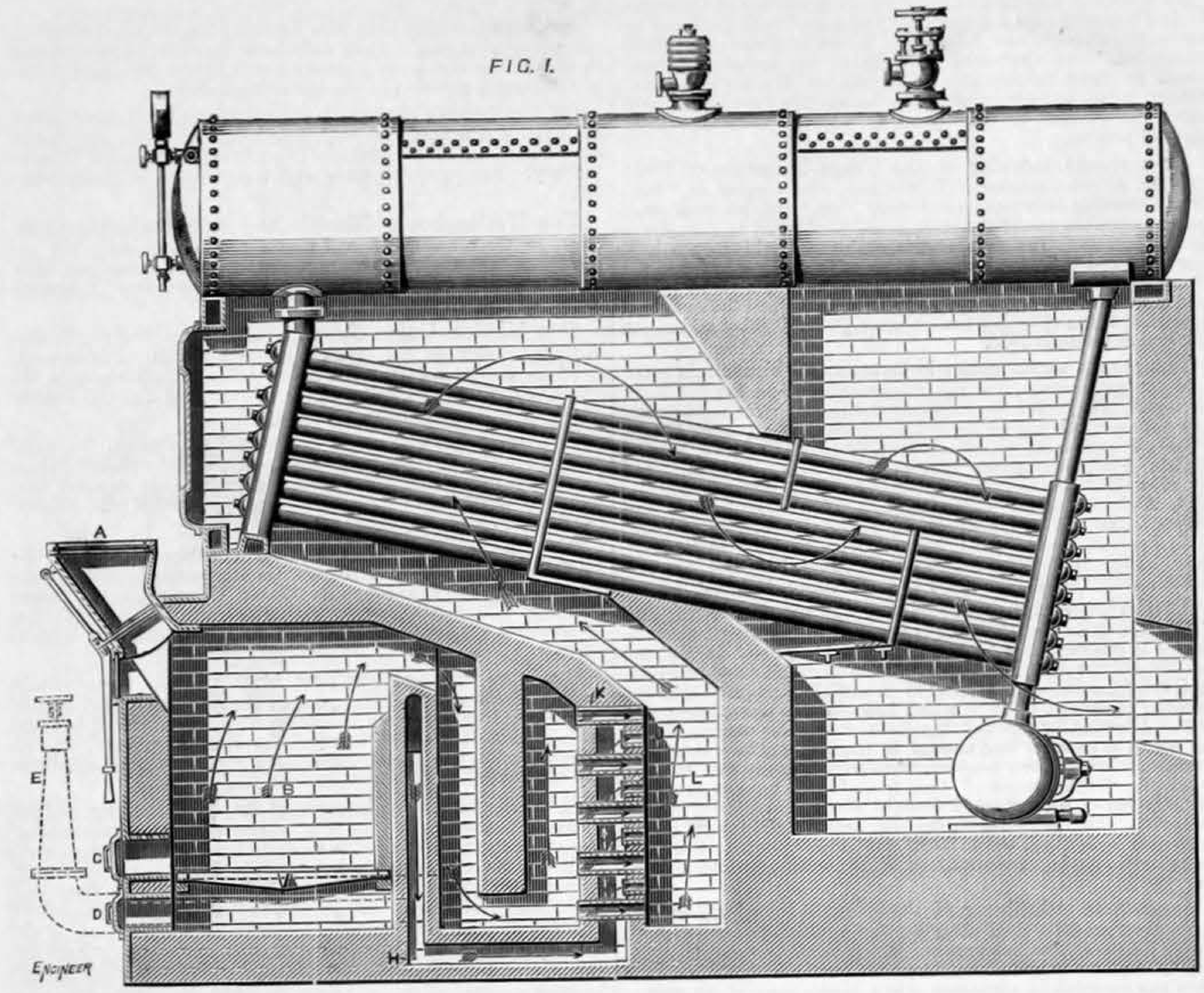
THE reconstruction of the Stockton Corporation Quay is still exciting great interest there. Sir Alexander Rendel, who was called in to advise, has laid plans and specifications before the Quay Committee, and the Committee have approved these and decided to advertise for tenders for carrying out the work. There was a lively meeting of the Corporation on Tuesday, when the minutes of the Quay Committee came up for confirmation, and certain members took exception to the fact that there was no estimate given as to the cost to be incurred, but the Town Clerk pointed out that it was not wise to make known the estimate, as if it were published there would be no tender under it. Ultimately, it was resolved that tenders for the work should be obtained.

"THE ENGINEER," says *Reynolds' Newspaper*, "is very frank in its references to the International Miners' Congress. *Reynolds' Newspaper* has been so successful in exposing the hypocrisies of modern life, that in latter years we hear much less of them than was formerly the case. The official organ of the great branches of industry connected with engineering in its latest number freely admits that it is impossible to run the industrial world on Christian principles. It says, 'One and all work mainly for themselves;' and again, 'The mainspring of human movements, actions, mental goings and comings, is self.' Of course, this is an admission of the existence of war between the producing and the owning classes. It is always satisfactory to have your enemy say exactly what he means, and, therefore, THE ENGINEER is to be thanked for its admissions."

AT a meeting of the Manchester City Council on Wednesday, a long statement was made by Sir J. Harwood, deputy-chairman of the Ship Canal Board. He said it appeared that by the end of the next year, and probably earlier, there could be nothing left of the corporation loan to the canal, and that they might expect a deficiency of £146,862 in December, 1895. Unless some action of a very drastic character were taken the corporation would in 1896 have to find money for the interest on debentures. He stated this some time ago, and that it would necessitate a rate of about 1s. 8d. in the pound. This was ridiculed at the time, but it turned out to be very near the mark, for the interest on £5,000,000 and the sinking fund which commenced in 1897 amounted to 1s. 7$\frac{1}{2}$d. in the pound, in addition to which there would probably be other matters requiring serious consideration. The work of the future would be for men of special training, and he thought himself entitled to be relieved from further responsibility. The council adjourned for a week for further discussion of the report.

TAYLOR'S GAS FURNACE FOR STEAM GENERATORS

FIG. 1.



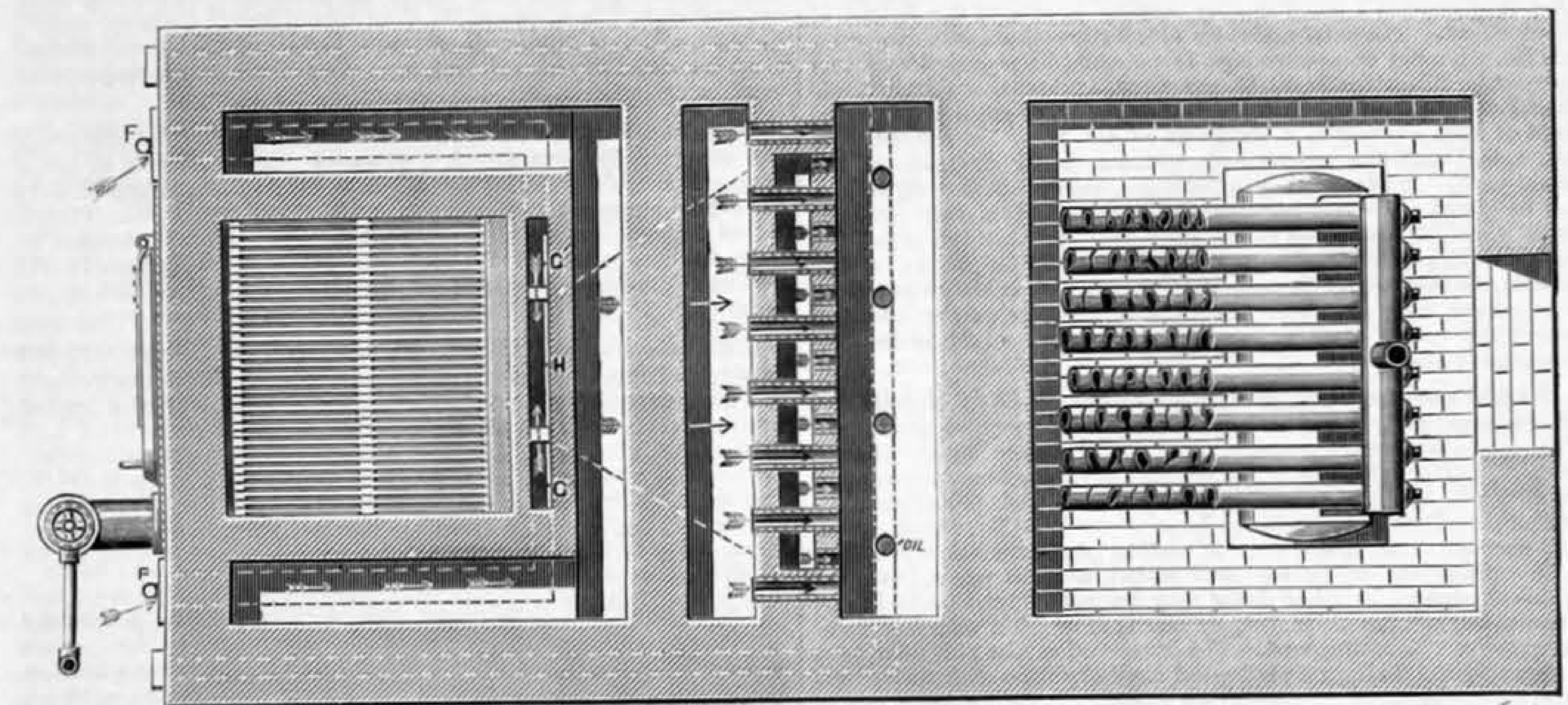


FIG. 2

TAYLOR'S SELF-CONTAINED GAS-FIRED STEAM GENERATORS.

THE problem of the best and most economical means of consuming coal in steam generators has been a subject of attention for engineers since at least the beginning of the century, but no general system of smoke prevention has yet been adopted. Great quantities of smoke are still produced, in spite of legal enactments for the suppression of the nuisance. Apart, however, from the unpleasant consequences of imperfect combustion, there is the equally important question of enhanced cost of steam production owing to waste of fuel. Every attempt, therefore, to improve the methods of consuming fuel must be of interest. One of the chief difficulties in the way of a satisfactory solution of the problem is the fact of the variable power demanded from a given generator. If cases were frequent in which an absolutely regular quantity of steam per hour were required, the arrangements for burning economically and perfectly a given quantity of coal would be comparatively simple. This case is met with in practice in the slow-running engines used in waterworks, and there no smoke should be produced, but the problem is not at all so simple where the demands for steam are variable both in amount and duration. It may be taken for granted that if the gases produced by combustion of coal are suffered to impinge upon surfaces which are much cooler than themselves, it will be impossible to prevent smoke, and the best surface for the purpose is undoubtedly fire-brick or some equally refractory material. In many boilers the use of fire-brick in contact with the metal surfaces which are heated is objectionable, therefore many attempts have been made to keep the fire-brick altogether separate. Many boilers have been fired with producer gas, with good results and a saving in coal consumption, but there must inevitably be a considerable loss of heat in all cases where the producer is at some distance from the boiler, and great care must be taken to avoid explosions in the gas conduit itself. If, then, the producer could be placed inside the boiler itself, or so close to it that the same brickwork which serves as the boiler setting would also serve for the producer, great economy should result, and if the quantity of air be properly proportioned to that of the gas, entire absence of smoke should ensue.

These views led Messrs. Taylor and Lowe to design such an arrangement as we have just named for all the well-known types of boilers, but our space will only permit of our illustrating one of these, which we think best illustrates the principle. Figs. 1 and 2 represent the arrangement as applied to a Babcock-Wilcox or other tubulous boiler. Fig. 1 is a sectional elevation, and Fig. 2 a plan. The small coal or burgy is charged into the hopper A, preferably about 2 cwt. at a time, and is discharged, by means of the lever, into the gas-producer B, in which a deep fire is kept. C is the clinker door, and D the ash door, which are closed by air-tight covers. A steam jet and air injector E is used to deliver air below the producer grate bars, and the delivery of air is thus under perfect control, and the fuel burns in layers, which cause the production of carbonic acid gas and its subsequent carbonisation to carbonic oxide. If the apparatus receives proper attention, no carbonic acid gas whatever should pass into the boiler flues. The whole of the gaseous products from the producer pass in the direction shown by the full line arrows over the bridge, and then descend. The whole of the setting is, of course, in fire-brick. So far, the gas is the same as that given off from the ordinary producer, and it is now necessary to mix it with the due proportion of air, and to cause combustion in the part of the apparatus best suited to supply heat to the boiler tubes. In order that the entrance of cold air may not cause a drop in the temperature of the rich gases, all the air used is caused to pass first through heated brickwork, and as the inventors prefer to dispense with the usual tall chimney stack, a fan is used to produce the requisite draught. This current is entirely separate from that produced by the steam jet, which merely feeds the producer. Referring to Fig. 2, it will be observed that there are two openings lettered F; each of these is connected with the air-duct from the fan, and air passes along in the direction of the dotted arrows up the side flues G, Fig. 2, and down the central flue H along the passage at the base of the setting, and through the pipes J into the combustion chamber L, having on its way become heated to a high temperature. The gases from the producer at the same time descend in the direction of the full arrows, and pass through the pipes K, and mix with the air in the combustion chamber L. It has been found that the mixing of the gas and air is best effected by the mingling of separate streams in this way. The combustion-chamber L is kept at a white heat by the perfect oxygenation of the gases, and the heated products pass in the usual manner round the water-tubes, and so to the chimney. It will be observed that the whole of the fire-brick is entirely separate from the boiler proper, except at the points where the latter rests upon it, and thus free expansion is allowed for.

The inventors claim that no trace of carbonic acid gas passes out of the producer, and that no trace of carbonic oxide gas has been found in the chimney gases. We recently had an opportunity of examining a vertical boiler made upon a similar principle by the inventors, and used at the Cadby Hall works of the Epstein Accumulator Company. The hopper was cylindrical, with its axis vertical, and the gases passed off up a central vertical group of small tubes into a chamber, from which they descended by four larger tubes and discharged into an annular combustion chamber built of fire-brick at the base of the boiler. Air was injected into an annular chamber of fire-brick, where it was heated and then passed into the combustion chamber, where it mixed and combined with the gases. The whole of the products then passed upwards through four groups of small vertical tubes to the smoke stack. The whole of the tubes through which the gases passed were entirely surrounded by water. No smoke was visible when we visited the place, but as we were unable to make any tests, we append a few results of trials made by well-known engineers. Professor Alex. B. W. Kennedy examined and tested a similar boiler some time ago, and Mr. D. K. Clark and Dr. John Hopkinson have on separate occasions carefully tested the apparatus.

The inventors inform us that with the boiler at Cadby Hall works alluded to above, the cost for coal consumption was only one-half of that previously required with the ordinary Lancashire boiler.

The boiler tested by Mr. D. K. Clark at the Cadby Hall works is rated at 30 nominal horse-power, and has a heating surface of 856 square feet. The shell is 6ft. 6in. diameter and 8ft. high between the upper and lower tube plates. The steam is collected in a horizontal steam chamber at the upper part of the boiler, 2ft. 6in. diameter and 4ft. 9in. long. The gas producer is 3ft. 9in. diameter and 5ft. 6in. high, measured from the grate to the lower tube-plate of the boiler. The grate area is 11 square feet. Six test trials were made, and the coal was charged in quantities of from 50 lb. to 120 lb. each time. The working-pressure of the steam was 80 lb. per square inch.

The coal used for trials Nos. 1 to 5 was Garswood Hall burgy, of which the following is an analysis:—Carbon, 81·5 per cent.; hydrogen, 4·0 per cent.; sulphur, nitrogen, oxygen, &c., 5·8 per cent.; moisture, 1·7 per cent.; ash, 7·0 per cent.; total, 100·0. The calorific value is 14,300 heat units per lb. of coal, represented by the evaporation of 14·8 lb. of water from and at 212 deg. Fah.

The following details are extracted from Mr. D. K. Clark's report:—

Number of trials	1	2	3	4	5	6
Duration of trial, hours	7	8	7	7	6	7
Coal consumed per square foot of grate, pounds	21·4	10·2	33·3	32·8	28·75	56·4
Feed-water, total evaporation per square foot of grate, gallons ..	1087·5	682	1054	1751·5	1508·5	2453·5
Feed-water evaporated per pound of coal, as from and at 212 deg. Fah., pounds	7·81	9·12	9·59	8·30	9·50	6·77
Average pressure in boiler per square inch, pounds	77	72	81	72·5	83·0	75·3

In the same report the following analyses of chimney gases are given:—

	By volume. Per cent.	By weight. Per cent.
Carbonic acid	5·21	7·749
Carbonic oxide..	0·00	0·000
Oxygen	14·17	15·266
Nitrogen	80·62	76·985
	100·00	100·000

The absence of carbonic oxide will be noticed, but it is obvious that on these trials too much air was passed into the furnace, as the percentage of unconsumed oxygen is high. This would of course have a cooling effect, and would lower the efficiency of the apparatus. With respect to the system of gas production in the boiler itself, we may refer to the method which has been employed by the London, Brighton, and South Coast Railway Company for the locomotives working the express trains to Brighton. Before leaving Victoria, the fire-box of the engine is filled with about 11 cwt. of coal, the fire being made up two hours before the train starts. The engine is brought to the train with a black fire, and after the stoker has pushed a dart through the whole depth several times, the fire is not touched until Brighton is reached. On arrival there is a very low fire, and if the train is delayed on the road the whole process of gas production is spoiled and ordinary firing has to be resorted to. The ashpan doors are made air-tight, and the front one is never opened unless absolutely necessary; the whole admission of the air is regulated by the back damper and the fire door. This is a case of a fire-box acting as a gas producer, but no greater distance than from Victoria to Brighton can be accomplished in this way, as the fire would need to be disturbed.

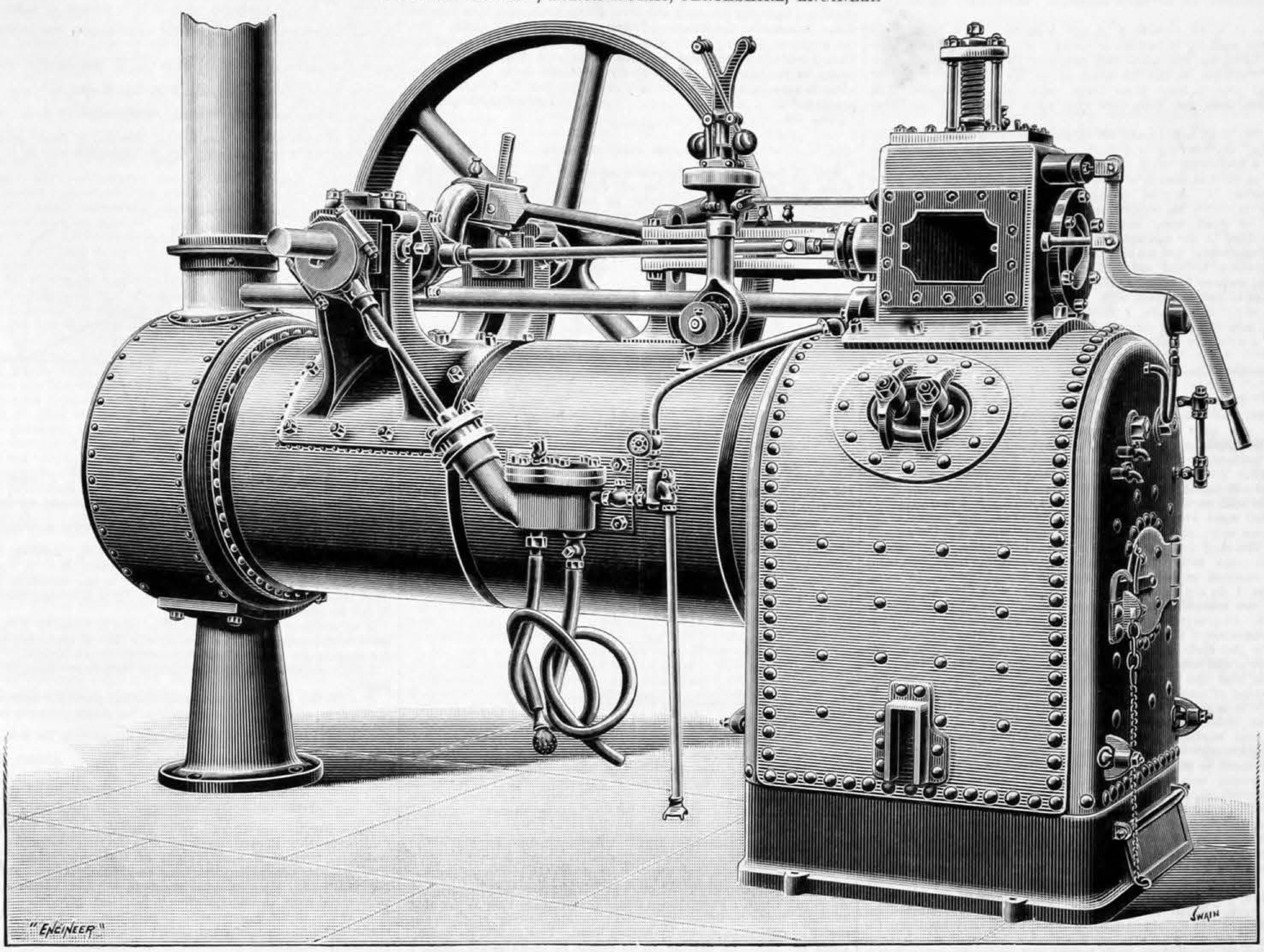
The design of Taylor's smokeless boiler appears to us to be a step in the right direction towards improved efficiency. We understand that a syndicate is now being formed to work the system.

CANALS AND NAVIGABLE RIVERS OF ENGLAND AND WALES.—We have received from the publishers a copy of the new map compiled by Mr. L. B. Wells, M.I.C.E., late engineer to the River Weaver Navigation, which for the first time places in the hands of engineers, a complete map of these navigable waterways. The canals and rivers are of different widths and depths, and therefore of different carrying capacity, are shown by lines of different thickness, while those, which may be considered derelict are practically abandoned canals including those in the hands of railway companies, are shown by dotted lines. The map is accompanied by a legend which gives the names, lengths, positions, and ownership of these canals, and is one which will be found of great value and importance to those now engaged in the Canal and Railway Rates Enquiry, and in investigations as to the possibilities of existing and projected inland waterways. Messrs. Geo. Falkner and Sons, Deansgate, Manchester, and 181, Queen Victoria-street, London are the publishers.

MASON COLLEGE ENGINEERING SOCIETY.—A general meeting of the above Society was held in Mason College, Birmingham, on Wednesday, May 23rd, Mr. R. J. Richardson in the chair. A paper on "Ironfounding" was read by Mr. John Ashford. The author remarked the small amount of scientific information obtainable on this subject, pointing out that to a great degree the practical experience of the workman is still solely depended on. The methods of moulding with greensand and dry sand were explained, and the various foundry sands and their preparation described. The relative advantages of mixing sands in the pug mill and by the Schultz mixer were discussed, the author pointing out the great economical efficiency of the latter. Stereo and plate patterns for repeat castings were shown and their use fully illustrated, the author concluding with a full description of the Lieder moulding machine, a working model of which was shown. The paper was illustrated by various models and drawings, and was followed by a discussion, in which Messrs. Richardson, Hawkins, Winn, De Villiers, and Waynforth took part.

SINGLE-CYLINDER SEMI-PORTABLE ENGINE

MR. R. G. MORTON, ERROL WORKS, PERTHSHIRE, ENGINEER



MORTON'S SEMI-PORTABLE ENGINE.

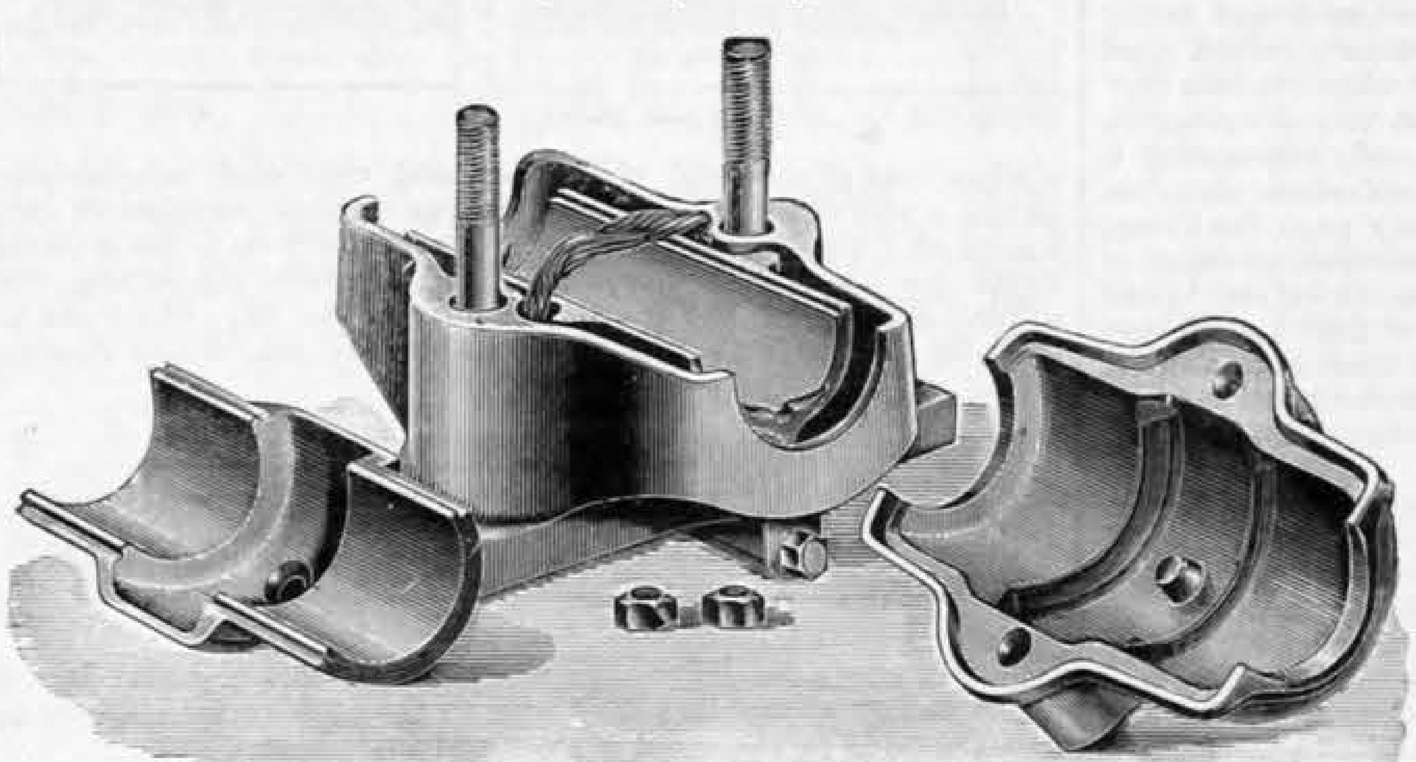
ABOVE we illustrate an improved single-cylinder semi-portable engine, made by Mr. R. G. Morton, Errol Works, Perthshire, from the designs of Mr. Duncan Morton. The materials used in its construction are of the very best quality, while the fit is perfect, and the finish leaves nothing to be desired. The cylinder is of hard, close-grained metal, steam jacketed by means of a 2½in. annular space run round it and forming a dome, from which it derives a constant supply of dry steam. The jacket is drained back to the boiler. The slide valve is of the double-ported Trick type, and can be examined while steam is up. By removing the dome cover which forms the safety valve seat, the regulator and throttle valve can be examined and adjusted. The piston is cast hollow, and fitted with two Ramsbottom spring rings. The piston and valve rods are of steel, the connecting rod and crosshead of finest scrap iron. All the working pins and joints are thoroughly case-hardened. The crank shaft, which is of steel and runs in heavy gun-metal bearings, is larger in diameter at the dip than in the body of the shaft. The governor, which is of the cross-armed type and loaded with a centreweight, controls the speed of engine by acting directly on a throttle valve. The feed pump is continuous acting, and is fitted with very large valves which rise only ⅛in., thereby reducing wear and tear to a minimum, and working noiselessly. In addition to the feed pump a graduating injector is provided, which can be regulated for any supply. The boiler is of the locomotive type, and made throughout of the finest Siemens mild steel; all riveting is done by machinery. All plates are flanged with large corners. The proportions of steam and water space are ample, and the firegrate is unusually large, being specially arranged for burning inferior fuel. This type of engine is made in all sizes, and with or without automatic expansion gear.

ETCHELL'S "NON DRIP" SHAFT BEARING.

WE illustrate herewith a shaft bearing, Etchell's patent, now being introduced by Messrs. Hudswell, Clarke and Co., of

Leeds. The engravings are almost self-explanatory. It will be seen that the brass, which is of the swivelling, or self-levelling type, has a cavity in which oil lies. Across the bearing rests a cotton wick which distributes the lubricant.

It is claimed that the bearing is very cheap, that there are



ETCHELL'S SHAFT BEARING

no oil cups and no drip, the arrangement preventing oil from running along the shaft to the outside of the bearing; one supply of oil will last for six months.

LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

ENGINEERING AS A PROFESSION.

SIR,—As you have invited discussion on the subject of "Engineering as a Profession," I see no reason why I should not call a spade a spade, and tell a few plain truths for the benefit of others like "Pater," whether they are acceptable or not to professors or to mechanical engineers as a body. As to civil engineering, which I have heard profanely defined as "glorified road-scraping," I have nothing to say, because I know next to nothing about it. *Ne sutor ultra crepidam*—let the cobbler stick to his last. I proceed to consider the position of the ingenuous youth who has been trained in a college, and has "gone through the shops," forsooth, as a gentleman apprentice.

This young man, if he has a head upon his shoulders, has made good use of his time. He has learned a great deal, and I shall assume that he finds himself placed in the position of manager of a department. The first thing he discovers is that the firm employing him make, let me say marine engines, by the dozen, and that they are all alike in every respect save size. There is a distinct set of patterns for each size of engine, and from one end of the year to the other engines are built from these patterns. Now and then small changes are made, never when it is possible to avoid them. None of my young engineer's college training is of the smallest use to him. The sole object of his existence is to get the largest quantity of work turned out on the old lines at the least cost. This is a science in itself, but it is never taught in colleges or schools, or books.

If any young man gets into a locomotive shop on a railway, he will find, as before, that there is no scope for theoretical knowledge. He may work for twenty years, and build a dozen types of locomotive, and never make a single calculation. Neither he nor anyone else wants to know how thick the shell plates should be, or how close the stays or how thick, or how many threads to the inch. All that was settled years and years ago; a little taking out of quantities is all the figuring that is needed. Even in the matter of testing, the whole affair is cut-and-dry for him. The one essential is —that he should be able to turn out the greatest possible quantity of work.

Now I assert, without fear of contradiction, that there is no scope for the display of scientific attainments in mechanical engineering in the present day. It is simply a matter of pounds, shillings, and pence. Machinery is no more scientific than blankets or tea. I hear it urged that surely such mechanism as that of the Havock, let me say, is certainly the result of science. I answer that it is not. It is the result of trial and error; the result of long and costly experiment. It is simply a survival of the fittest. I do not hesitate to say that there is not a portion of the machinery of a torpedo boat whose dimensions have been arrived at by calculation. Does anyone suppose that the steel framing has been calculated at so many tons per square inch of section Not a bit of it. Does anyone imagine that they will find in a book a rule based on calculation that will give them the dimensions of a torpedo boat crank shaft, or of a leading axle of a modern express locomotive? If they do they have everything to learn. All the so-called special mechanism that we see around us has grown. If there are any rules extant that can be taught, they have been deduced from the machines, not the machines from the rules. As for the other machinery of the world, it is all cut and dried. Nothing is taught in college or school that is of the least pecuniary value in this direction.

"Oh," but it will be said, "look at the new machines, look at the oil engine for instance." When I hear this I always laugh, I cannot help it. The oil engine has emanated from men who have had no scientific training. One of the best is the invention of a medical man. There is not a college professor in existence who ever invented one, or even hinted that one was possible. I do not think that any knowledge of thermodynamics has ever come to the aid of anyone making them. I do not believe that the makers of the best oil engines in the market could pass an examination in such subjects as those recently dealt with in your pages by Dr. Lodge. The scientific side of mechanical engineering has no existence out of the brains of professors.

I have said I would call a spade a spade, I do so. Mechanical engineering in the present day is not a profession, it is a trade. It has only one aspect, the commercial. It has been found that there is no money, but very much the reverse, in scientific mechanical engineering. What the young engineer wants is a knowledge of men; great forethought; an infinite grasp of the future, its eventualities and possibilities, discipline; organisation; zeal; perfectly in tune with every surrounding note, order. Let me explain. If work is to be turned out in quantity no department of the works must be idle; none run overtime to supply the demands of the remainder. The turnery must not be idle, waiting on the foundry for castings. The erecters and fitters must not be kept standing because they cannot get the work from the turners or planers. Just think what this means in a large establishment. Is it possible to overrate its importance? I tell you, Sir, and I tell your readers, that it is in this matter of keeping all going together that success lies. Firms have been ruined in a couple of years after long periods of prosperity, simply because of a change of management. I have known men to be dismissed because, forsooth, they were not engineers, and I have known the same men to be sought out and implored to return. Of course I cannot give names.

All this is quite outside a college training. It is not at all outside the training to be had in works. If a young fellow keeps his eyes open, he will soon find out why he and his mates are working overtime, on the one hand, or, on the other, are trying to ferret out jobs to keep them from being idle. Of course, if a young man does not keep his eyes open he will not see these things.

Now, Sir, in all this I have not referred to the question whether mechanical engineering is a good profession or not. I hold that it is not a profession at all—that it is a trade or business. But I will go on to add that it is simply first-rate for those who have really learned it. A good manager who can get out work up to the mark is worth his weight in gold. There is a never-ceasing demand for good men, but scientific mechanical engineers are simply a drug in the market. The Admiralty have been for years training engineers, and making men of science of them. They are now beginning to find out that all this is worse than useless, and that what suffices to pass the Board of Trade is good enough.

Perhaps at another time, with your leave, I may have a little more to say. Meanwhile, I should like to hear somebody else who will take the other side, and let us hear what the commercial value of a scientific training is, though I fear this is expecting too much.

DENARIUS.

Manchester, June 5th.

SIR,—"Pater's" letter deserves the attention of other paters and their sons, who propose to take up engineering as a profession. Parents who have had non-commercial careers, such as military, naval, clerical, and medical men, are too apt to gauge the advantages of the profession through contact with those who have been successful. Technical education is of value to every engineer, but that it is not absolutely essential is shown by the numbers of great engineers who have succeeded without it. This fact is overlooked more and more every day, and theoretical training seems to be introduced to avoid so-called shop drudgery, while it is the experience of this shop drudgery which is the key of engineering. Many lads are sent to work who loathe the sight of the shops, and seldom succeed in becoming more than draughtsmen. In using this term I do not refer to those engineers who through circumstances are compelled to work at the board for a draughtsman's pittance. At present quantity, not quality, rules the market. Your able article on "Design and Repairs" is, I regret, too true, and points to the fact that not only are many draughtsmen ignorant of the practical uses of machinery, and the principle of construction, but that the managers and principals are alike ignorant of the working of machinery they sell. The cause of this is not far to look for—it is simply the training. Of the large number of young men who enter the lists for engineering fame, only about one-fourth find workshop pursuits tasteful, and a large number of these fail through want of physical robustness; consequently their training must be either in the drawing-office or a college.

Such young men flood the market, and often obtain employment in preference to better men because they can make a drawing a little faster and neater, and will take a smaller wage than the man with shop experience, and also because so many engineering concerns are run by purely commercial men, whose only qualifications generally are cash or interest, and who imagine engineering to be a series of calculations. No account is apparently given to the cost of drawings made twice over, or the extra cost of unnecessary machining due to faulty designs, or the unfitness of machinery to do the work. While this lasts, young men cannot be blamed for following the less arduous college course, which only fits them for the board, generally at a salary less than a labourer, which from a monetary point does not justify the expenditure in costly college courses. They may eventually drift into positions of trust, at salaries which are a disgrace to those who pay them. I instance a firm who offered for the management of a works employing 200 to 300 hands, a salary of £200 to £250 per annum—about what a good plater can make at his trade. Through bad work and faulty design, this firm has had to make good machinery which must have cost many hundred pounds. Some day when too late they will realise their mistake. I do not imply that this is universal, but it is as well to know that, taking it all round, engineering is about the worst paid and hardest-worked profession there is. After years of struggle at a salary which barely pays for living, most engineers find themselves nearing the coveted position of trust, which often they do not get; many have, therefore, to end their days in bitter disappointment at a salary of £100 to £150 per annum, while the few who get the plums find them cut down for their benefit to £300 or £400 per annum—about the pension of an officer who would have probably retired at the age when the engineer has worked for and won his prize.

I do not wish to criticise employers on the salaries they pay. Times are bad, their profits are uncertain. One cannot blame them in struggling to cut their expenses down, but I think it is only right parents and lads should know that in following one of the finest, most interesting, and absorbing professions, that for a livelihood it is bad, that the door to good appointments is closed as a rule, without both large interest or capital. Chance may favour, and has favoured many men, but should not be relied on. Parents should, therefore, think twice before drifting their sons into an over-stocked and under-paid profession, and would do better to take the advice of those who may employ them, or from those who, like myself, are trying to make a living at it.

May 30th. MECHANIC.

BELLEVILLE BOILERS.

SIR,—We find that reports are being spread by persons who are evidently fearing the competition of the above boilers with those of the ordinary type, to the effect that the Lords Commissioners of the Admiralty have counter-ordered the large contracts that they have already placed for the manufacture of the Belleville boilers. There is absolutely no foundation for these reports, and as agents, and holding a concession for the manufacture of these boilers, we shall be glad if you will give publicity to this letter.

FOR MAUDSLAY, SONS, AND FIELD, LTD.,
WALTER H. MAUDSLAY,
Chairman.

London, S.E., June 1st.

THE BOARD OF TRADE UNIT OF ELECTRICITY.

SIR,—The Board of Trade unit of electricity is 1000 watts, that is a kilowatt, and I know that 746 watts = 1-horse power.

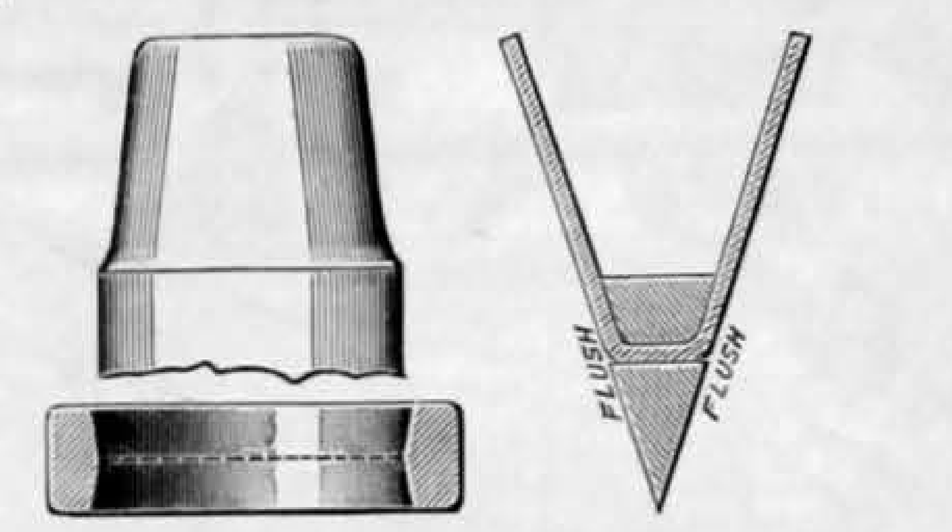
Now a watt is got by multiplying volts by ampères. The volt stands for "pressure," and the ampères for "quantity." In old times the term Coulomb was used, but as it was not the unit of electricity, but the unit of current that was to be measured, Coulomb was disused, and ampère was made to imply the second. That is to say, the ampère stands for the quantity of electricity given off per second by a dynamo at the stated pressure in volts. All this is very clearly set forth in MacFarlane's "Physical Arithmetic."

Now, what I am at a loss to know is, what does a Board of Trade unit mean electrically? Curiously enough, I have consulted electrical engineers and they tell me they really do not know, that it never struck them before. The question is this, is the kilowatt a time quantity or not? To put the question another way, suppose I have a dynamo with an output of 40 ampères at 2000 volts. That means $2000 \times 40 = 80{,}000$ watts, and represents $\frac{80{,}000}{746} = 107 \cdot 2$-horse power. Now, I want to know how long will that machine take to deliver 80 Board of Trade units? So far as I can see, inasmuch as all the quantities are expressed in seconds, it appears that the machine will deliver 80 units per second, or 4800 per minute, or 288,000 per hour. This cannot be right, because at 6d. a unit a single dynamo would earn a colossal fortune in one night. If we suppose that the minute is the factor, then the income would be £12 per minute, which again is nonsense. If I take the hour as the time, then the machine will earn £2 an hour, which is reasonable. Nominally, the Board of Trade unit is 1000 watt hours. But the watt has nothing to do with hours; it is a seconds quantity. Then I want to know what has this to do with the kilowatt? It seems to me that the unit is really 3,600,000 watts. The whole affair is very confusing. Will any reader of THE ENGINEER help a perplexed TOWN COUNCILLOR.

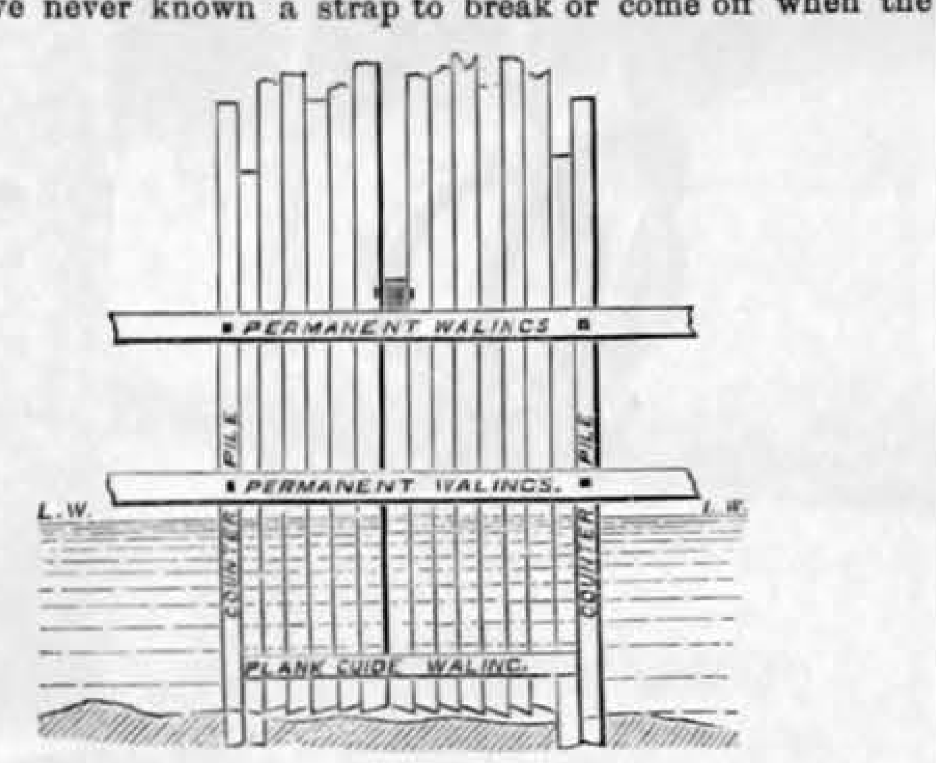
June 6th.

PILES AND PILE DRIVING.

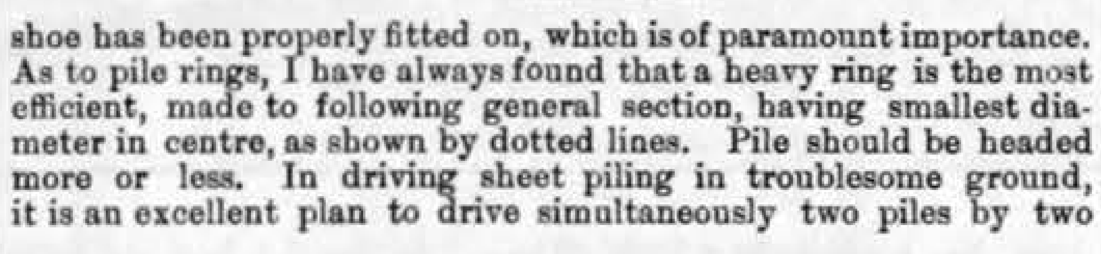
SIR,—I have read the excellent paper by Mr. J. R. Baterden, Assoc. M. Inst. C.E., on "Piles and Pile Driving," and am glad to see this much neglected subject so fully and ably dealt with. Having had large experience in various kinds of pile driving in many parts of the world, I venture to offer the following remarks



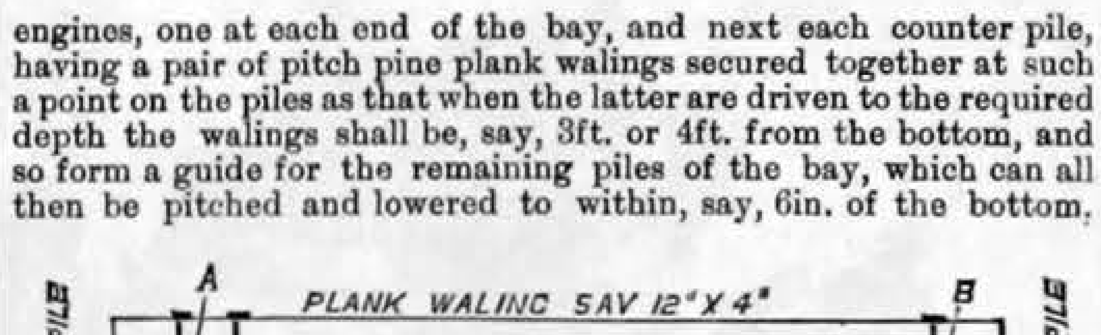
which you may possibly consider interesting to your readers. With reference to the shoes, I have always found that when the piles have to be driven through difficult ground, the straps of wrought iron should not be riveted to the casting, but simply run through slots left in the casting and then bent to required angle, one piece of iron forming two straps. In this case no rivets are necessary, and I have never known a strap to break or come off when the



shoe has been properly fitted on, which is of paramount importance. As to pile rings, I have always found that a heavy ring is the most efficient, made to following general section, having smallest diameter in centre, as shown by dotted lines. Pile should be headed more or less. In driving sheet piling in troublesome ground, it is an excellent plan to drive simultaneously two piles by two



engines, one at each end of the bay, and next each counter pile, having a pair of pitch pine plank walings secured together at such a point on the piles as that when the latter are driven to the required depth the walings shall be, say, 3ft. or 4ft. from the bottom, and so form a guide for the remaining piles of the bay, which can all then be pitched and lowered to within, say, 6in. of the bottom,

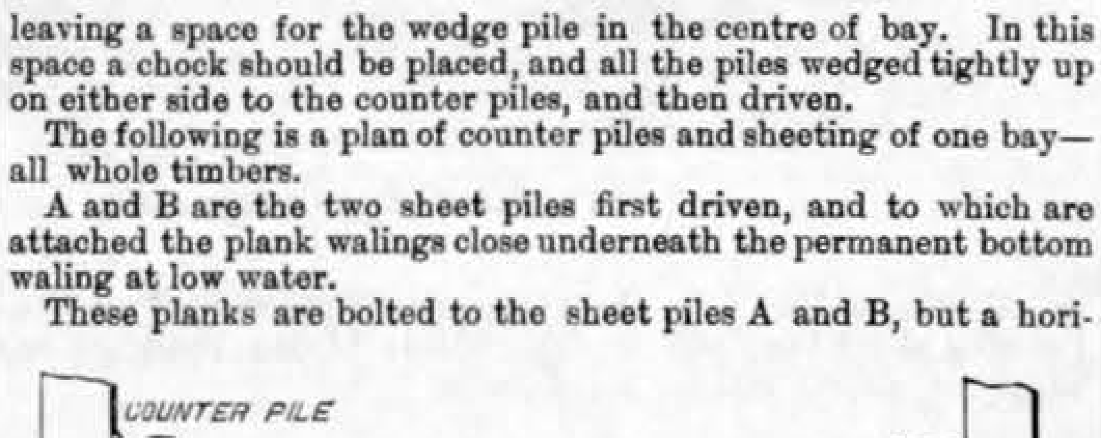


leaving a space for the wedge pile in the centre of bay. In this space a chock should be placed, and all the piles wedged tightly up on either side to the counter piles, and then driven.

The following is a plan of counter piles and sheeting of one bay—all whole timbers.

A and B are the two sheet piles first driven, and to which are attached the plank walings close underneath the permanent bottom waling at low water.

These planks are bolted to the sheet piles A and B, but a hori-



zontal slot is made in the planks to allow of play in case the bay is not quite rectangular. The planks come slightly on counter the piles, which thus serve as guides.

As Mr. Baterden remarks, the subject of pile driving is a very extensive one, and a great deal remains to be said; but I will not now take up more of your valuable space. SAML. H. AGNEW.

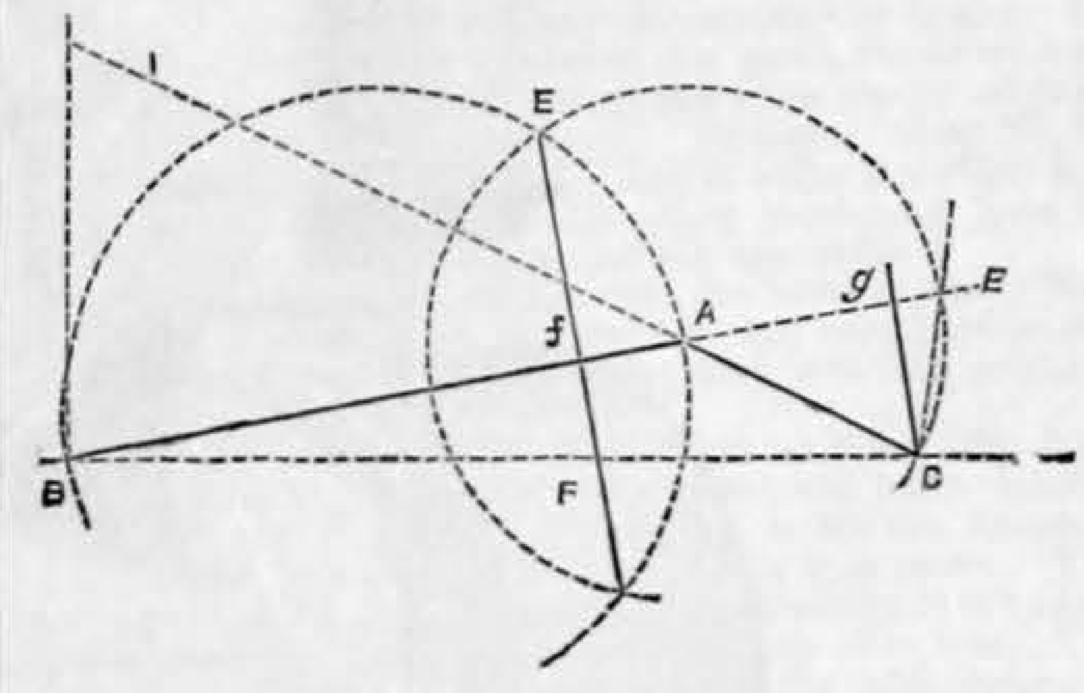
London, June 2nd.

INERTIA OF THE RECIPROCATING PARTS OF A STEAM ENGINE.

SIR,—The very simple graphical construction of Professor J. F. Klein, Lehigh University, for the determination of the acceleration of the piston of a steam engine, seems to be little known on this side of the Atlantic, as several new text-books have appeared since its publication—*Journal* of the Franklin Institute, September, 1891—in which the analytical treatment of the subject is given, or the less simple graphic method of Ritterhaus.

The following is Klein's construction:—Let O A and A B be the crank and connecting-rod in any position. Let the lengths of the crank and connecting-rod be r and l respectively. Produce the connecting-rod B A to cut the perpendicular O E to the line of stroke. With A as centre and A E as radius draw a circle; on A B as diameter draw another circle, and let the common chord of the two circles cut the line of stroke in F. Then F O is the acceleration of the crosshead to the same scale as O A represents the centripetal acceleration of the crank-pin.

The demonstration is as follows:—The motion of the crosshead B may be compounded of two motions: (a) A motion of constant velocity V in the crank-pin circle; (b) a motion of rotation about A with angular velocity $\frac{V}{A\,l}$. The acceleration due to the motion (a) is $\frac{V^2}{r}$, and is in the direction A O. If the scale of velocity be chosen so that V is represented by the length A O, the acceleration $\frac{V^2}{r}$ may also be conveniently represented by A O. The component of this acceleration in the direction of the connecting-rod will then be A g, O g being drawn perpendicular to A E. The



radial acceleration due to the motion (b) is $\frac{V^2}{A\,l^2}\,l$, and, making the same assumption as to scale, will be represented by the length $\frac{A\,E^2}{A\,B} = f\,A$, since $\frac{f\,A}{A\,e} = \frac{A\,e}{A\,B}$. The tangential acceleration due to (b) has no component in the direction A B. Adding, the component of B's acceleration in the direction B A is $f\,g$. But, obviously, the total acceleration of B is in the direction B O, and must therefore be equal to F O, since $f\,g$ is the component of F O in the direction B A.

If an ordinate be drawn from B of length equal to F O, and the construction repeated for a number of different crank-pin positions, the rectangular curve of piston acceleration is obtained.

Klein's construction does not fail, as Ritterhaus' does, at the dead points.

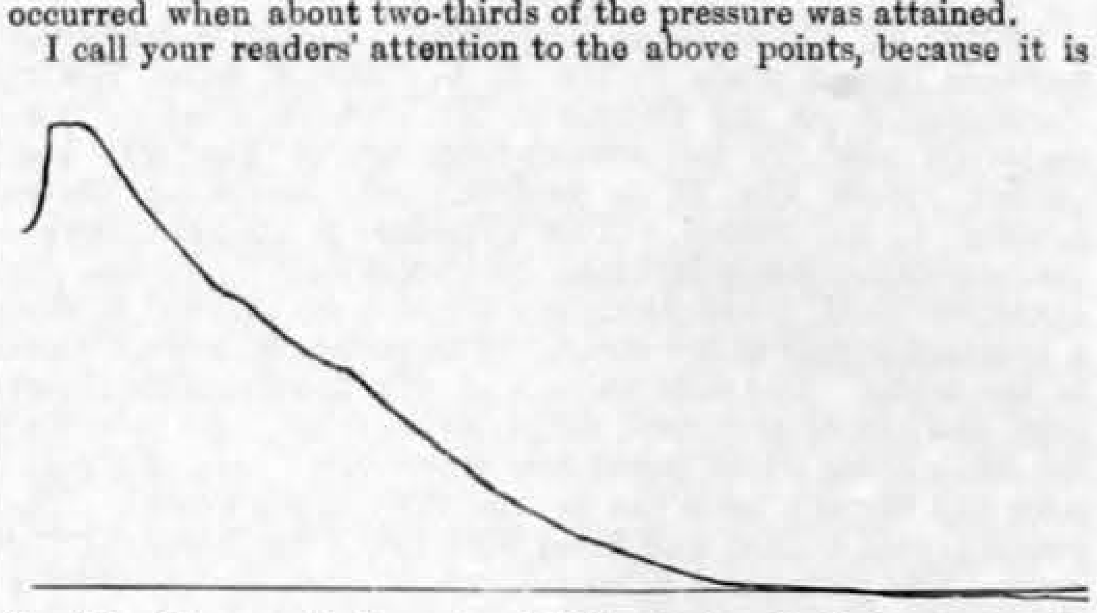
If w be the weight of the reciprocating parts per square inch of piston area, and f be the acceleration, the steam pressure in pounds per square inch required to accelerate the moving parts is $\frac{w\,f}{g}$.

Guilds Central Technical College, ARCHD. SHARP.
May 31st.

PORTLAND CEMENT-MAKING MATERIALS.

SIR,—Permit me to call your attention to an inaccuracy in "Molesworth's Pocket Book of Engineering Formulæ," under heading, "Strength and Weight of Materials," item "Chalk." Two samples are given, weighing respectively 145 lb. and 162 lb. per cube foot. My own experiments in weighing numerous blocks, as received from various quarries in England, give results varying from 110 lb. to 126 lb. according to moisture present. The crushing strain was also experimented upon; 3in. cubes were submitted to gradually increasing pressures in a hydraulic press, with clock-work-driven Richards indicator attached. The crushing strains varied from 500 lb. per square inch to 220 lb. per square inch; Molesworth gives 501 lb. In most cases a preliminary breakdown occurred when about two-thirds of the pressure was attained.

I call your readers' attention to the above points, because it is



Crushing Diagram of a 3in. cube of White Chalk. Vertical scale, 3456 lb. per inch. Horizontal scale, 5in. per minute. Datum line = Pressure to balance ram and friction.

a very common error to consider a cubic yard and a ton as about the same thing; and because the importance of testing the strength of the material seems up to the present to have been completely ignored, both by purchasers of chalk and designers of chalk-breaking and washing machinery. The foregoing experiments also go far to clear up the apparent anomaly of some Portland cement works taking double the horse-power per ton for their wet washing and grinding that is found to be developed under similar circumstances by other factories using what are nominally the same materials. I enclose a tracing of one of the autographic diagrams referred to, showing two preliminary yield points, then a general yielding without reduction of pressure, and finally a sudden and complete collapse. PERCY J. NEATE.

Rochester, June 4th.

OIL FUEL AT SEA.

SIR,—In the *Scientific American* supplement for the 19th inst. there is published an account—credited to you—of liquid fuel burning on the steamer Baku Standard, by Mr. A. Suart.

We enclose a printed sheet of the rig for burning oil—which was the suggestion for our painting machines as used at the Columbian Exposition in Chicago. It has been suggested that this way of spraying oil might be of service to Mr. Suart, as it would save the steam now used to spray the oil into the furnace. The statement is made that the loss of steam is one of the drawbacks in his work. In spraying oil in the way shown the only power consumed is that needed to drive the blower, which is nothing compared to the steam used to obtain the same jet. One of our blowers consuming ½-horse power will spray 40 to 60 gallons of oil per hour. The oil tank is below the blower and jet pipe into the furnace, and may be any distance away from the blower, say 60ft. outside the walls of the building, which is the requirement of insurance companies. They also require that the oil supply shall be below the fire. In the make-up of this rig we comply with these conditions. When the blower is not running the oil will sink to the level of the oil in the tank. Upon starting the blower the air pressure at the stop valve, acting through the small pipe to the gauge and the top of the oil tank, forces the oil out of the bottom, and by way of a small pipe to a valve located over the air inlet to the blower. This valve regulates the amount of oil fed to the blower, which breaks it up, mingles it with the air, and forces it to the fire by way of the jet pipe, which pipe may be made to pass to the back, and then forward, so as to heat the gas before delivery to the fire. The result of this plan of work is that we can at all times get a perfect combustion of the oil fed in any amount needed to do the work, by the use of the most simple devices, which will take care of themselves, there being no small openings to gum up or clog. If the feed is adjusted to the amount of oil wanted the thing is automatic.

35, W. Fourteenth-street, New York City, May 24th. T. G. TURNER.

THE INDIANA ARMOUR PLATES.

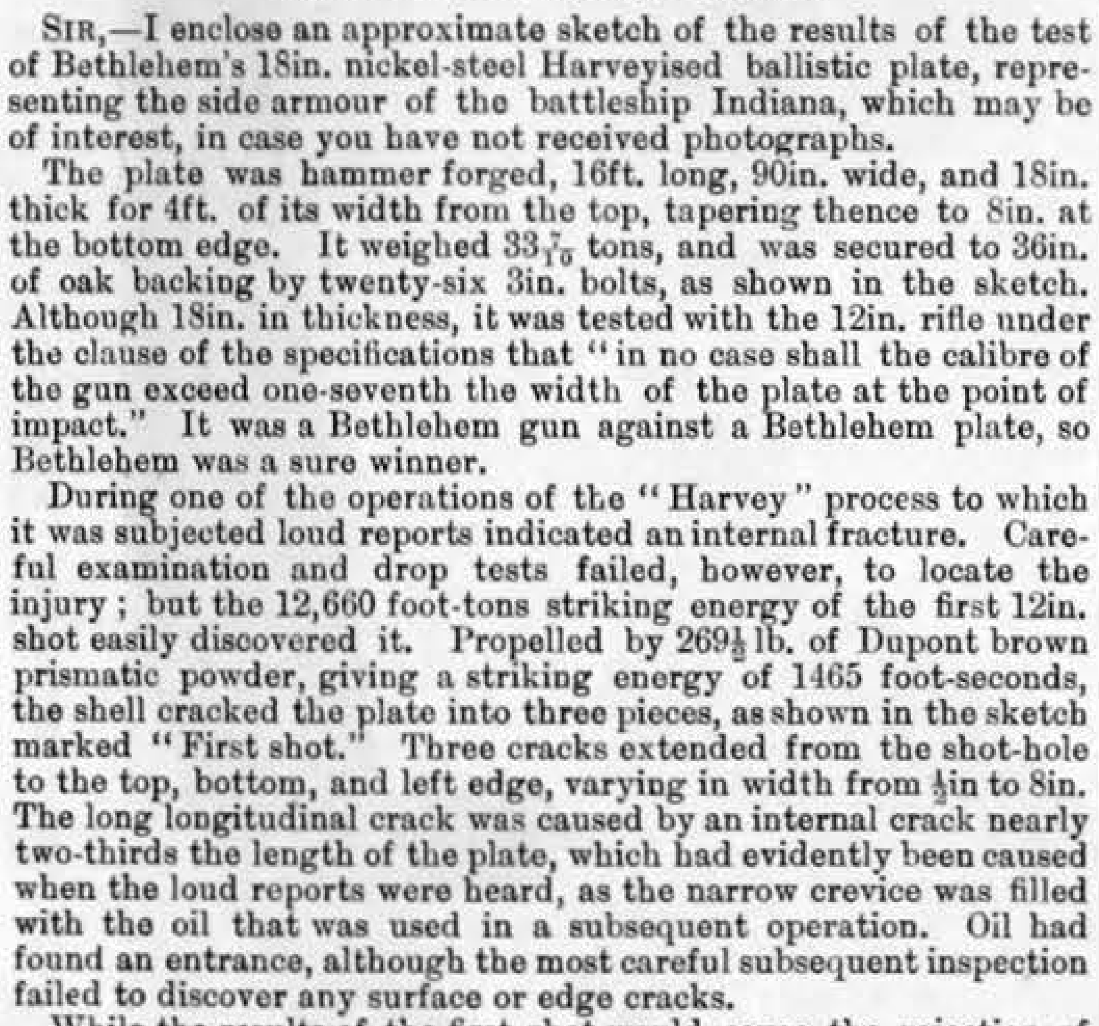
SIR,—I enclose an approximate sketch of the results of the test of Bethlehem's 18in. nickel-steel Harveyised ballistic plate, representing the side armour of the battleship Indiana, which may be of interest, in case you have not received photographs.

The plate was hammer forged, 16ft. long, 90in. wide, and 18in. thick for 4ft. of its width from the top, tapering thence to 8in. at the bottom edge. It weighed $33\frac{7}{10}$ tons, and was secured to 36in. of oak backing by twenty-six 3in. bolts, as shown in the sketch. Although 18in. in thickness, it was tested with the 12in. rifle under the clause of the specifications that "in no case shall the calibre of the gun exceed one-seventh the width of the plate at the point of impact." It was a Bethlehem gun against a Bethlehem plate, so Bethlehem was a sure winner.

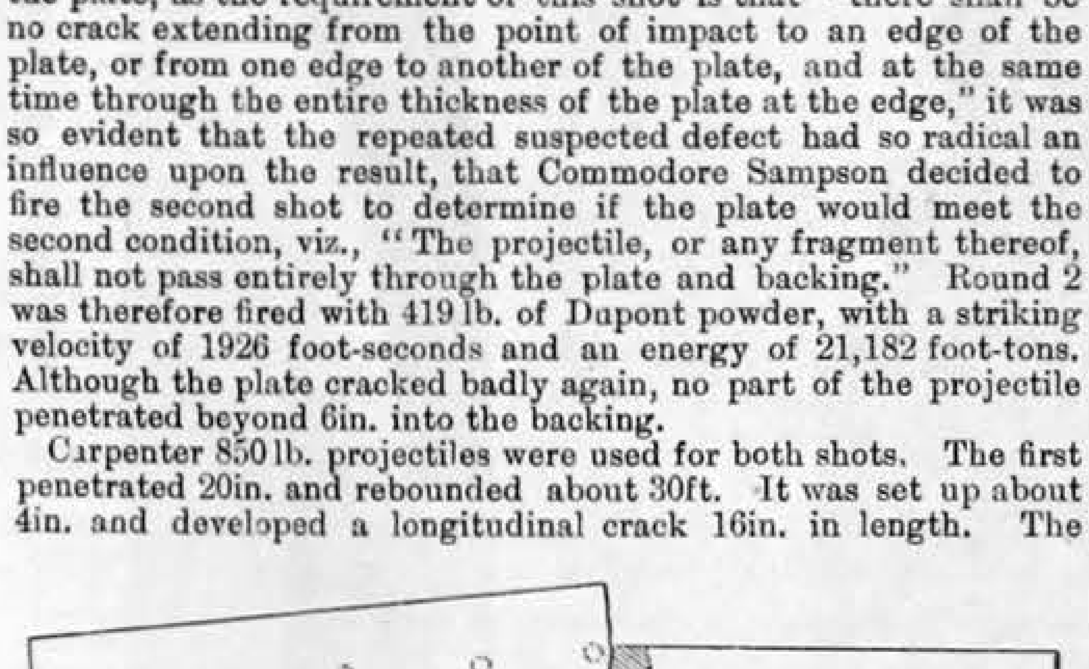
During one of the operations of the "Harvey" process to which it was subjected loud reports indicated an internal fracture. Careful examination and drop tests failed, however, to locate the injury; but the 12,660 foot-tons striking energy of the first 12in. shot easily discovered it. Propelled by $269\frac{1}{2}$ lb. of Dupont brown prismatic powder, giving a striking energy of 1465 foot-seconds, the shell cracked the plate into three pieces, as shown in the sketch marked "First shot." Three cracks extended from the shot-hole to the top, bottom, and left edge, varying in width from $\frac{1}{8}$in to 8in. The long longitudinal crack was caused by an internal crack nearly two-thirds the length of the plate, which had evidently been caused when the loud reports were heard, as the narrow crevice was filled with the oil that was used in a subsequent operation. Oil had found an entrance, although the most careful subsequent inspection failed to discover any surface or edge cracks.

While the results of the first shot would cause the rejection of the plate, as the requirement of this shot is that "there shall be no crack extending from the point of impact to an edge of the plate, or from one edge to another of the plate, and at the same time through the entire thickness of the plate at the edge," it was so evident that the repeated suspected defect had so radical an influence upon the result, that Commodore Sampson decided to fire the second shot to determine if the plate would meet the second condition, viz., "The projectile, or any fragment thereof, shall not pass entirely through the plate and backing." Round 2 was therefore fired with 419 lb. of Dupont powder, with a striking velocity of 1926 foot-seconds and an energy of 21,182 foot-tons. Although the plate cracked badly again, no part of the projectile penetrated beyond 6in. into the backing.

Carpenter 850 lb. projectiles were used for both shots. The first penetrated 20in. and rebounded about 30ft. It was set up about 4in. and developed a longitudinal crack 16in. in length. The



1ST SHOT



2ND SHOT

second penetrated the plate and 6in. of the backing, the forward two-thirds was broken, twisted, and partly welded into the plate and itself, the rear third being broken into several longitudinal fragments. As diametrically opposite opinions regarding the value of the Harvey process have been reported as emanating from me, I shall be glad to tell you what I have said on the subject. The views against Harveyising thick plates accredited me were not based upon the results of the test of the Bethlehem 18in. plate at Indian Head, May 19th. This was a mere incidental endorsement of the opinion I have often expressed in my lectures, writings, and conversation.

While we have abundant and reliable data relating to the penetration and perforation of plain steel and nickel steel plates of nearly all the thicknesses that are liable to enter naval construction, we have very little information regarding the cracking and shattering effects of the larger calibres attacking surface-hardened homogeneous plates at very high energies. The action of the few plates that have been tested led me some time ago to express the opinion that, "The greater value of carbonisation was with the thinner plates, and that although the recent development has been chiefly in the direction of securing a harder face to the homogeneous steel plates there still remains two types for comparison, that of a resistance which will keep out a projectile of any calibre if thick enough, and that which will destroy the projectiles until a calibre is reached whose smashing and racking energy will demolish the protection, although perhaps at the risk of its own destruction."

I think there is a limit to the thickness of the plates that can be advantageously Harveyised. Just what that limit is we have not yet had enough experience to determine. There are reasons for doubting its usefulness for plates above 12in., and the best 12in. plate that has ever been Harveyised cracked badly when struck with a 10in. projectile having a striking energy of 13,564 foot-tons. Not only is the thickness of the hardened surface less in proportion to the thickness of the plate, but the larger masses of steel, when subjected to the sudden shocks of water-hardening, are more liable to initiate defects or develope minor ones that may occur in the ingot, which, in the condition they exist after forging, might not sensibly decrease the ballistic resistance.

Further, any minor defect that may occur before carbonisation is liable to be developed into an injurious one during the very long period the plates are undergoing the process of carburisation. Furthermore, the withdrawal of 30 tons of steel from the blacksmith's forge, and dipping into a bucket of water, carry many more risks than the dressing of an ordinary tool; these risks must have their influence in determining the thickness of plates that are to be subjected to this unnatural treatment.

As to the value of carbonisation of plates of certain thicknesses there appears to be no doubt, and I gave prominence to its employ only as early as 1891, in a paper prepared for the British Iron and Steel Institute. Its value in destroying projectiles of calibres up to and sometimes including 10in. calibre, assuring a decrease in the weight of armour to be carried for protection against these calibres, cannot be over estimated, but we have not yet enough practical evidence to say if its application to the thicker plates will be finally adopted. While the defect in the plate on test of May 19th was suspected by the action of the plate during treatment, and was a prominent cause for its rejection, although there may have been a want of uniform chemical distribution in the ingot or some piping remaining after forging, all the opinions expressed agree that the final defect which was so prominent in causing the failure of the plate was the result of one of the operations of Harveyising. Other thick plates selected for ballistic test will no doubt perform better than the 18in. plate in question, but I believe 13in., 12in., and even 10in. armour-piercing shells, attacking at service energies, will crack the Harveyised plates, and although increasing the number of bolts may keep the cracked pieces in position, we find ourselves back again to the old discussion of which is the least objectionable, considerable penetration or cracks. No matter what future tests may decide, one thing is certain, the calibres and energies of guns must be increased, not diminished. W. H. JAQUES.

South Bethlehem, Pa., May 22nd.

THE MAXIM BREAST-PLATE.

SIR,—As there has been so much in the papers during the last week regarding me and my cuirass, I think it is nothing more than right than that I should give my friends connected with the scientific world a few facts relating to the affair.

During the past few months a great deal has appeared in the English Press concerning a new bullet-proof cloth or bullet-proof coat which had been invented by a German tailor. The device, however, instead of being a bullet-proof cloth or coat is, I believe, simply a piece of armour-plate sewn up in a bag. Had it been brought to England and exhibited at a music hall as a clever juggling trick, it might have been highly amusing to the unscientific, who are not acquainted with the laws of dynamics. But they were not content to exhibit the thing in its legitimate sphere; they entered the realm of science, claimed that it was a new scientific discovery, and succeeded in getting some of the best men—from his Royal Highness the Commander-in-Chief down—to see their experiments. The great number of high officials and scientific and technical men who went to see it, and the publicity that was given to it by the Press, brought it before everybody, and the claim set forth was an open challenge to me as much as to any other scientific man in England. I saw the game at once, and claimed that I had something better and lighter, the secret of which I would sell for 7s. 6d. cash, and that the substance which I proposed to use was a compound of organic and inorganic matter. This was set forth in a letter which I wrote to the newspapers, and I offered to show my alleged invention and to sell the secret on a certain day.

On that occasion the London terminus of the railway that runs to Erith was simply overwhelmed with people wishing to go to Erith, and the number that went was only limited by the transportation facilities that the railway was able to offer. Many went to towns near Erith, and walked across country. Some of my friends who were on the train have informed me that everybody was talking about it, saying that Mr. Maxim was a very clever man, that he had probably made a very marvellous invention, and that ironclads would likely go out of use because he probably had some very light bullet-proof cloth that would resist all kinds of shots, even from large guns. One gentleman was anxious to have a complete suit of Mr. Maxim's new cloth, to wear under evening-dress, so that he could stand up and be shot at from all sides with a military rifle—to amuse his friends. I must confess I had not the remotest idea that my 7s. 6d. cash secret would be taken in such dead earnest.

The crowd that assembled at Erith was so great and so unruly that it was impossible to conduct the experiments in anything like a satisfactory manner, and notwithstanding that I had a considerable number of men to assist me, the crowd broke down all barriers, mounting my table and swarming over everything. I had provided myself with scales and a 2ft. rule, and I asked the gentlemen to stand back and allow me to show them what my cuirass measured and how much it weighed. I said I had agreed to make something which would beat Herr Dowe's cuirass, and to employ certain organic and inorganic substances, and I had found that the most suitable inorganic substances were iron and nickel, and for the organic substance a small percentage of carbon. When, however, they found out that my cuirass was nothing but a steel plate in a bag, that the process of manufacture which I described to them was nothing but the process of steel making, they were exceedingly indignant, and about 100 of them headed by a very pompous officer, who had come down with two orderlies, left in a great huff. They were perfectly furious, and said they had been sold. About 600 remained behind, and a large number of shots were fired at the cuirass, which had a larger protected area for its weight than Herr Dowe has ever shown. It was simply a piece of very fine highly-tempered steel $\frac{1}{4}$in. thick. Two shields were shown, one sewn up in a bag, and the other covered with felt.

At Herr Dowe's demonstration on the night of the 5th inst., to prove that his cuirass was all that he claimed for it, the area actually fired at was about 8in. by 11in., and it was claimed that the weight was $11\frac{3}{4}$lb. They, however, would not submit to the 2ft. rule and scales.

We are now able to provide armour-plates for the Maxim guns which will stop the small bore projectile, and which weigh 7 lb. to the square foot, and this, I think, all scientific men would be willing to back against all other substances, weight for weight.

I hear from Germany on pretty good authority that Herr Dowe's armour-plate is a piece of very hard aluminium bronze, but this, as we all know, is never quite as strong as good steel. The amount of abuse which I have received for giving away this little trick is simply wonderful. Had I been a pirate and sunk half the ships on the Thames it could not have been worse.

I notice in this morning's papers that the general manager of the Alhambra says that no one has ever said that Dowe's cuirass is formed of fibrous material only, but in your issue of June 1st you say:—"It is said to contain not only no iron or steel, but no metal of any kind." HIRAM S. MAXIM.

June 6th.

JOY'S FLUID VALVE GEAR.

SIR,—I regret that your correspondent Mr. S. J. Ross has seen fit to assume the pseudo-jocular style in his letter in your issue of June 1st. In such form I must decline altogether to carry on the correspondence, which so conducted could have no practical end, so far as your readers are concerned. I am in earnest and have plenty of earnest practical work to do. Hitherto I have answered all questions in good faith, and some of those which your correspondent now repeats had been already answered in my last and other letters. Has he not noticed this? My confidence in my new plan seems to offend him, but it is based on very crucial and positive tests; and I do claim that I have some right to speak with confidence on this special question under discussion after the care I have devoted to it, and after so long an experience as I have had in this class of pioneering work, of which my old valve gear is an instance.

Many of the details, however, against which your correspondent tilts so recklessly are not my own, but have been adopted after criticism and discussion with abler men than myself, and with whom I am in treaty for the introduction of the plan on a large scale. I repeat that I welcome fair criticism made with the *bonâ fide* object of getting at information, but of this mere "picking to pieces," for the sake of "picking to pieces," I must decline to take any further notice. Your correspondent says he "has handled a few engines, and knows pretty well what they are," but he cannot know much about my new system, and I think he would have found that he had yet something to learn had he accepted my invitation, which I now do not repeat. DAVID JOY.

17, Victoria-street, Westminster, June 6th.

SALE OF MATERIALS OF THE ALBERT PALACE AND CONNAUGHT HALL.

SIR,—As the last issue of your paper contained a most erroneous report of our recent sale, may we be allowed to place before you the actual facts.

The glass, after being taken down, packed, and removed, would give the purchaser an extremely small margin of profit, and we valued it at *nil*, though we succeeded in obtaining some £50 for it—exclusive of the glass on the roofs, which was sold with the ironwork. The floor boards realised 5s. per square, at which price new can be purchased. Joists fetched £4 per standard, and new can be bought for £5. As for the ironwork, about 800 tons sold for £900, and the cost of getting it down, estimated at about 20s. a ton, falls on the purchaser. The hot water piping sold for £3 10s., whereas new can be purchased for £5. The zinc on the roof sold for nearly £14 per ton. The whole of the materials realised equally satisfactory prices, and exceeded the estimate made previous to the auction by about 40 per cent.

HORNE, SON, AND EVERSFIELD.

85, Gresham-street, E.C., June 6th.

ADAMS' SEWAGE LIFT.

SIR,—May I add a few words to the description you give of our "Sewage Lift" in your last issue? The automatic syphon mentioned has *no* moving parts—as this would seem to imply—but is our ordinary deep-trap syphon as used for sewer and flushing, depending only upon the liquid reaching the desired level in the tank.

The arrangement adopted for allowing exit of liquid from the air chamber when full is simple, briefly a spindle valve is closed against the less pressure, that of the column of liquid in the rising main and opened by the greater pressure, that of the column of liquid in the air chamber. To secure this increase of pressure the connection between the two chambers is severed by a ball valve, which floats into position as the air chamber fills.

S. H. ADAMS.

Old Queen-street, Westminster, S.W., June 2nd.

THE INSTITUTION OF CIVIL ENGINEERS.

THE Council of this Society has made the following awards for papers read and discussed during the session 1893-94:—

A Telford Medal and a Telford Premium to William John Bird Clerke, B.A., C.I.E., M. Inst. C.E., for "The Tansa Works for the Water Supply of Bombay."

Telford Medals and Telford Premiums to James Henry Greathead, M. Inst. C.E., and Francis Fox,[1] M. Inst. C.E., of Westminster, for "The Liverpool Overhead Railway."

A George Stephenson Medal and a Telford Premium to Thomas Parker, M. Inst. C.E., of Wolverhampton, for "The Electrical Equipment of the Liverpool Overhead Railway."

A Telford Medal and a Telford Premium to Henri Léon Partiot, of Paris, for "Estuaries."

A Watt Medal and a Telford Premium to Robert Edden Commans, Assoc. M. Inst. C.E., for "The Concentration and Sizing of Crushed Minerals."

A Telford Medal and a Telford Premium to Professor Franz Kreuter, of Munich, for "The Design of Masonry Dams."

A Telford Premium to Boverton Redwood, F.R.S.E., Assoc. Inst. C.E, for "The Transport of Petroleum in Bulk."

A Telford Premium to William Colquhoun, Assoc. M. Inst. C.E., for "The Manufacture of Briquette Fuel."

A Telford Premium to Charles Hunt, M. Inst. C.E., for "The Construction of Gas Works."

A Telford Premium to Leveson Francis Vernon-Harcourt,[2] M.A., M. Inst. C.E., for "The Training of Rivers, illustrated by the Results of various Training Works."

For Papers Printed in the Proceedings without being Discussed:—A Watt Medal and a Telford Premium to Bryan Donkin, M. Inst. C.E.,[3] for "Experiments on the Condensation of Steam in Cylinders of Iron and other Metals."

A Telford Medal and a Telford Premium to Sidney Richard Lowcock, Assoc. M. Inst. C.E., for "Experiments on the Filtration of Sewage."

A Telford Medal and a Telford Premium to Sakuro Tanabe, M.E., Assoc. M. Inst. C.E., for "The Lake Biwa-Kioto Canal."

A Telford Premium to Henry Ewart. M. Inst. C.E., for "The Maligakanda Service Reservoir, Colombo."

A Telford Preminm to John Mitchell Moncrieff, Assoc. M. Inst. C.E., for "The Design and Construction of Dock Gates of Iron and Steel."

A Telford Premium to George Croydon Marks, Assoc. M. Inst. C.E., for "Cliff Railways."

For papers read at the supplemental meetings of students, the Miller Scholarship, tenable for two years, has been given to Leonard Hodgson Appleby, Stud. Inst. C.E., for his paper on "Forms of Tensile Test Pieces," and Miller Prizes to Arthur Robert Gale, Stud. Inst. C.E., for "Refrigerating Machines;" to Walter Beer, Stud. Inst, C.E., for "Ship Slipways;" to William Garnys Wales, Stud. Inst. C.E., for "Discharging and Storing Grain;" and to Henry Thomas White, Stud. Inst. C.E., for "The Sinking of the Cylinder Foundatians of the Trent Viaduct under Compressed Air."

For papers read before local associations of students, Miller prizes have also been awarded to Pierce Joseph Tucker, Stud. Inst. C.E., of Birmingham, for "Locomotives in Regard to Speed;" to Henry Newmarch Allott, Stud. Inst. C.E., of Manchester, for "Cylinder Foundations;" to Arthur Watson, Stud. Inst. C.E., of Manchester, for "The Salford Widening of the Lancashire and Yorkshire Railway;" to William Orr Leitch, jun., Stud. Inst. C.E., of Glasgow, for "The Renewal and Maintenance of Short-span Bridges;" and to Thomas Harkness Watt, Stud. Inst. C.E., of Glasgow, for "The Lanarkshire and Dumbartonshire Railway." It has been determined to print the first three students' papers, either in whole or in part, in the "Minutes of Proceedings."

POWER FROM ARTESIAN WELLS.—In several cases of artesian wells, where the well pressure is considerably over 100 lb. per square inch, the water is used for driving electric light plants and flour mills, through the intervention of water-wheels. In England, says *Cassier's Magazine*, the driving of water-wheels by artesian well supply is not unknown, and in at least one case an overshot wheel has been operated by the water from such a well for more than twenty years, driving a colour-grinding mill and other machinery. The subject calls to mind a similar use which has been proposed for natural gas in the early days of gas well development. The gas issued from many of the wells at pressures of from 60 lb. to 80 lb. per square inch, and it was thought quite possible to use it, first in the cylinders of engines as a motive power, and then to exhaust it into storage reservoirs, from which it could be drawn afterward for heating. The gas in at least one of the districts was actually used in this way, being put directly into engines, and for a number of years gave apparently quite satisfactory results. One drawback to the method, however, resulted from the fact that the gas, as it issued from the wells, carried with it more or less sand, which must have worked serious harm in the cylinders by cutting the walls and pistons.

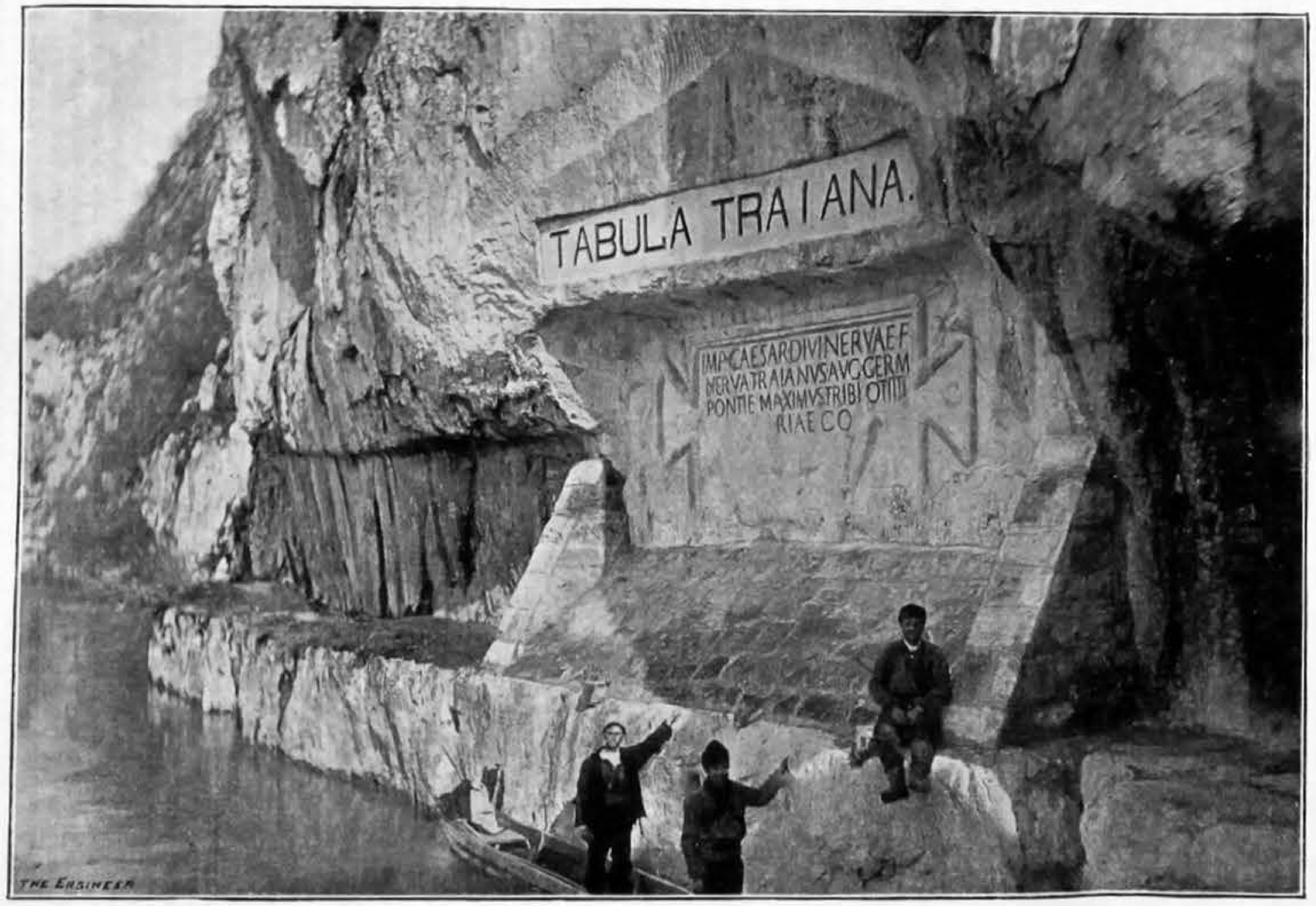
[1] Has previously received Telford and George Stephenson Medals and Telford Premiums.
[2] Has previously received a Telford Medal and Telford and Manby Premiums.
[3] Has previously received Telford Premiums.

VIEWS OF THE WORKS FOR THE REGULATION OF THE DANUBE

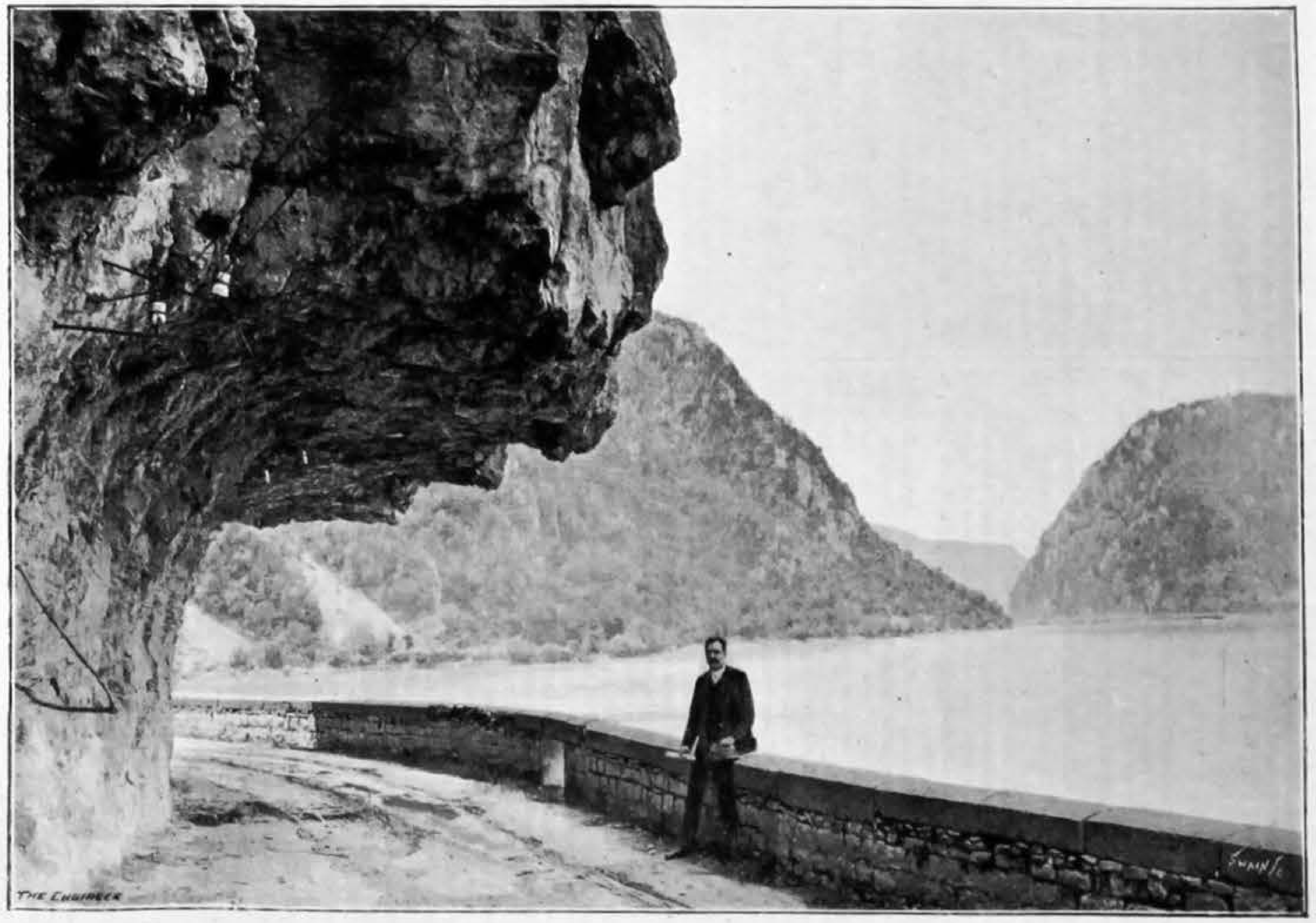
(*For description see page* 496)

EXCAVATION OF THE IRON GATE CANAL

THE GREBEN TIP OF THE HONE DAM—LOWER GREBEN



THE TABLE OF TRAJAN IN THE STRAITS OF KAZAN



THE PASSAGE OF KAZAN WITH THE "SZECHENYI" WAY

CONTENTS.

THE ENGINEER, June 8th, 1894.

TO CORRESPONDENTS.

Registered Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."

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

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

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

X. Y.—*About twenty seven miles an hour. Write to Mr. De Vignes, Chertsey.*

P. G. H. (Bournemouth).—*The distance of the horizon in statute miles is found by the formula* $S = 1{\cdot}42\sqrt{H}$, *where* S = *miles and* H = *height in feet. Objects such as ships being much higher than the horizon are, of course, visible at much greater distances.*

F. S. (Red Post-lane).—*The idea is ingenious and by no means impracticable. To work it out and get anything done in the matter would require, however, a considerable expenditure of money. You could get provisional protection for £1, and then you might apply to some of the makers of ball bearings, and try if they would take it up.*

ANALYSIS OF WATER.

(*To the Editor of The Engineer.*)

SIR,—I shall be much obliged if some of your readers will inform me if there are any books published which will assist an engineer with practical and easily-applied chemical means of testing water for drinking and boiler purposes, also for removing obnoxious elements. All the chemistries I have seen fall short of concise and practical methods necessary to an engineer abroad.

ANALYSIS.

Bayswater, W., June 2nd.

RECIPROCALS.

(*To the Editor of The Engineer.*)

SIR,—I shall feel obliged if any of your readers will kindly give titles, publishers' names, and any other information as to tables of reciprocals—numbers divided into unity. I want an extended table, such as will give by mere inspection the reciprocal of any number up to, say, 999,999. For instance, required the reciprocal of 203,545? I want to at once turn to the given number and find opposite it the required reciprocal. It will not be of much use to me if there is any process to be gone through, as when I am at this work results are wanted with great speed.

Madron, June 2nd. CALCULATOR.

[Our correspondent will find an excellent table up to 1000, the reciprocal of which is ·001, in Clark's "Rules, Tables, and Memoranda."—ED. E.]

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Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.

Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.

Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of THE ENGINEER.

MEETINGS NEXT WEEK.

ROYAL SOCIETY.—The Annual Conversazione will be held on Wednesday, June 13th.

LIVERPOOL ENGINEERING SOCIETY.—Friday and Saturday, June 15th and 16th. Excursion to the site of the proposed Elan water supply of the Birmingham Corporation, by the kind permission of the Birmingham Water Committee, Mr. Jas. Mansergh, M. Inst. C.E., engineer-in-chief.

THE ENGINEER.

JUNE 8, 1894.

THE UNITED STATES ARMOUR-PLATE SCANDAL.

WE have been favoured with a set of pamphlets and letters connected with the fines imposed on the Carnegie Steel Company for tampering with armour-plates delivered to the United States Government. We may say at once that, after all pleas have been urged, we do not see that Messrs. Carnegie have anything to complain of in the final decision of President Cleveland, that 10 per cent. of the price paid should be forfeited. At the same time, we confess to being rather puzzled at the way the various bearings of the question are regarded in the United States, and we think that our business readers will agree with us in concluding that the entire game is played under different rules from those which obtain in England.

Briefly, it may be said, if armour passes a certain minimum test, it is purchased at a given contract price. A premium is offered for plates resisting the attack calculated as the match for armour of 25 per cent. greater thickness than that under trial. This is definite and intelligible, but the following is also stated:—"He [the manufacturer] is to use every endeavour, and incur all the expense necessary, to produce the most resisting and enduring plates; and he is to regard the tests herein set forth merely as minimum limits of quality, which he is bound to excel, as much as practicable, by the use of all the means within the reach of his establishment." This we regard as an unbusiness-like and objectionable paragraph, such as a manufacturer would only agree to if he had confidence that it would not be used against him with its full meaning. For example, it appears that plates have been benefited by repeated treatment, involving, of course, extra expense. Can any one say that repeated treatment might not be enforced by words which specify that he is to incur "all the expense necessary to produce the most resisting and enduring plates?" Yet how can a man contract to make armour at a reasonable profit if he is open to totally new conditions being enforced? This paragraph was not insisted on in this sense, but it was employed afterwards, and we think it a wrong weapon, although as we began by observing, no injury, in our judgment, was inflicted, for the verdict might have stood upon other and sound ground.

The circumstances which occurred were related in our article of April 13th last. The very searching system of watching the manufacture of armour and checking it in all stages was defeated, both as to samples tested and as to processes carried out, while in two cases plates selected by inspecting officers to be fired at were "re-treated," and their powers thereby improved, the evidence being furnished by a gang of workmen acting under the guidance of a Pittsburg attorney. Our object in recalling all this is to bring out the novel way in which each step is regarded by the United States authorities and others concerned. The first question seems to have been whether, on recovery of money from Messrs. Carnegie, the informants could legally be paid part of it. The Attorney General decided in the affirmative on the following original plea:—Your "inspection force" has clearly been "inadequate," and these informants can be paid the money proposed as "watchmen," either "for inspectors' wages or for detective work." We think that most U.S. gentlemen will agree with us that this is most unnecessary. Surely it is more desirable in every way to say, "You have done some dirty work, but useful work, and we acknowledge a claim for information offered, and pay it." There is nothing to be concealed or got over. Why, in the name of all that is dignified, was it necessary to hunt up a plea for involving the Government in the unpleasant position of dealing with contractors by two systems of inspection at the same time? One consisting of officers acting for the Government, and purporting to be the only recognised and sufficient representatives; the other, men in Carnegie's pay, false workmen following the trade of irresponsible detectives, and using means that probably could not be traced. Can we conceive the English Government allowing of such relations with our manufacturers to be contemplated?

Next we come to the recommendations of a Board, of which Captain Sampson is president. We admire the ability of this body of officers, but not their process of reasoning. They conclude that there is evidence that the company has shown the possibility of making armour of 20 per cent. better quality than the acceptance standard, and they arrive at the conclusion that the armour delivered, owing to fraud, is 15 per cent. worse than it might have been made, and consequently they recommend that 15 per cent. besides all premiums should be deducted, thus laying themselves open to a forcible rejoinder from Carnegie and Co., that by their own showing the plates were 5 per cent. better than the acceptance tests, and therefore ought to be fully paid for. They urge that the paragraph we noticed early in the article, which is quoted by Captain Sampson and Board, could not be intended to be used as they use it, as an engine to raise the standard of acceptance, as they get better and better plates; for, say Messrs. Carnegie, if so "we have only to produce one plate pre-eminently good to ruin ourselves irrevocably." Here again we think we should have done better in England. We should have said "You have fraudulently violated the conditions of the contract, and brought on yourselves the rejection of your plates; however, if you prefer it, we will accept them at a price reduced by 15 per cent." We do not see what appeal could have been made against this. We may observe that Messrs. Carnegie put forward bad arguments as well as good. For example, they tried to defend the re-treatment of selected plates on the plea that it was valuable to learn what was effected by such special treatment. To which the United States officers naturally reply that such a plea is idle when they were not consulted or told of it, and that it should have been a special experiment. Undoubtedly this was the worst feature in the whole conduct of the business by Messrs. Carnegie. There is no excuse for it, but we think one plea might be made on their behalf, which, perhaps, they could hardly urge themselves wisely, namely, that the United States Government lay down conditions which admit of being enforced so as to become very hard—if not impracticable—of fulfilment. Moreover, the authorities insist on being initiated into all the working of the plates to such an extent that they ought to pay for learning manufacturing secrets as well as for their armour. We fancy that this may have given an additional motive for the secret treating of plates. One other feature should be noticed, namely, that while the fraudulent dealing was exercised to make fairly good plates pass for something better than they were—for there is no evidence of bad plates having existed—we may conclude by observing that we are indebted to Mr. Frick for very fairly supplying us with full correspondence on both sides of the question. We trust that he personally may not have known of the fraudulent dealings which were going on, but we must maintain what we have said before, that they could not have gone on without the approval and direction of some one in high authority at Carnegie's, and that the mere removal of a manager from one department to another is no adequate treatment of the matter. Altogether, we admit that a standard excellence in armour, and in shot too, has been achieved in the United States, so high that we think their materiel may fairly challenge any in the world, and whatever we hope, we do not feel at all certain that it would be beaten, but we see much to avoid in the business transactions connected with its contract and delivery.

MECHANICAL EFFICIENCY.

PROFESSOR KENNEDY'S presidential address, which has appeared in full in our columns, has apparently vexed the souls of numbers of electrical engineers. We are not surprised. Professor Kennedy is an engineer first, an electrician afterwards. He possesses a great deal of the strong common sense which is scarce enough in general to render its value in particular very great; and he has said things concerning electrical transmission and generation which are in no wise acceptable to those whose special avocation it is to design and construct transmission machinery. After all, the question is, he very properly points out, reducible to a matter of pounds, shillings, and pence. We fear that the fact is overlooked. It is possible to pay a great deal too much for high mechanical efficiency, and it is just as well that inventors, and designers, and men of science, should have it made quite clear to them, that in mechanics at all events, the merits and demerits of things are usually reducible to a pecuniary basis. Thus, for example, a steam engine may be a far less efficient machine than a motor, but, nevertheless, the engine may cost less per annum in the long run, and so far it will be the better of the two. Professor Kennedy does not stand alone, Mr. Segundo read on Monday, the 4th instant, before the Society of Engineers, a paper on "Power Distribution by Electricity, Water, and Gas." He has no hesitation in stating that electricity stands low, and holds that hydraulic transmission must stand high as compared with it. No doubt exception will be taken to his utterances, but there they are, and they will need some ingenuity to refute them.

A consideration of the facts connected with the transmission of power by electricity is really very instructive. At the first glance it will be seen that there is the strongest possible *prima facie* evidence in favour of the contention of such men as Mr. Mordey, Mr. Crompton, Mr. Sellon, &c. Ostensibly there is no reason why the engines employed to drive dynamos should not be the most economical of their kind. They can be reasonably large, worked with steam at a very high pressure, fitted with condensers, expected to run at a uniform speed. Again, the efficiency of a dynamo may be taken at 95 per cent., that of a motor at 90 per cent., that of the engine at 90 per cent. The difference between the indicated horse-power and the dynamometric horse-power, assuming the former to be 100, will be 10; that is to say, 100 indicated will give 90 dynamometric. The electrical horse-power will be 85·5, and the motor will give out 76·95-horse power. The unknown element is the energy expended in overcoming the resistance of the wire. In workshops and places where the wire is short, the loss must be small. It ought to be possible to reckon on getting 70 indicated horse-power out of the motor for every 100 indicated horse-power developed by the engine. If the engine managed with 2 lb. of coal per hour, the motor could get on with about 2·86 lb. This would be an eminently satisfactory result. Taking each element in the system, we have a very high efficiency. The efficiency of the whole ought to be high, but as a matter of practical fact it is not high; on the contrary, it is very low. Professor Kennedy gives it at little more than half what we have stated above. Sometimes, indeed, the realised work is not one-third of the indicated horse-power, and that costs much, very much, more for coal than 2 lb. an hour. Working on a somewhat different basis Mr. Segundo has arrived at the result that a Board of Trade unit, that is to say, a kilowatt hour, should be supplied for 2·86 lb. of coal. But a kilowatt hour represents 1·34 horse-power, a more favourable result than we have ventured to suggest as possible. The way in which Mr. Segundo has arrived at these figures will serve to illustrate the erroneous methods of estimation in use. He states that he has been told that certain boilers evaporate over 12 lb. of water from and at 212 deg. per pound of coal. This may or may not be true. As a matter of fact, however, the boilers do not evaporate at 212 deg., seeing that the boiler pressure is 180 lb.; nor do they get their feed at 212 deg. but at 175 deg., which is the maximum temperature that the economisers in the flues will give. But, indeed, as we come to examine the whole chain we find that link after link is weak. The engines, instead of being worked at that constant load which is essential to economy, run under various loads. The friction of an engine is very nearly constant at all loads, and if it is 10 per cent. in an engine indicating 1000-horse power, it will be 20 per cent. when the engine indicates 500-horse power. As for the dynamos, 95 per cent. efficiency is quite possible in the laboratory; it is not possible from year's end to year's end in daily work. As for motor efficiency, that must be an exceedingly variable quantity. On an electric tram line, for example, it is certain that there is nothing like harmony among the results obtained from the different cars; so with the line, and the trolley, and all the rest of it. These things should always be borne in mind. They are constantly forgotten or pushed out of sight. Professor Kennedy will not suffer them to be hidden, that is the head and front of his offending.

To do some electricians strict justice, they admit the substantial accuracy of views such as those we have just expressed, but they none the less hold that such men as Professor Kennedy and Mr. Segundo are pessimists. What they say is perhaps true; but wait a little. Like the traditional stage bandit, the electricians stamp their feet, and say, "Ha! a time will come!" They point to the fact that thousands of motors are at work on tramways, in mills and workshops; and they say, "If these are so good, what may not be possible in the way of improvement?" The answer seems to be, Very little; and for the simple reason that it is almost impossible to say where the improvement is to be effected. The engine builder is quite prepared to supply superlatively economical engines. If we apply to any firm making dynamos, they will give machines which are so near perfect efficiency that we are quite at a loss to see how they can be improved upon. Messrs. Siemens, Ferranti, Mordey, Kapp, and half a dozen others, will tell the purchaser, and with truth, that their dynamos are of maximum efficiency. If we go to cable makers, they leave us in no doubt that perfection in cables has been reached. The same may be said of motors. All the different parts, members, or elements of the system of power transmission are as nearly as possible perfect. But the combination breaks down. How is this to be mended? That seems to us to be the problem to which attention should be directed. Unless it can be solved, we fear that Professor Kennedy's statement must remain unrefuted.

CHINA AND HER PROGRESS.

When the Chinese, a quarter of a century ago, tore up the rails of the little Woosung railway, they furnished an example to the world at large of being the only people who had deliberately rejected the benefits of civilisation. It is not that other nations and other people have not resented and opposed, even *vi et armis*, the intrusion of aliens wiser and more enlightened than themselves, but their hostility resulted from causes totally different from those which, it will be seen as we proceed, actuated the denizens of the celestial empire. In fact, the majority of nations—with the exception of our own—who are free to express their opinions, not unnaturally view with feelings not altogether of a fraternal character the influx of strangers foreign to them in speech, physiognomy, habits, and manners. Divide two nations by a hemisphere, and it is not difficult to perceive how the complications of the situation become accentuated. There are a few in China, a very few, who are wiser, a very little wiser, than their predecessors of the bygone twenty-five years; but still at the present day, the country of old Cathay, whose annals reach back to an epoch fabulous in its antiquity, in spite of peaceful, warlike, and scientific expeditions, remains almost a *terra incognita* to the rest of the world. The progress of a country of the enormous extent and population of China, to which we propose briefly to draw the attention of our readers, cannot fail to possess interest for them, nor is the subject, in a general point of view, devoid of a certain amount of attraction. Isolated, petrified, fossilised in a matrix of its own arrogance, exclusiveness, and superstition, this people, to whom historians and statisticians assign a minimum census of four hundred millions, not including the Thibetans, their ancient and extramural foes the Tartars, nor other independent Mongolian races, has remained until yesterday a nation *sui generis* in every essential characteristic.

The difference between the civilisation of the East—which some, perhaps, may hesitate to acknowledge—and that of the West is that the former has always, from our standpoint, which is a pretty correct one, remained, and but for external interference and pressure would probably always remain, stationary, while the letter has always been, and is daily, progressive. Those who are inclined to chafe at the tardy adoption by Orientals of the results of Western civilisation, which in its entirety they never will receive, should not forget the difficulties we have ourselves experienced. How often has our own onward current been impeded, checked, and thwarted, although, providentially, the bed of the channel has never been so completely choked, or so hopelessly silted up, as to render impossible future navigation! In comparing the advance of Western civilisation in our own Indian Empire with that of China, it must be borne in mind that we conquered that country, vast as it is, by the sword, and by the sword we hold it. It is very different with China. In the interests of international trade, commerce, and frequently of humanity itself, we, in common with other great European Powers, have insisted upon certain concessions which were at first refused, and subsequently wrung from the Government of Pekin by the only means it could be brought to recognise, that is, force. Hence the opening of the twenty-two treaty ports, and the permission for the foreigner to carry his goods and merchandise to and from certain parts of the coast. As a nation—and herein lies the obstacle which for the present is well nigh insuperable—the Chinese do not recognise the superiority of the civilisation of the West over their own, sacred to them and engrained in them for centuries upon centuries. Consequently, they regard, so far as the mass of the people is concerned, the adoption of any of the most prominent, useful, and scientific results of our civilisation, such as railways, telegraphs, and steam machinery, not as an improvement on their part, but as an absolute retrogression. The old Roman phrase, "*Tempora mutantur et nos mutamur in illis*," or the pithy equivalent French rendering, "*Autres temps, autres mœurs*," is not applicable to the sons of the flowery land. We are still the barbarians, the foreign devils, although, as will be seen, not quite to the extent we were.

It is barely thirty-five years since the signing of the treaty of Tientsin broke through the greater wall which had for ages excluded China from the rest of the world, and it is but fair to state that its progress since that period, as we understand the term in a scientific and engineering point of view, has been both considerable and rapid. In our impression of March 2nd we drew attention to the opening of the railway from Tientsin to Shan-Hai-Kwan, which is a gratifying assurance, it is to be hoped, that the Woosung raid will not be repeated. The same subject was again alluded to in our columns of the 4th ult., in our description and illustration of the new railway bridge over the Lan-Ho. Taking Tientsin, which is eighty-five miles from the capital, as the starting-point of the future railway system, and remarking that it is connected by rail with its port Takur, on the Gulf of Pectchelee, a length of twenty-five miles, there is at present, it is stated, in construction a line which has for its object the union of Tientsin with Kirin, in Manchuria. Of this route, ninety-four miles are in the hands of the China Railway Company, and the remaining mileage belongs to the State. It should be noted here that while acknowledging at last the expediency of adopting steam locomotion, the Chinese Government evidently intends, and we do not say unwisely, to retain under its own control the management of the new lines, irrespectively of the conditions which have brought about their construction. The financial success of the undertakings launched under such auspices is a little doubtful, and not altogether likely to lead to any general development by private means of the railway system. Strategical reasons, no doubt, count for a good deal in the future extension of railways in China, as they have done with ourselves in India, but the building and maintenance of lines of this description do not hold out any very great inducements to the capitalist and the shareholder.

The Chinese are a people who, as a rule, have dealt tenderly with mother earth, and if it be humiliation to us not to have penetrated deeper than about half a mile into the terrestrial crust, their feelings ought to be of a very abject character. In their tin mines in the Malay Peninsula and in Dutch Settlements, they rarely work the ore beyond comparatively a very shallow depth, and their superstition exacts from the European visitor the penalty of walking in his socks over certain portions of the mine he wishes to inspect, furling his umbrella, and adopting other precautions not to "frighten the ore away." Their prejudice is strong against tunnels, as the subterranean operations would seriously provoke, no doubt to their own detriment, the great dragon who resides in an uncertain zone beneath the surface. Similarly, their dislike to telegraph lines, which is by no means overcome, arises from a belief that they are hostile intruders in the dominions of the aërial genii, and the jealousy with which they guard their cemeteries is well known to those who have lived among them, and have had the misfortune to interfere with them. Part of this reverence for the relics of the dead, which is common to all nations, may possibly be traced to their strong sense of filial duty, which is a marked and favourable trait in their character, and one which they fulfil at almost any personal sacrifice to themselves.

When a people numerous as the Chinese, hitherto practically secluded from the rest of the world, finds itself compulsorily brought into communication with it, the necessity of acquiring a knowledge of the more widely used languages outside its own country becomes imperative, and a college for this purpose exists at Pekin. At the capital, as well as in other towns, schools have been established for the teaching of science, for instruction in the different branches of learned and practical professions, and generally in the arts of war and peace. The example set so prominently before them by the great European nations has not been disregarded by the Chinese, and their attention has recently been directed towards the more efficient organisations of their army and navy. With the assistance of foreign officers, a large portion of the military forces has been armed and trained according to the European standard, and it is calculated on good authority that, including artillery and cavalry, the Emperor could bring into the field over a million of men. With a coast line extending over nearly thirty degrees of latitude, it is not surprising that the state of the navy should be regarded by the Chinese Government as deserving fully the same consideration as that accorded to the land forces. Its present fleet may be said to be divided into two divisions, the one to cruise in its northern, and the other in its southern waters. Of these, the former consists of a couple of ironclads, of between 7000 tons and 8000 tons each, a dozen cruisers averaging 1800 tons, eight or nine gunboats, and the same number of smaller craft. The other division includes some forty torpedo boats, a third of that number of gunboats, and an ironclad, the whole fleet being manned by about 28,000 men. It is probable that the spirits of the air have been conciliated, for it appears that very recently the basis of a Russo-Chinese agreement for the establishment of telegraphic communication between St. Petersburg and Pekin was agreed upon. A great difficulty had to be overcome in connection with this enterprise, which was to render the almost monosyllabic language of the Chinese amenable to the requirements of electric transmission. This task has, however, been successfully achieved, and the oriental vernacular supplemented by many thousand new words. Liberty of the Press, as might be anticipated, does not exist in China proper, that is, in any district governed by native officials; and it may be asked where does it exist, as we understand the phrase, except in England and America? It is gratifying to learn from an independent source, that nearly three-quarters of the whole trade carried on at the Treaty Ports is in the hands of our countrymen.

Within the last few years that "first step," which costs so much, of attempting to emancipate China from the trammels of its own torpid civilisation has been effected, and, in spite of the drawbacks and obstacles referred to, she has responded to the call, and a corresponding progress has attended her tardy acquiescence. It is improbable that she will ever again go back to her old state, for it must be borne in mind that in everything the Chinaman is the most imitative of mankind, and, provided his prejudices are not too violently assailed, he can, and will, do anything if he is fairly remunerated for it.

MR. MAXIM'S CUIRASS.

On Friday, June 1st, a large number of officers and civilians responded to Mr. Maxim's invitation to see a cuirass of his tested at Erith. In a letter to the *Times* Mr. Maxim stated that, "jealous" of Herr Dowe's success, he had at 11 o'clock on Wednesday commenced a series of experiments, that "at half-past 12 the experimental stage had been passed," and he had then seriously commenced to construct a cuirass of his own "with a certain combination of organic and inorganic materials;" weight 10 lb., thickness 1½in. He undertook to rival Herr Dowe's cuirass with one weighing 6 lb. only. He added that Herr Dowe was said to ask £200,000 for his secret, whereas Mr. Maxim would divulge his for 7s. 6d., which would "pay for the materials, all of which" he "obtained in the village of Erith." Everyone interested in the subject was invited to bring their own rifles and ammunition, especially Mr. Lowe, who was authorised to see that the experiments were conducted in exactly the same manner as those at the Alhambra Theatre. The impression generally conveyed by this announcement was that Mr. Maxim had arrived at some means of stopping bullets so simple and obvious that a secret could hardly be made of it, the inference being that perhaps Herr Dowe's was more or less similar. The tone of the letter naturally prepared visitors for something in the nature of a surprise, though hardly for one in the particular shape which awaited them. After exhibiting some Maxim guns made for the Sultan of Turkey, the trial of the cuirass took place. It was hung from the neck of an absurd-looking dummy with long white hair, and a look of bland expectancy in his face, who shouldered an umbrella and was supported by props against the sand cliff built behind him. The shield was a plain slab 16in. × 13in. × 1½in. Next the figure was a steel plate ⅜in. thick. Mr. Maxim fired five bullets through the latter, and two at the shield on the dummy figure, whose hat and wig fell off. The steel plate was then shown to have five holes in it, while the shield had stopped the two bullets. Mr. Maxim then made a comic speech, explaining how he had laboured sleeplessly for an hour and a-half to make his shield, which he had sold, according to his offer, to the owner of the Aquarium, and therefore that he was unable to continue firing at it, but that he would allow any of the musketry officers or others to fire the service ammunition or any other they had brought with them, at a second shield of the same material, of which he was happily able to find a small piece. He then produced a thin plate of steel. Some visitors, especially Captain Dutton-Hunt and the officers who expected to fire the service rifle at the shield, denounced the whole affair as a fraud, and went off angrily. Mr. Maxim then expressed regret that this view should be taken of his exhibition. He said that he was certainly not debarred from using steel if it answered the purpose. There was, however, a feeling among the visitors that they had been imposed on by "a sort of Barnum dodge." In our judgment, it is greatly to be regretted that Mr. Maxim acted as he did, and we think it damaged him in the eyes of the public. The gain was that he brought a few hundred people together to see his battery of guns, and that he got written about in the papers. The loss was that he conveyed the general impression that he was an unblushing exhibitor of American bunkum—in fact, a Barnum on scientific lines. He would not easily again collect an assembly such as were gathered on Friday last. Many people greatly dislike feeling that they are made fools of, and in England, if once a man gets the name of puffing or boasting, it is difficult to get any credit accorded to him that he actually deserves. Mr. Maxim's explanation in the *Times* of June 4th makes matters worse. He commits himself to the statement that Herr Dowe's cuirass must contain steel. This seems especially rash, as he was not present at the trial. We have had a bullet shown to us as one that has been set up on the cuirass, and it is distinctly unlike any bullet which we have ever seen set up by impact against iron or steel. It is in the form of a sphere, except that the base protrudes. Not pretending to the profound knowledge that extends to all undiscovered possibilities, we decline to discredit Herr Dowe and Captain Martin, and protest against the language used by Mr. Maxim as a gratuitous insult to them and to the officers who were specially invited to watch the trial, who Mr. Maxim pretty nearly calls fools, and something worse, for he says that he could not have allowed any unknown ammunition to be fired at his shield, because it might have contained a "hardened steel projectile." It is, we repeat, greatly to be regretted that a useful experiment should have been discredited by something worse than bad taste. Putting the comic and offensive elements aside, however, and only looking at Friday's trial in its scientific aspect, it will be seen that it is by no means valueless. The shield, so far as we had the opportunity of examining it and hearing about it, consisted of a nickel steel plate specially hardened, with a mock leather face stretched about an inch in front of it. Apparently it also contains felt. The leather and felt had no significance. The valuable fact is that a comparatively light plate of nickel steel can be so treated as to stop bullets which will perforate an ordinary ⅜in. steel plate. The weight of armour is the principal point to consider. The lightest armour that will stop a given blow is, on the face of it, the best kind, though bulk no doubt is also important. If steel can be so treated as to beat all other materials in these two respects, then steel seems to be the best shield that offers itself. The remarkable feature in the Dowe cuirass was that something said not to be metal of any kind appeared to beat steel weight for weight. Apparently Mr. Maxim not unnaturally wondered whether hardened nickel steel, which has been resisting steel projectiles admirably on a large scale, would not produce remarkable results if employed against ordinary bullets, and so completely beat the cuirasses of ordinary steel hitherto tried. We have in our possession a cuirass of Cromwell's time which has stopped a bullet of that day, presumably saving the life of the wearer. It measures 14in. from throat to waist and 18in. across from under one arm to the other, $10\frac{3}{8}$in. between the arms, and it weighs just over $8\frac{1}{2}$lb. It seems to be good steel, but a modern bullet would doubtless perforate it very easily. Mr. Maxim's nickel steel would probably admit of a cuirass of this size and weight being made completely bullet-proof, for the area in each case happens to be about the same, and if Mr. Maxim is correct in the statement of the reduction he could effect in weight, there would be a considerable margin over and above what is necessary. Lastly, we may consider the shock of the blow on a living man wearing the cuirass. As we noticed in the case of Herr Dowe's trial, the living man can stand up almost without motion against the blow of impact in a 12lb. cuirass. As the weight is reduced the shock is felt more. With a service bullet weighing 215 grains and a velocity of 2000 foot-seconds, the striking energy is equal to 12lb. falling through 6in., or 6lb. through 12in. This jar is not quite pleasant, perhaps, but it is distributed and is very endurable, and it saves the man's life. We are not, however, contemplating body armour proper so much as mantlets, whether of Herr Dowe's material or hardened nickel steel pure and simple. No doubt more will be done in this direction. Three or four years ago Holtzer had made a considerable number of chrome steel breast plates to resist the Gras bullet, but metal has been greatly improved in quality since then.

THE P. AND O. STEAMSHIP FLEET.

THE change in the character of our steamships is well shown in the report which the directors of the Peninsular and Oriental Steam Navigation Company have just placed before their shareholders before the half-yearly meeting next week. That great ocean-carrying corporation has now fifty steamers at work, as well as four building, and twenty-two steam tugs and launches. But it is not the number of the vessels so much as the class and the tonnage that marks the alteration. If we refer to the year 1887, we shall find that the tonnage owned was then 194,000; now it is 213,000 tons; but the contrast is more marked if the comparison be carried back a little later. Looking to the fleet as given in the report nearly fifty years ago, we find that the largest vessel then was one of 1800 tons, and of 520-horse power; now the largest vessel is the Australia, of 6901 tons, and of 10,000-horse power effective; whilst the Caledonia, just launched, will make a still further increase both in size and power. Putting aside the tugs and launches, the smallest of the present fleet is 2622 tons; and the average size is about 4223 tons, but the average will be improved when the four vessels building are added to the fleet at work. These four, including the Caledonia, to which we have referred as just launched, are of 23,300 tons in the total, so that they are considerably above the average of the working fleet, the smallest of the three being 4500 tons. The whole course of the shipping trade has been altered in the years that have passed, and very naturally there has been alteration in extent, in power, and in average size of the steamships in the premier fleet. The change is marvellous; but it is one that needs to be maintained, for we have now a great and growing rivalry in that branch of work in which the Peninsular and Oriental Steam Navigation Company has been prominent—the carriage of the mails. There are no signs of a cessation of that rivalry, but rather an increase, so that it may be anticipated that the alteration in the size and character of our greatest English fleet will be continued, and that for years to come there will be a marked tendency towards the use of greater power in larger steamers in this the premier mercantile fleet.

THE CRITICAL STATE OF THE COAL TRADE.

THE position of affairs in the coal trade has now assumed a critical phase. Though not in actual conflict, the Midland counties—the backbone of the Miners' Federation of Great Britain—are looking on with no small anxiety to what is going on in the Scotch districts, and on a smaller scale in Somersetshire, on the borders of the Federation area. The natural complications are evidently recurring, and accumulate to the discomfiture of the Miner's Federation. Even though there is a general gloomy prospect pervading the area of that organisation, it is seen that in the less powerful districts the trade is in a serious state consequent upon these owners being unable to compete with the more advantageously situated counties in the Midlands. But the principle is to apply all round, and a minimum wage is to be maintained. Though this on the face of it may have been enforced, the pinch has been felt by a reduced number of working days, and the Forest of Dean miners have declined to be associated with the Miners' Federation, viewing the coming difficulties. But it is the Scotch trouble which causes the greater anxiety, and the failures there to get together the miners in a united force are certainly ominous signs. The Scotch miners have been called upon to obey the mandate of the Miners' Federation of no reduction. But what will the response be? Possibly the federated miners may decide to fight, but numerically their strength appears to be comparatively small. The influences at work in Scotland will in all probability in their turn affect the English districts with whom the Scotch owners compete keenly in some markets. The Miners' Federation in their conference at Carlisle promised help, but Mr. Weir, the Scotch miners' secretary, put the situation clearly when he asked the men not to expect cartloads of gold from England. The present state of the English coal trade practically answers that question, for in addition to the present depression, the effects of the four months' battle last autumn have not yet altogether disappeared. True, the Board of Conciliation, it is assumed, will be a peaceful factor, at any rate until November, in the English districts, and this to consumers is, at all events, some assurance of stability in the trade of the Midland district. The situation is admittedly grave. It brings to the front a weighty and difficult point for consideration. Can the Scotch reduction be resisted?

THE AMERICAN COAL WAR.

THE United States, like our own country, is rarely without a strike of some sort. Now it is the turn of the American miners. That conflict has had considerable effect upon the coal trade of Great Britain. Prior to the abnormally large Atlantic liners, it was the custom of the shipowners to take sufficient coal on board at Liverpool to last for the round journey. But when the floating palaces became so huge as to require tremendous weights of fuel, the management of the different lines found it more convenient to recoal at New York for the homeward journey. Through the scarcity of fuel in the States, the shipowners are now reverting to their old practice of taking with them from the Mersey supplies sufficient to bring the ship safely back again. Several companies in other parts are also sending out stocks for vessels that trade along the American coast. The effect, of course, is to impart a stimulus in some parts of the Welsh and English coal districts. Several American gas companies, who are large consumers of coal, are also laying in heavy supplies lest they should be brought too near the working margin. The American coalfield now practically idle, is being partly compensated for by increased work in Virginia and Cumberland. In Virginia the mines are worked by negroes, and in Cumberland by white men. New York requires weekly 50,000 tons of bituminous coal. Of that amount, the Virginia and Cumberland mines, by working double time, can supply one-half; the other half comes from this country, mainly cannel coal from the western district of Scotland. As the strike in America has sent up prices 100 per cent. within a month, and freights across the Atlantic are at present exceptionally low, British coal can be delivered, even with a duty of 75 cents per ton upon it, in the United States market at a profit. The American Government are credited with the intention to grant a rebate of this duty while the strike lasts. If they do so, a brisk business will spring up between the old country and the new. But what would have been thought in England if during the late coal strike our Government had offered to foreign coalowners a subsidy of 3s. $1\frac{1}{2}$d. per ton on all coal brought into this country? What would the labour leaders not have said? Yet this is practically what is reported to be in the mind of the Government of "Triumphant Democracy."

LITERATURE.

Systems of Car-Lighting. New York: *Engineering News* Publishing Company. 1892.

THE complete title of this volume is "The Comparative Merits of Various Systems of Car-Lighting: an Investigation of the Comparative Cost, Safety, Light-giving Powers and General Advantages of Oil Lamps, Gasoline Carburetters, Compressed Gas, and Electric Lighting." The authors are Messrs. Wellington and Baker, editors of the *Engineering News*, and Mr. Penniman, chemist to the Baltimore and Ohio Railroad. The treatise is a revised reprint of a series of articles which appeared in the paper, describing a series of tests made of the several systems. The makers of the various appliances had the opportunity allowed them of stating their own views, and the authors have avoided the expression of any opinion as to which is the best system, leaving that to the reader. The chemical composition of the various oils producible from petroleum is first treated, and photometer test records specially made by Mr. Penniman with Dibdin's radial photometric apparatus.

The Frost dry carburetter plant, by which gasoline is vaporised in a chamber placed above the lamp, and air passed over a series of wicks steeped in gasoline, appears to find great favour in the States. The system is also in use in private houses and hotels. From a table we find that 450 cars of the Pennsylvania Railroad Co. are supplied with the apparatus, and a total of 866 cars have been fitted, of which nine-tenths came into use during the two years preceding 1892. The authors deal fairly with the reader, and after pointing out the advantages of the system, add accounts of accidents caused by the apparatus. The Pintsch gas system is then dealt with, and the authors appear to have derived most of their information from British sources, as they quote freely from papers by Mr. Hunter and by Mr. Ayres, printed in the "Proceedings" of the Institution of Civil Engineers. In all cases the descriptions of fittings are well illustrated. Notwithstanding the advances made in car lighting, it is stated that out of 30,000 cars now running on passenger trains in the United States, at least 27,000 are lighted by oil-lamps.

Alluding to the use of oil of low flashing point, or as the authors describe it, "low fire test oil," they state that formerly oil of specific gravity 50 deg. Beaumé, firing at 150 deg. Fah., and giving off inflammable vapour at 110 deg. Fah., was used, but now the laws of many States require the use of oil with a flashing point of 300 deg. Fah. on passenger cars. The use of the lighter oil is, of course, very dangerous indeed. The specification of the Pennsylvania Railroad Co., which is given in full, shows that the "300 deg. fire test oil" will not be accepted if it flashes below 249 deg. Fah., or burns below 298 deg. Fah. The method of testing employed by the company appears to be very crude; the oil is placed in an open porcelain dish, placed in a small iron cup sand-bath, and heated over a Bunsen flame. A small test flame at the end of a glass tube is used, and, in our opinion, the results must be very unsatisfactory and untrustworthy. Why the Abel close test is not used we do not know. The cold test required is that the oil shall not become cloudy when the sample has been ten minutes at a temperature of 32 deg. Fah.

Electric lighting appears so far to have found little favour in the States, in fact the use of secondary batteries has been so far avoided as much as possible. Details are given of the English and continental practice, and the authors state that the amount of illumination which appears to give satisfaction in Europe is not considered at all adequate in America. The Pullman Car Company has made the greatest use of electricity so far. The authors say it must be admitted that "the use of the electric light is hardly advisable at present for any railway which is not willing to go down deep into its pocket to pay for the luxury." Our own opinion is that one of the chief difficulties in the matter is to get a secondary battery which will stand the rough usage it receives on trains, and also to produce a thoroughly satisfactory coupler. The lighting of block trains, that is to say, of trains in which the coaches are never separated, is easy, but when it is necessary frequently to divide trains, and when coaches must remain standing on sidings for long periods, the matter becomes much more complicated. The book is a valuable little work, inasmuch as, besides the original matter it contains, there is also a collection of data from various other sources.

Electricity and Magnetism. By S. R. BOTTONE. London: Whittaker and Company. 1893.

THE author has not endeavoured to write a text-book, but states that his object is to present an easy and attractive introduction to the sciences of electricity and magnetism. His desire has been to awaken a wish for further information. The expression of such a desire places the critic in a somewhat awkward predicament, as, if he should observe a lack of information, he must, we suppose, assume, in charity to the author, that this was intentional. As is usual in all such books, we are taken first, in the spirit, to Asia Minor, to Magnesia—the land of the lodestone—and, after this initiation, begin our examination of the properties of magnets. We then pass into the realm of pith-balls and influence machines. The latter part of the book is of the most value, and we are glad to see that the author has not thought it necessary to burden the work with descriptions of all kinds of cells, but has confined himself to a few well-known types. The illustrations represent current types, and descriptions of induction coils and other apparatus are given.

We suppose there must be a demand for introductory works on electricity or they would not find publishers, but the number now in the market appears somewhat excessive. If other branches of knowledge were treated in the same liberal manner it might tend to produce other interests, and deflect part of the stream of would-be electricians, which now seems to flow so strongly.

BOOKS RECEIVED.

Railway Policy in India. By Horace Bell, M. Inst. C.E. London: Rivington, Percival, and Company. 1894.

Practical Hints on the Construction and Working of Regenerator Furnaces. Being an elementary explanatory treatise on the system of gaseous firing applicable to horizontal and inclined retort settings in gas-works. By Maurice Graham, Assoc. M. Inst. C.E. London: E. and F. N. Spon. 1894.

The Metallurgy of Gold. By T. Kirk Rose, B.Sc. Being one of a series of treatises on metallurgy written by the Associates of the Royal School of Mines. Edited by Professor W. C. Roberts-Austen, C.B., F.R.S. With numerous illustrations. London: Charles Griffin and Company. 1894.

Curtice's Index to "The Times," the London Morning and Evening Papers, One Hundred and Twenty Weeklies, and Thirty-one Provincial Newspapers, July 1st to September 30th, 1893. London: Printed and published by Edward Curtice, and of Romeike and Curtice's Press Cutting Agency.

An Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland, and Ireland for the year 1893, being the twenty-fifth year of publication. Compiled and arranged by John W. Field. London: may be had of Eden, Fisher, and Company, or of the Compiler, Horseferry-road, Westminster, S.W.

Year-book of the Scientific and Learned Societies of Great Britain and Ireland. Comprising lists of the papers read during 1893 before societies engaged in fourteen departments of research, with the names of their authors. Compiled from official sources. Eleventh annual issue. London: Charles Griffin and Company. 1894.

Cotton Manufacture. A manual of practical instruction in the processes of opening, carding, combing, drawing, doubling, and spinning of cotton, and the methods of dyeing and preparing goods for the market. For the use of operatives, overlookers, and manufacturers. By John Lister. With numerous illustrations. London: Crosby Lockwood and Son. 1894.

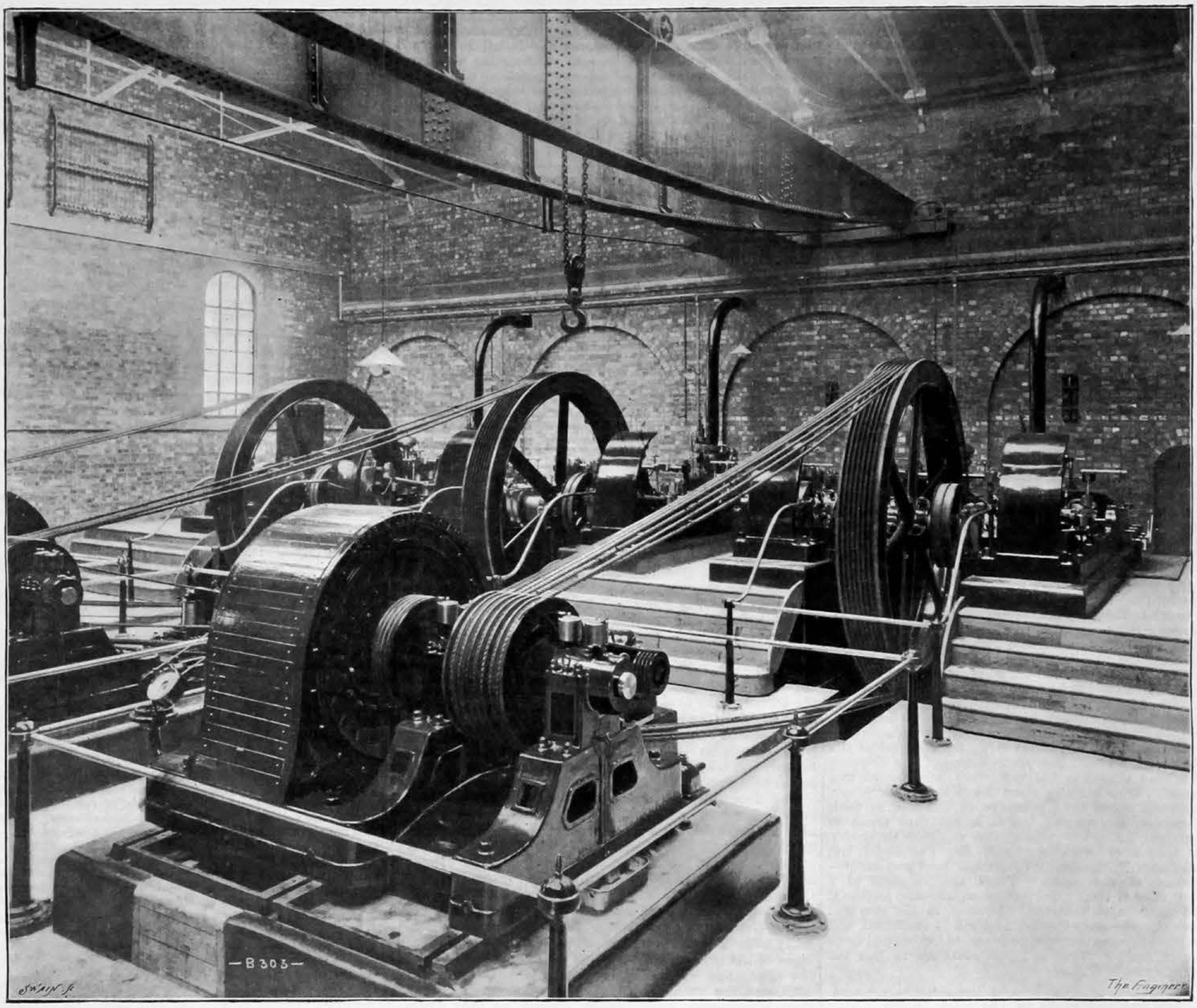
Micro-organisms in Water: Their Significance, Identification, and Removal, together with an Account of the Bacteriological Methods Employed in their Investigation. Specially designed for the use of those connected with the sanitary aspects of water supply. By Percy Frankland, Ph.D., B.Sc. (Lond.), F.R.S., and Mrs. Percy Frankland. London: Longmans, Green, and Company. 1894.

Refuse Destructors, with Results up to the Present Time. Second and revised edition. A handbook for municipal officers, town councillors, and others interested in town sanitation. By Charles Jones, M. Inst. C.E. With a paper on *The Utilisation of Town Refuse for Power Production.* By Thomas Tomlinson, B.E., A.M.I.C.E. With numerous diagrams. London: Biggs and Company. 1894.

JAPANESE WAR VESSELS.—After some seven years' consideration on the part of the Imperial Japanese Government respecting the construction of two powerful armourclads, it has been decided to place both in this country, one with the Thames Ironworks and Shipbuilding Company, London, and a second one with Messrs. Sir W. Armstrong and Co., Newcastle. The original inquiry was for an improved Collingwood, but the displacement tonnage was to be limited to 8000 tons, and seeing it was difficult to improve on a Collingwood with 1500 tons less weight, the necessity of a larger tonnage soon became evident, and a limit was then given of 10,500 tons, or a Centurion type, but as it was required to carry a heavier armament than that vessel, a still larger tonnage became necessary, resulting in a vessel of 12,250 tons, and of the Royal Sovereign type. A commission has been appointed, and they have visited the most important shipbuilding establishments, both on the Continent and in America, in which latter country they have inspected the manufacture of the Harvey system of casehardening armour-plates, which method has been adopted and improved upon with great advantage in this country, both by Messrs. Cammell and Co. and by Messrs. Vickers and Co., who divide the honours of providing the armour for these vessels. It speaks well for the two firms who have secured the contract for the ships, that they only have been invited to tender for these vessels, though the Japanese Government have had large experience, both in this country, in Germany, and in France, in war-ship construction, but though the greatest pressure was exerted in Tokio to obtain permission for Continental firms to tender, such permission was refused. The Thames Ironworks have built for the English Admiralty in all fourteen vessels of the collective connage of 80,000 tons. The vessel to be built by the Thames Ironworks is to be named the Fuji Yama, after a celebrated mountain in Japan, and the following are a few of the principal points in her design:—Length between perpendiculars, 370ft.; breadth, 73ft.; draught of water, 26ft. 6in.; displacement, 12,250 tons; coals at this draught 700 tons; total capacity 1100 tons; armour belt, 226ft. long, 18in. through machinery and boiler spaces, 16in. at ends; two barbettes, armour-plated with 14in. armour, each carrying two 12in. breech-loading guns, ten 6in. quick-firing guns in casemates, fourteen 3-pounder Hotchkiss quick-firing guns, ten $2\frac{1}{2}$-pounder Hotchkiss quick-firing guns, and six torpedo ejectors. The armour deck extending from stem to stem is $2\frac{1}{2}$in. thick, and terminates in a powerful ram at fore end. The decks to be of teak. Two military masts with double tops, with derricks for lifting the boats in and out off skid beam. Thirteen boats in all are to be carried, including two 56ft. vidette boats, Navy pattern; five search lights, and the whole of the vessel to be lighted internally by electricity. The engines, which are to be triple-expansion of 14,000-horse power, will be constructed by Messrs. Humphrys, Tennant, and Co., of Deptford, the boilers being of the usual cylindrical type, and the tubes protected by Messrs. Humphrys' patent ferrules. Speed 18 knots.

INTERIOR OF BURTON-ON-TRENT ELECTRIC LIGHT WORKS

MESSRS. JOHN FOWLER AND CO., LEEDS, ENGINEERS



THE BURTON-ON-TRENT ELECTRIC LIGHT WORKS.

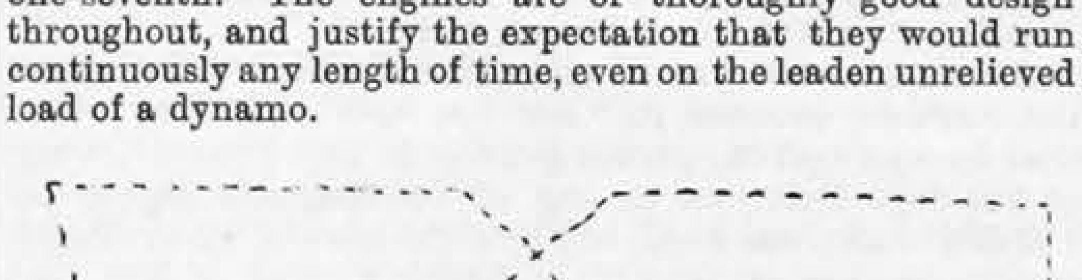
ON Friday last a large assembly gathered in the new electric generating station of the Burton-on-Trent Corporation, to see the new works which have been erected there, with machinery and engines and boilers by Messrs. John Fowler and Co., Leeds. By the Burton-on-Trent Electric Lighting Order, 1890, powers were granted to the Corporation to lay down works for the supply of electricity from a central station. The Electric Lighting Committee inspected the leading electricity works in the United Kingdom, and obtained competitive tenders. The Town Council having adopted the report of the committee and obtained tenders for the buildings and plant, the specifications were examined and amplified by the borough electrical engineer, and final tenders invited, with the result that the whole contract, with the exception of the buildings, were let to Messrs. John Fowler and Co. and Messrs. Hammond and Co., the latter afterwards retiring from the contract by permission of the Corporation, and Mr. Hammond becoming the consulting electrical engineer.

The high-pressure —2000 volts—alternating current transformer system of supply at constant pressure to transformers fixed in suitable positions in street boxes on the route of the high-tension mains, has been adopted, feeding on to the low pressure—100 volts—cables for private supply.

The buildings are on a site adjoining the Corporation gas works, and the gas lighting and electric lighting committees work together. The buildings comprise engine and boiler houses, test room, &c., carefully designed for the most efficient and economical working of the station and for ease of supervision. A large piece of land is available for extensions as necessity demands.

The engine-room is 60ft. long by 63ft. wide. The plant at present installed consists of three 125-horse power engines, driving by ropes three 66-kilowatt alternators, capable of supplying electricity for about 6000 8-candle power lamps fixed on consumers' premises, with one plant in reserve.

Engines.—The type of engine selected is, as shown in our engravings, that known as the horizontal, coupled, compound, non-condensing, the sizes adopted being considered suitable units to work in sections, having regard to the varying load. The speed of the engines is 90 revolutions per minute, and the ordinary working load 125 indicated horse-power, at a steam pressure of 95 lb. per square inch, but the engine is capable, by increasing the steam pressure, of giving a much larger output. Both high and low-pressure cylinders have automatic cut-off gear controlled by the governor. The chief dimensions of the engines are:—High-pressure cylinder, 14in. diameter; low-pressure cylinder, 24in. diameter; stroke, 24in. The fly-wheels are 12ft. in diameter, grooved for seven 1½in. ropes. Another point in these engines worthy of note is the massive character of the bedplates. The annexed diagrams are from one pair of the engines, all of which give similar diagrams. They are taken with 40 lb. and 16 lb. springs respectively, and are reduced in size about one-seventh. The engines are of thoroughly good design throughout, and justify the expectation that they would run continuously any length of time, even on the leaden unrelieved load of a dynamo.



High-pressure indicator diagram

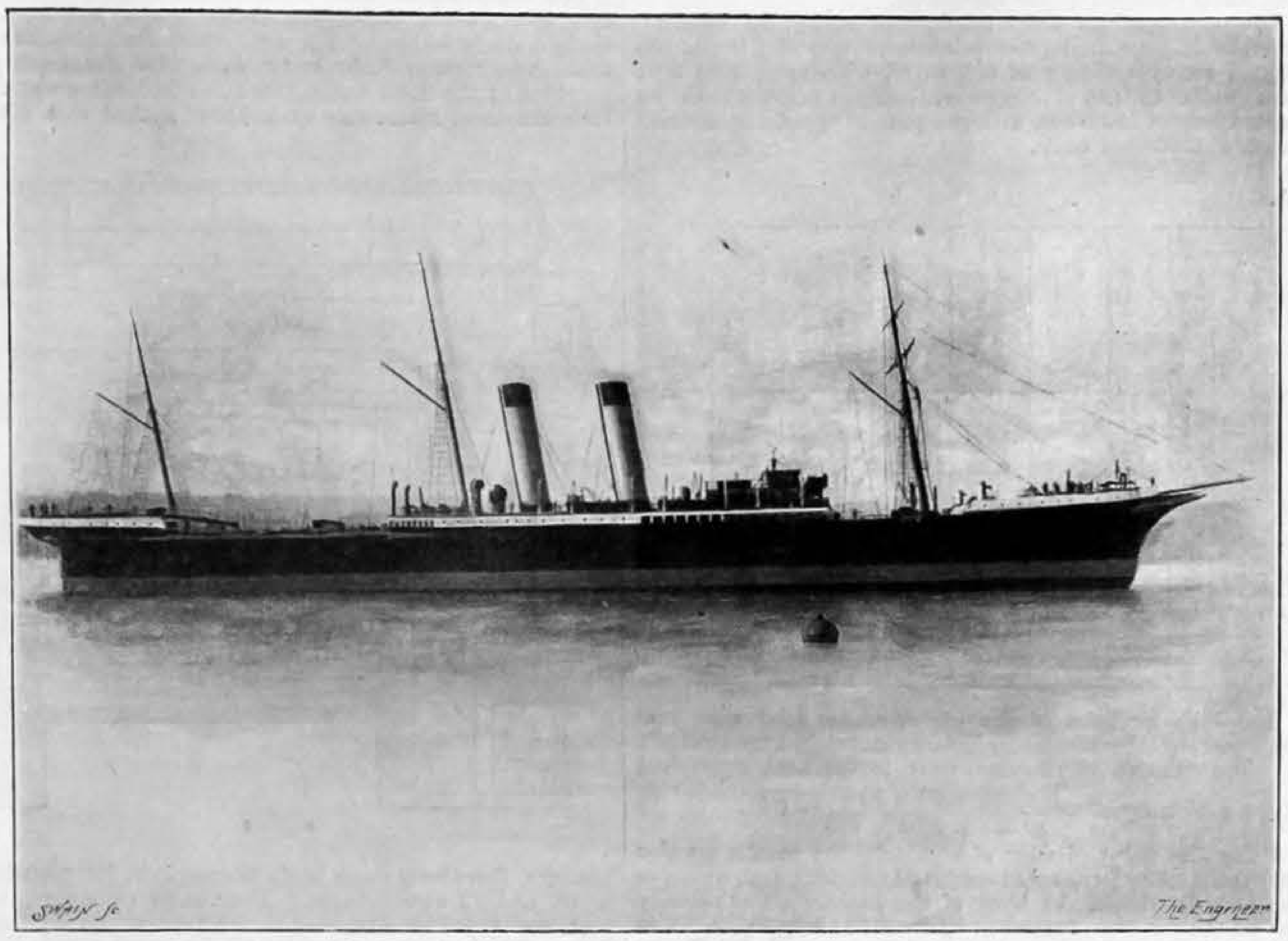
Low-pressure diagram

Alternators.—Three 66-kilowatt alternators are of the Leeds and London type—Hall's patents—manufactured by Messrs. John Fowler and Co. The electrical working pressure is 2000 volts, at a speed of 450 revolutions per minute. All the above machines have been constructed to synchronise or run in parallel with each other at all loads. The field magnet and armature conductors do not carry more than 2000 ampères per square inch of section, thus allowing a good working margin. The terminals to which the high-tension mains are connected are boxed in by hard wood lagging, so that they cannot be touched except by the proper officials. The exciters for these alternators are driven by ropes from grooved pulleys on the alternator shafts, and can just be seen in our engravings. They are each of ample size to generate current sufficient to easily excite the fields of the corresponding alternator at full load. The alternators are provided with slide rails, by which they can be moved to regulate the tension on the ropes. The magnets are the rotating part, and consist of laminated horseshoe stampings, built up overlapping — alternately —so as to form a complete circle with polar projections; these are bolted together solid, and secured to the shaft at the boss by means of keys and set-screws. Magnets so constructed give, as our electrical readers are aware, the maximum efficiency for the energy expended in magnetising them, partly owing to the quality of the iron, and partly owing to eddy currents, which would cause energy to be dissipated in them if they were solid, due to the armature reaction. The armature being stationary, lends itself for sectional construction, and as this is built up of laminated charcoal iron sheets with short polar projections, each section having its own armature coil securely attached, can readily be removed for inspection or repairs without interfering with any other part of the machine. The armature coil is insulated from the armature core, this is then again insulated from the frame of the machine, thus giving a double insulation between the conductor and frame or earth. The main terminals being mounted upon porcelain insulators, and enclosed in the wood lagging, make it impossible for personal contact with the high-pressure conductors.

Switchboard.—The switchboard, of enamelled slate, on which are arranged the most recent appliances for controlling the circuits and maintaining a constant voltage, was constructed under the Lowrie-Hall patents by Messrs. John Fowler and Co., and it is on the lines of that of the electricity works at Madrid, Leeds, Brighton, Eastbourne, West Brompton, Halifax, &c. It also includes the special apparatus known as a synchronising board, which is necessary when alternators are run in parallel, or when the load is changed over from one alternator to another. The alternating plant, however, is designed so that it may run continuously in parallel, as by so doing great economy and steadiness is effected. The trenches containing the cables from the exciters and alternators and from the main circuits lead into the back of the switchboard, where ample space is provided in which the connections from cables to switches, or cross connections on the switchboard, can be easily and safely inspected. At the same time it is perfectly isolated except for the proper officials. A test room is provided in the building.

Boiler house.—This is 60ft. long by 45ft. wide, and in it are placed at present three Lancashire boilers, each 26ft. long by

THE TWIN-SCREW STEAMER ST. PETERSBURG



7ft. diameter, constructed for a working pressure of 100 lb. per square inch, with ample spare space for further boilers as they may be required. The fittings and mountings on these boilers include Mr. Bryan Donkin's forced draught arrangements for burning the coke dust and rubbish from the gasworks, coke screenings, coke and coal slack. Each boiler is fitted with the bars dipping in a water tank, and one fan provides the blast for all. Three feed-water heaters are also provided. By these the exhaust steam is utilised to raise the temperature of the feed-water, so as to economise fuel. No condensers are used.

Pipe connections.—A very simple arrangement of the pipes rendered necessary by so many auxiliary parts of the plant, including all the requisite pipes to and from the engines, feed-water heaters, pumps, tanks, &c., has been neatly worked out. An auxiliary steam pipe is provided for supplying the pumps and stoker engine, independently of the main steam pipe. The donkey pumps for feeding the boilers are of the duplex ram type, each of sufficient capacity to feed two boilers when working at their full power. The main steam pipes are connected up in the form of a ring, to which both boiler and engine branches are connected, thus providing two ways by which the engines can be supplied with steam, so guarding against the possibility of break-down of the running of the engines, should any portion of the steam range give way or be under repair. These pipes are provided with a suitable number of stop valves placed between each engine and boiler, and are carried on brackets fixed to the wall of the engine house. The branch pipes to the engines are of wrought iron, with wrought iron flanges. The exhaust pipes lead off from under the low-pressure cylinders, and a stop valve is provided to each engine exhaust to shut it off from the main exhaust pipe. Valves are arranged so that the whole or part of the exhaust steam can be turned through the heaters or direct into the atmosphere through the roof of the boiler house.

Distribution.—The distribution of electricity is effected by means of stranded copper single cables, insulated with vulcanised india-rubber and laid in a system of pipes combined with service and junction-boxes. Each junction-box has a loose cover, held in position by a wrought iron clamp. The culvert connection from the box to the consumer is made by a wrought iron pipe. The surface-boxes are in all cases placed at the corners of the roads, and in the case of a long straight run they are placed at distances of eighty yards to one hundred yards apart. The surface-boxes are made in two parts, the bottom part being permanent and the upper part with the cover being adjustable, so as to allow its surface to be raised or lowered as the road level may vary, the lid being filled in with wood, macadam, or pavement, according to the construction of the road. From the surface-boxes the cable can be drawn in or out as required. Where passing road corners the cable is placed on a revolving drum, which entirely prevents the possibility of abrasion. The jointing of branch cables for consumers' premises is done by cutting away part of the insulation of the main cable, which consists of india-rubber in the junction or surface-boxes, and soldering the copper conductor to the conductor of the branch cable; the joint is then lapped over with rubber to the full thickness of the original insulation, and vulcanised on the spot, and the cable well taped and mechanically protected. This makes the insulation of the joint practically equal to that of the cable itself. The converters are of Lowrie-Hall pattern, and made by Messrs. John Fowler and Co. They are placed about two hundred and twenty yards apart in cast iron waterpoof chambers with side wings or boxes cast upon them, so that the pipes conveying the high-pressure cables—2000 volts—pass in on one side, and those containing the low-pressure cables—100 volts—on the other side; the cables themselves passing through the stuffing-boxes into the water-tight chamber. The principle of the stuffing-box is the compression of a substantial vulcanised india-rubber ring of the same quality as the cable itself. In the interior of the box is placed a converter, together with high and low-pressure fuses, earthing device and high and low pressure switches; the latter are double-pole double-break, and connected together by an insulated distance piece, so that both switches are turned off at the same moment, thus preventing any sparking whatever load may be switched off. In order to take up any original moisture which may have been in the air and fittings in the box, a jar of caustic potash is placed to absorb this moisture, and once dry it remains so until any future date when the box is reopened. The mains are laid and a supply of electricity is at the disposal of any householder in eight streets and roads, and in St. Paul's-square, which is three thousand yards distant from the generating works.

THE RUSSIAN VOLUNTEER FLEET.

THE new twin-screw steamer, the Petersburg, now moored off the shipbuilding yard of Messrs. R. and W. Hawthorn, Leslie, and Co., Hebburn, has created a large amount of public interest. The vessel, one of the largest and finest steamers built on the Tyne, is the third of the same class constructed and engined by the firm named for the Russian volunteer fleet, her dimensions being 460ft. in length, with a beam of 54ft., and a depth of 35ft. Her capacity exceeds 6000 tons. Her speed is 19 knots per hour. The bunker stowage amounts to 1200 tons of coal, a feature being that all fuel is shipped through the sides of the vessel, no dust reaching the decks above. The steamer is built of steel throughout, on the longitudinal cellular double bottom principle, extending right fore and aft, with no fewer than ten water-tight compartments. The engine and boiler-rooms are divided by water-tight bulkheads. All decks are of steel, sheathed with teak, and to insure increased steadiness to the ship in rough weather, the bilge keels have been made exceptionally long and broad. The vessel has been constructed on the three deck grade, with long poop, bridge, and topgallant forecastle, and to the highest class at Lloyd's.

The dining saloon is a magnificent apartment on the main deck amidships, entrance to which is obtained by a descending corridor with beautifully carved balustrades of solid oak. The floor is composed of parquet flooring, of variegated oak artistically arranged, and the framing and panelling throughout is of solid oak, handsomely carved, and harmonising with the sideboard, which extends the entire width of the saloon, the style adopted being Jacobean. The reception-room is divided from the dining saloon by a rich curtain of plush, beautifully embroidered. In both apartments the tables and chairs are of solid oak, with bronze settings, the side-lights being exceptionally large and numerous, the windows in the corridor leading to the state rooms being cathedral tinted. The music-room is on the navigating deck amidships, the framing being of carved walnut, artistically relieved by the introduction of holly panelling, in poker work and marble. The windows are of stained glass, of classical design, and in this apartment are placed life-sized portraits of the Empress and Emperor of Russia, which have been sent direct from St. Petersburg for the new vessel.

Cabinets of variegated wood are placed around the hall, and, contrasted with the rich tapestry and panelling, the effect produced is very fine. The state rooms, which are on the same deck as the saloon, are remarkably well lighted and ventilated and arranged, none of the berths being more than two tiers high, while several have been made large enough to accommodate parties or families, the furnishing being on the bed-room and sitting-room combined principle, every comfort and convenience having been provided, including electric light and fans, electric bells, portable dressing cases, &c.

The crew is berthed in the forecastle, all berths being of teak, with cabinets underneath, fitted with locks and fronts of iron trellis work. On the 'tween decks right fore and aft, except where the state rooms intervene, are accommodation for 1500 emigrants or troops. This space is lofty and airy to a degree, the height from floor to ceiling being upwards of 8ft. clear, natural ventilation being obtained by numerous side-lights and patent ventilators, while the electric fans with which the vessel is fitted keep all decks free from accumulation of stale air from stem to stern. The engineers and firemen are berthed in close proximity to the engines; three distinct sets of pantries and cooking apparatus are supplied for the use of passengers, emigrants, and crew respectively.

The hospital is immediately under the poop, and in the case of sickness occurring on board the patients can be completely isolated from the passengers and crew, the doctors' room and dispensary being in the immediate vicinity. One division of the hospital is set apart for the use of male and the other for female patients. All necessary convenience is on the same deck and within the hospital area, a promenade being provided on the poop above.

Patent fire-extinguishing apparatus is fitted at the hatches leading to all the holds, and in the case of fire a powerful jet of steam can be forced from the boilers to every compartment on board, passengers, after giving the alarm, having to close the door and ascend to the deck, the action of the steam instantly extinguishing the flames.

The vessel is fitted with the full complement of deck machinery of the latest and most improved type. The steering gear is on the upper deck amidships, while a reserve set of powerful machinery of the same class is placed under the poop aft, to be used in case of emergency, or instead of that on the bridge. The pumping arrangements are of exceptional power, being capable of discharging water at the rate of 1000 tons per hour, thus providing for the clearing of the largest hold in sixty minutes. Temperley's transporters for the rapid discharging and stowage of cargo are placed at each hatch, in addition to the full equipment of silent winches, warping capstan, and windlasses. The vessel has been engined by the builders, the propelling and auxiliary engines numbering altogether over forty, the former being in two sets working triple-expansion, having cylinders 34in., 54in., and 85in., with a stroke of 51in. The steam distribution valves are worked by Marshall's system, and the whole of the machinery in the engine-room is duplicated, steam being supplied by seven large cylindrical boilers having thirty-six furnaces. A notable feature of the engine-room is the division of the coal, which is stored in bunkers extending along the port and starboard sides of the ship, thus furnishing additional protection in time of war.

The Petersburg recently went on her official trip, in the presence of the representatives of the builders and engineers and the following Russian naval experts, viz.:—Colonel Linden, inspector of the Russian Volunteer Fleet; Mr. Poretchkine, appointed by the Russian Minister of Marine; Mr. Varshafsky, the engineer-in-chief at Odessa; and Captain Radloff, who will take command of the vessel. In a continuous run, extending over twelve hours, the vessel gave an excellent account of herself, the contract speed of nineteen knots per hour being attained, the engines during the whole day working smoothly and without any perceptible vibration. In response to numerous inquiries for admission to inspect the vessel, the owners and builders have mutually agreed to admit the public on Saturday, between the hours of 2 and 5 p.m., at a charge of 1s. each, the proceeds to be handed over to the benevolent fund for aiding the adult blind in the towns of Newcastle and Gateshead.

The vessel will leave this week for St. Petersburg, the city after which she is named, and, having been placed on view there, will at once enter upon her regular line.

REPORT ON TRIALS OF A CROSSLEY GAS ENGINE AT MESSRS. WALLAERT FRERES' MILL, LILLE.

By M. AIME WITZ.

THE Crossley motor which Messrs. J. and O. G. Pierson have installed at the establishment of Wallaert Brothers, for the electric lighting of their spinning factory in the Rue de Poids, drives by means of a belt, a countershaft on which are mounted a fast and loose pulley, a Raffard coupling with elastic connections, and a fly-wheel of 1·10 m. in diameter weighing 750 kilos. This shaft, which makes 350 revolutions at a speed of 160 revolutions of the engine, transmits the motion by a second strap to a dynamo making 1000 revolutions. The motor is of the XII type. It occupies a space of 3·66 m. by 2·50 m., comprising therein two fly-wheels of 1·761 m. in diameter. The diameter of the cylinder is 335 mm., and the stroke of the piston is 530 mm. The trial was made with the town gas, and the initial compression is about 5 kilos.

The lighting is effected by an incandescent tube; the burner maintaining it incandescent, consumes 250 litres of gas per hour.

The system is started with remarkable ease with the aid of the new self-starter patented by Crossley Bros., the fly-wheel being untouched. The following observations have been taken at the trial which bear especially on consumption and speed. A revolution counter actuated by a small connecting-rod at the end of the driving-shaft gives the total number of revolutions, and admits of observing the mean speed during an interval of any desired duration.

In order to count the number of admissions of the explosive mixture, M. Witz employed his electrical contact apparatus, marking at each lift of the admission valve a stroke on the scroll of a Morse receiver.

An ingenious and very simple automatic speed register, contrived by M. G. Otten, of Wallaert Bros., has served to show graphically the speeds, the maximum variations of which are given by vertical strokes traced by the pencil of the instrument, 1 mm. in height corresponding to a variation of 1·1 revolution per minute.

The power indicated has been determined by the mean pressures based on a number of diagrams, sufficient in number to reduce to a minimum the error arising from the incessant variations of admission; each time three diagrams were taken on the same paper, one above the other. The tension of the spring was adjusted following the usual method employed by M. Witz in mounting his apparatus on a reservoir containing compressed air, the pressure of which was measured by an excellent Bourdon gauge. The mean range of flexure of the spring employed was 2·54 mm. per kilogramme of pressure.

The effective power of the motor was measured by a rope brake dynamometer—which was applied without any trouble to the two fly-wheels. This brake rope made two turns, embracing the whole circumference of the rim. The upper extremity was secured to a fixed point by the intervention of a small spring dynamometer, of which the tail weight p should be deducted from the value of the load P attached to the other end of the rope and kept floating. The effective load W was then equal to $P - p$. As the brake was double, less than 20-horse were developed on each fly-wheel. The nature of the place and the form of the fly-wheels did not lend themselves to the cooling of the rims, and it was necessary to reduce the length of the trials for fear of overheating the metal. On the other hand, the values of P and p have been determined with the greatest care, and the diameters over the rims accurately measured, which were 1·761 m. and 1·762 m., the rope being 15 mm. in diameter.

The consumption of gas was shown by a special counter, placed in a room maintained at a constant temperature—this temperature did not sensibly vary, remaining steadily at 24 deg. A preliminary trial determined the importance of the leakage and loss in the piping and gas bags. The mean atmospheric pressure has been noted by a barometer which M. Witz procured expressly from his laboratory of the

"Faculté libre des Sciences de Lille." It has thus been possible for him to compute the volumes at 0 deg. at 760 mm. pressure.

The charges of gas taken in the course of the trial were measured by means of the eudiometer tube of the experimenter, the exact calorific power of the gas consumed being also ascertained. It varied little, being 5·011 heat units on the 26th, and 5·024 units on the 27th October, the volumes being reduced to 0 deg. at 760 mm., and the combustion taking place at a constant volume.

Finally, it must be said that the periods were counted to the second on an excellent chronometer. This succinct description of the methods observed in order to insure rigorous exactitude in the results of the trials testifies that nothing has been left undone which could contribute to that end.

Seven trials have been made. The first was running light; the second was also running light, but with the transmission. In the four following trials, 3, 4, 5, and 6, the indicated horse-power and the effective power were determined at the time in such a way as to establish the exact value of the mechanical efficiency of the motor: the power increased from 35 to 43 indicated horse-power.

Trial 3 of least power, was carried out in such a way as to have one explosion for two revolutions without any miss—the gas admission valve had to be regulated in consequence. In the two other trials, on the contrary, the valve was full open, and under the action of the governor, the quantity of gas admitted per charge varied with the number of admissions producing a moving impulse. It is evident that in the different trials the mean speed of the test assumed different values. These differences were desired by M. Witz, who has sought to know the values of the mechanical efficiency at different speeds. In fact, the Crossley regulators allow of sufficient modification of the speed of the motor by a simple screw adjustment—otherwise the regularity of the cycle might be affected. This is an advantage which is appreciable in certain cases. The counting of the mean number of explosions per minute ought to be very precise if it is desired to measure the indicated horse-power with exactitude. The length of these trials could not exceed thirty minutes, owing to the excessive heating of the rims. The seventh trial was a trial of lighting, and extended over three hours.

Taking a triple diagram every quarter of an hour, it was possible to determine with great accuracy the mean indicated horse-power, and also by using the mechanical efficiency obtained in trial No. 3, the corresponding effective power. We must note, as a matter of fact, that the trials Nos. 3 and 7 were made under identical conditions. The above Table A expresses synoptically the results obtained.

The constants of the calculations are the following:—

Indicated power, T_i.

$$\frac{S\,C}{4500} = 0{\cdot}10381.$$

$$T_i = 0{\cdot}10381 \times n \times p_m \begin{cases} n = \text{number of ignitions.} \\ p_m = \text{mean pressure.} \end{cases}$$

Brake power, T_e.

Mean circumference of fly-wheels, including rope—5 m, 5815.

$$T^e = \frac{5{\cdot}5815}{4500} \times N \times \pi \begin{cases} N = \text{number of revolutions.} \\ \pi = P - \upsilon = \text{net weight on brakes.} \end{cases}$$

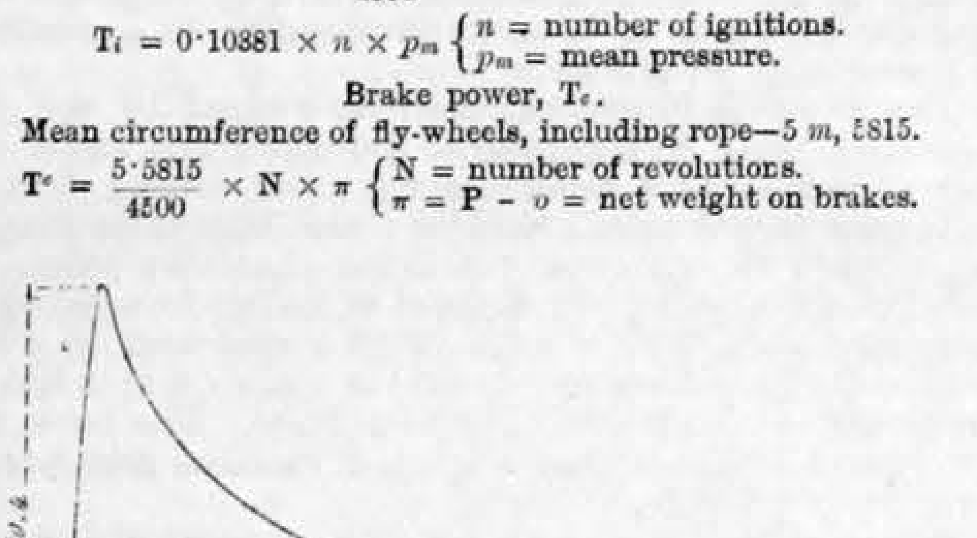


Diagram A—Crossley engine

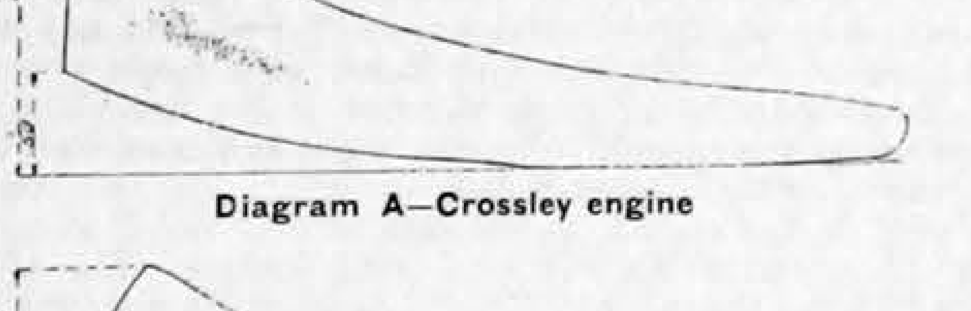


Diagram B—Crossley engine

The above diagrams are reproductions, A of the main diagram of the fourth trial, and B of the third trial. In the first, the valve was full open—while in the second, the valve checked the admission of the gas, in the same way as that in which there were as many explosions as compressions. It is remarkable that, in spite of these conditions, generally considered favourable, the consumption of gas, in connection with the effective work, has hardly changed. It is as if the mechanical efficiency slightly decreased with the reduction of the power, this being compensated, on the other hand, by the fact that the combustion took place better in a cylinder constantly reheated by the explosions.

The consumptions observed deserve notice, for they are remarkable, considering the relative poverty of the gas employed, an expenditure of 603 litres, with gas giving 5011 heat units to the metre-cube, being equivalent to an expenditure of 570 litres, with gas possessing a mean calorific power of 5300 heat units.

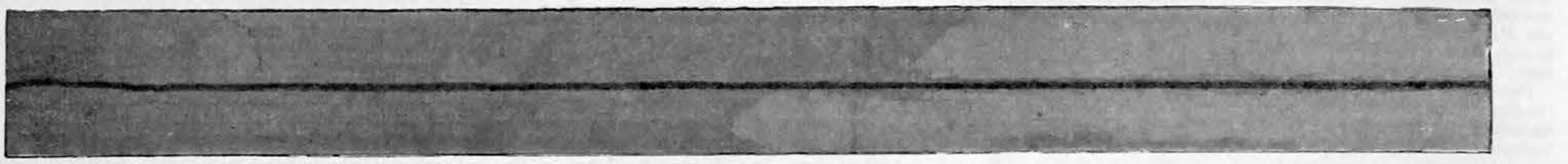
The high qualities of the engine under trial were best displayed by the thermal efficiency furnished by trial No. 6. The relation of effective work to the heat equivalent of gas used is equal to $\frac{75 \times 60 \times 60}{10{,}603 \times 5011 \times 425} = 0{\cdot}21.$

From the point of view of regularity the results are also very satisfactory; the speed remained constant, and, owing to the two fly-wheels, the blow of the explosion was scarcely felt on the diagrams furnished by the Otten apparatus. The height of the strokes does not exceed 2 mm., corresponding to a variation of 1·9 revolutions in 150 revolutions. The X motor is eminently suitable for electric lighting, from the fact that variations of voltage are very small, and the light is steady. The Raffard coupling certainly contributes to this result, but the regularity of the engine is the principal factor of success in the installation. We may remark *en passant* that a luminous intensity of 4922 candles for an hourly consumption of 18·5 metre-cubes of gas reduced at 0 deg. and 760 m. was obtained. The direct utilisation of the gas by the Bengel burners would give less light at three times the expense.

As the dynamo furnishes 16,491 watts with 1109 volts and 1487 ampères, the watt-hour costs, in consequence, 1·1 litre of gas. These results, showing the benefits which the use of a good motor for the electric lighting of industrial establishments procures, speak for themselves.

TABLE A.

No. of trial.	Conditions of trial.	Length of trial.	Mean speed N.	Net load on brake	Effective power.	Number of explosions n.	Mean pressure p_m	Indicated horse-power.	Mechanical efficiency.	Atmospheric pressure.	Temperature of meter.	Calorific power of gas.	Gas consumed by trial.	Consumption per hour.	Consumption reduced to 0 deg. & 760 mm.	Consumption per indicated horse-power per hour.	Consumption per effective horse-power per hour.	Consumption per effective H.P. per hour, burner deducted
				k.							deg		Litres.	Litres	Litres.	Litres.	Litres.	Litres.
1	Running light	15 min	168·8	—	—	15	4·77	7·42	—	759·4	24	5024	1,418	5,672	5,210	704	—	—
2	With shafting.	30 min	160·0	—	—	20	5·52	11·50	—	757·0	do	5011	3,385	6,770	6,198	539	—	—
3	On brake.	15 min.	142·8	163·6	28·98	71·4	4·78	35·43	0 820	759·4	do.	5024	5,042	20,170	18,526	523	639	632
4	Do.	20 min.	152·5	189·1	35·77	70 0	5·69	41·35	0 865	757·0	do.	5011	8,198	24,594	22,472	543	628	622
5	Do.	20 min.	161·3	181·1	36·23	74·5	5·31	41·09	0 880	759·4	do.	5024	8,173	24,519	22,522	548	622	616
6	Do.	25 min.	163·36	187·8	38·05	73·0	5 45	43·00	0 884	757·0	do.	5011	10,554	25,330	23,190	539	609	603
7	Lighting.	3 hrs.	150·68	—	28·54	75·3	4·45	34 81	0 820	757·0	do.	5011	60,660	20,220	18,511	532	648	641



SPEED DIAGRAM—CROSSLEY GAS ENGINE

SIX GERMAN STEAM BOILER EXPERIMENTS WITH THE SAME COAL (RUHR.)

By Bryan Donkin, M.I.C.E.

SUMMARY OF TRIALS.

At the Frankfort Exhibition of 1891 a committee was formed for the purpose of testing different machines, &c. It was divided into nine groups, three of which undertook experiments upon steam engines and boilers. The following firms agreed to submit their boilers for trial:—(1) Schulz, Knaudt and Co., Essen, Cornish boiler; (2) E. Willmann, Dortmund, water-tube boiler; (3) Düsseldorff-Ratinger Boiler Co., water-tube boiler; (4) Herrmann und Schimmelbusch, Kaiserslautern, water-tube boiler; (5) Göhrig und Leuchs, Darmstadt, water-tube boiler; (6) Maschinen-Bau Actien Gesellschaft, Nürnberg, water-tube boiler.

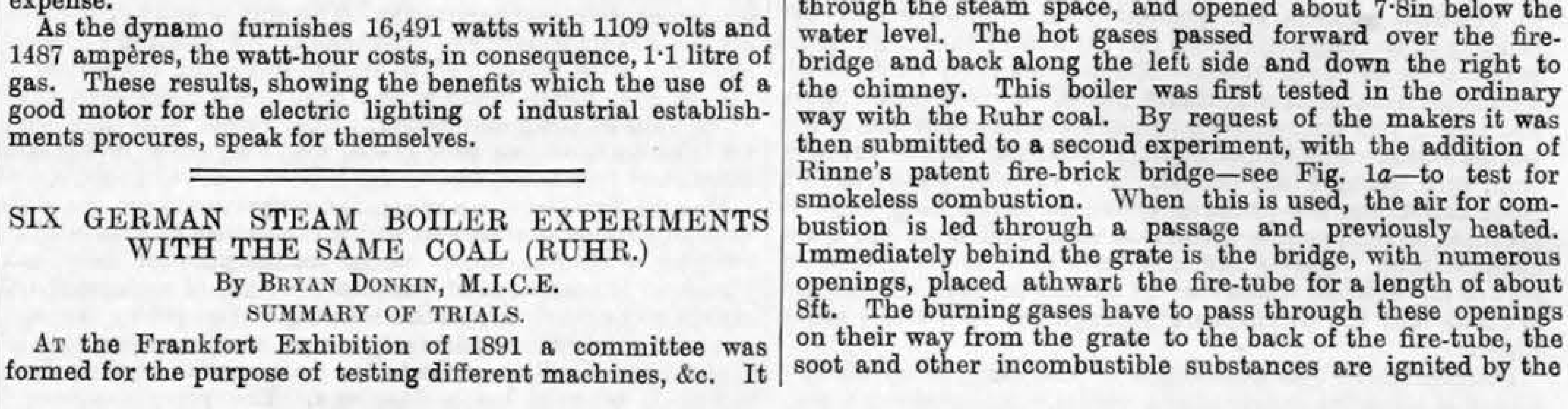


Fig. 1

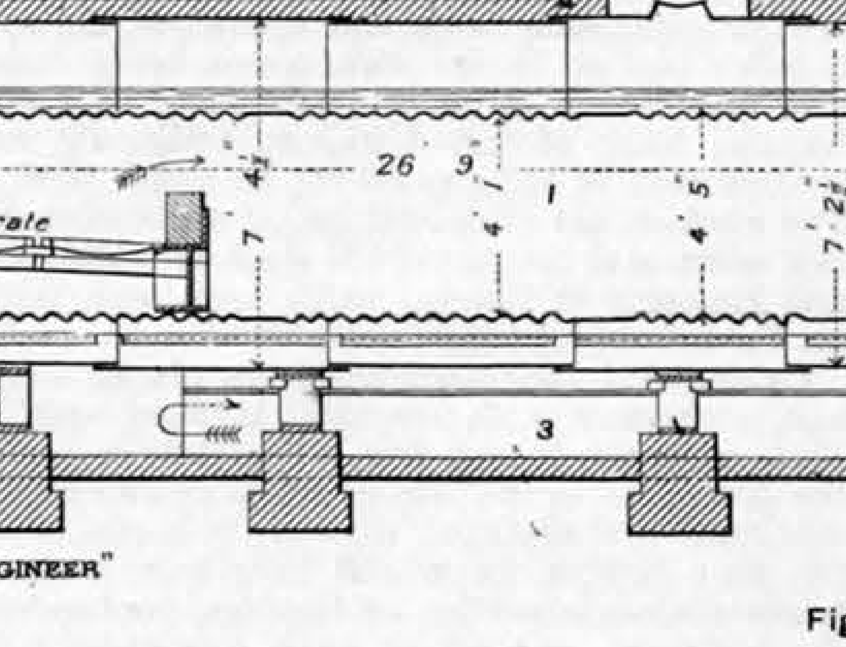


Fig. 1a

The experiments were made from August to September, 1891, in the Exhibition boiler house, but have only lately been published. The coal used throughout the six trials was "clean Ruhr nut," from the Shamrock mine, provided by the trial committee; the feed-water was drawn from the town main. As each boiler worked at a different

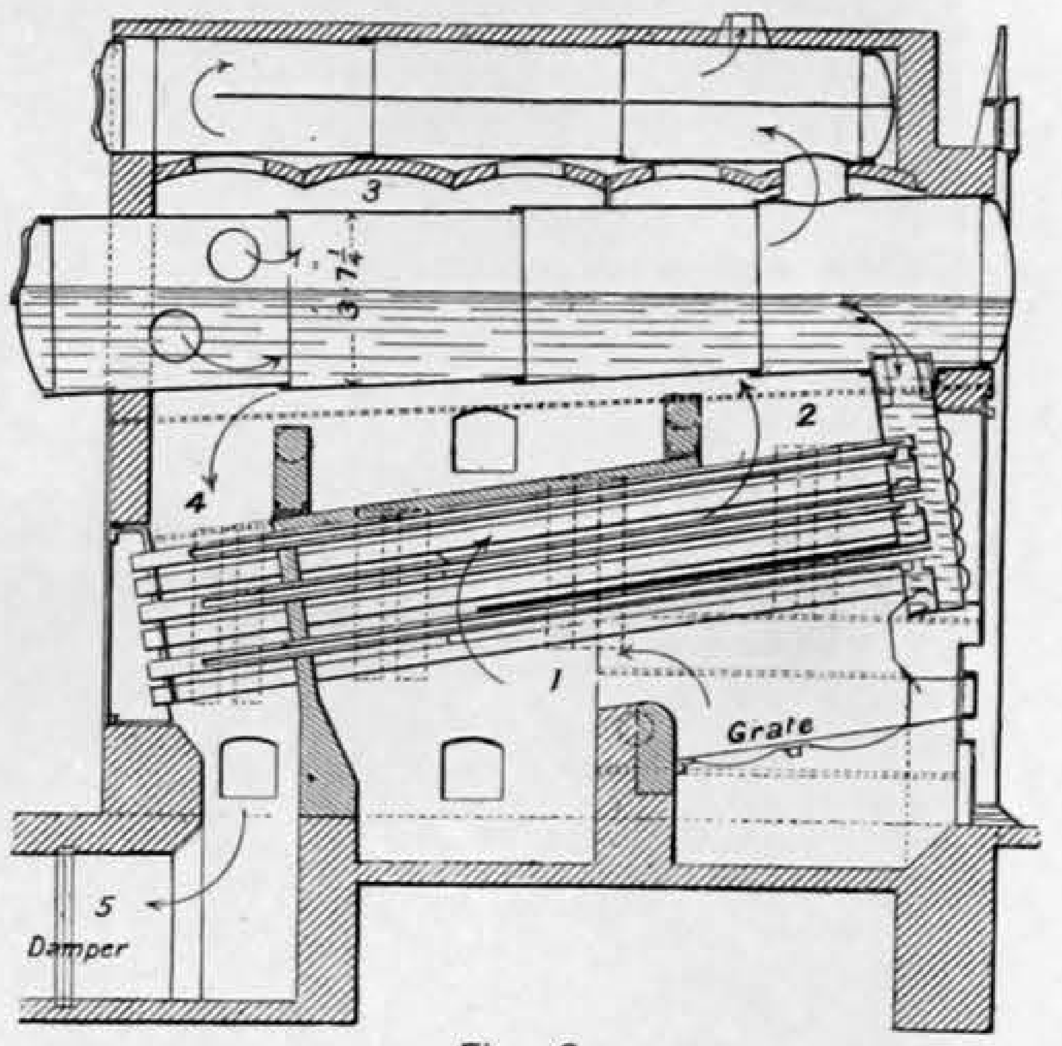


Fig. 2

pressure, there were three main steam pipes, for pressures of 8, 10, and 12 atmospheres. Four large chimneys, 147ft. high, and about 5ft. diameter at the top, carried off the hot gases. The boilers were mostly fed by steam pumps, in one case by an injector. Water purifying apparatus was also used, and during the experiments two of the boilers were supplied with purified, and four with ordinary water. The dimension and constructions of the boilers tested were as follows:—

(1) *Schulz-Knaudt.*—Horizontal single flue Cornish boiler—Fig. 1—with one internally-fired grate. Working pressure, 12 atmospheres; heating surface, 645 square feet; grate surface, 15½ square feet; length of boiler, 25ft.; mean diameter of the fire tube, 4ft. The feed-water pipe was led through the steam space, and opened about 7·8in below the water level. The hot gases passed forward over the fire-bridge and back along the left side and down the right to the chimney. This boiler was first tested in the ordinary way with the Ruhr coal. By request of the makers it was then submitted to a second experiment, with the addition of Rinne's patent fire-brick bridge—see Fig. 1*a*—to test for smokeless combustion. When this is used, the air for combustion is led through a passage and previously heated. Immediately behind the grate is the bridge, with numerous openings, placed athwart the fire-tube for a length of about 8ft. The burning gases have to pass through these openings on their way from the grate to the back of the fire-tube, the soot and other incombustible substances are ignited by the heat of the brickwork, and more perfect combustion is said to be obtained. There are also two iron tubes, 5·8in. diameter, protected by fire-clay, extending from the back of the boiler to the Rinne bridge, which admit warm air, as shown in the drawing. This trial with Rinne's patent was made with coal from another mine, Lothringen, near Herne, instead of the usual "Ruhr nut." The results were kept separate, and do not appear in the table giving the results of the six trials, but are shown as No. 7 in the graphic representation.

(2) *Willmann, Dortmund.*—This water-tube boiler—see Fig. 2—contains 66 tubes, 4in. diameter, and 15 7ft. long; working pressure, 10 atmospheres; heating surface, 1307 square feet; grate surface, 25 square feet. There are two grates, 5ft. long by 2ft. 9in., separated by a wall. In the first two flues the hot gases circulate parallel with the water tubes, then pass along the upper pipes, and downwards to the main flue.

(3) *Düsseldorff Ratinger* water-tube boiler—Fig. 3.—This boiler is similar in design to the one described above, and has two large upper tubes and a steam drum. Below are 93 tubes, 4in. diameter, 14·7ft. long; working pressure, 8 atmospheres; heating surface, 1688 square feet; grate surface, 33 square feet. The grate is in three parts, divided by walls. The arrangements for improved combustion, &c., are similar to

those of boiler No. 2, and asbestos is used to make the joints of the doors for cleaning, and prevent air from penetrating to the flues.

(4) *Herrmann and Schimmelbusch*, Fig. 4.—In this vertical water-tube boiler the tubes are disposed in three groups, forming three boilers joined together. The diameter of the tubes is 4in., length 7·3ft. Each boiler is connected to the others at the top and bottom by cylindrical tubes, and the three steam spaces are also in connection. A "Cario" grate is used, and as the firing takes place in front of the first

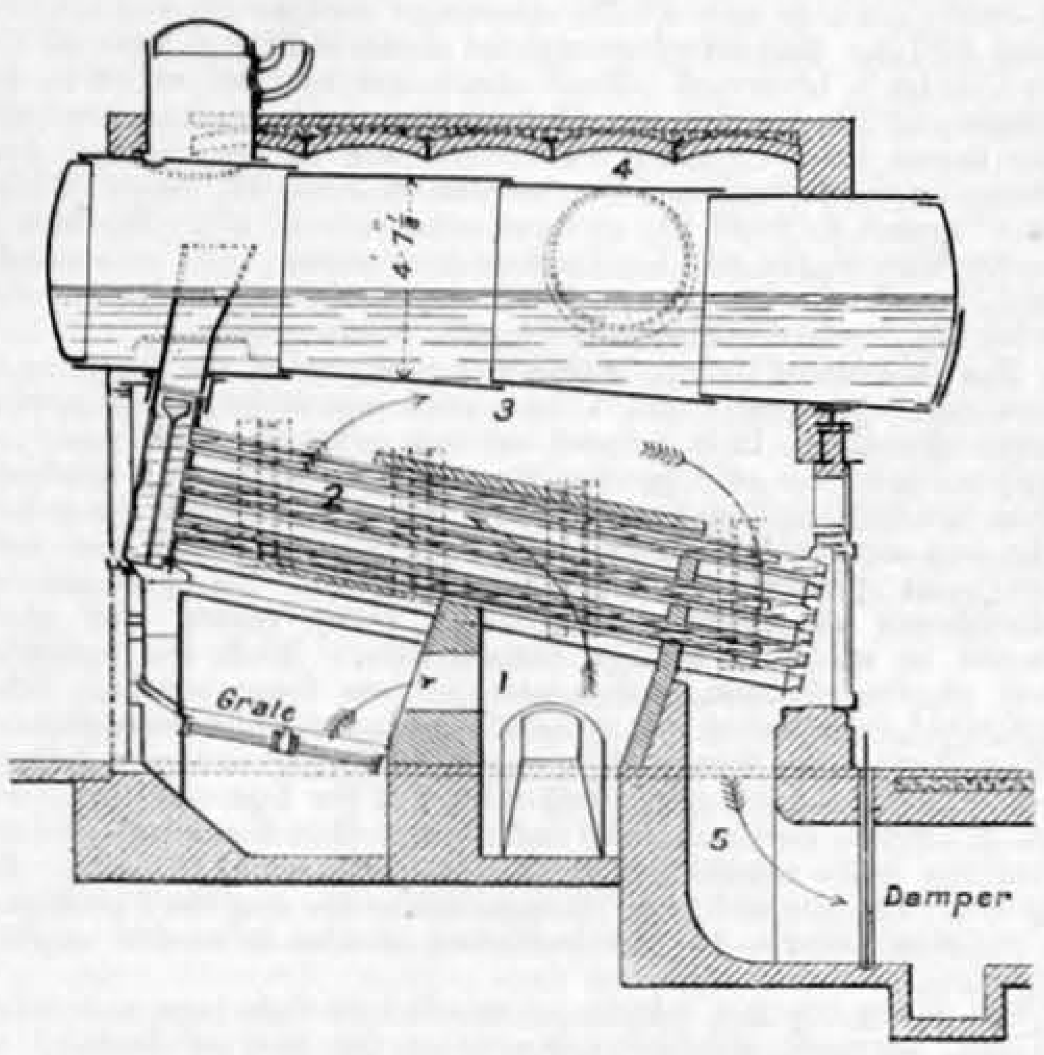


Fig. 3

boiler the water and hot gases are led off through the other two. Working pressure, 8 atmospheres; heating surface, 1614 square feet; grate surface, 32·9 square feet. Diameter of the upper boiler tubes 6·5ft. and 5·2ft. The hot gases circulate up and down between the vertical nests of tubes. With the exception of the lower parts of the three upper tubes, and the steam collector, the whole of the boiler is well protected from external radiation.

(5) *Göhrig und Leuchs, Darmstadt*—Fig. 5—This is one of the ordinary type of water-tube boilers. There are ninety-five tubes 16·4ft. long and 3·7in. diameter, connected by a water chamber with an upper reservoir, 4·9ft. diameter and 20ft. long. Working pressure, 12½ atmospheres; heating surface, 1651 square feet; grate surface 31·2 square feet. The feed water is introduced into the upper vessel, and passes first through a stand pipe in the boiler, to separate the lime and impurities. The horizontal grate is about 2·2ft. below the nearest pipes. The masonry in which the boiler is set extends to half the height of the upper tube, above which the boiler is covered with heat-protecting material. The upper part of the drum and the ends of the upper boiler are not protected.

(6) *Maschinen-Bau Gesellschaft, Nürnberg*.—This water-tube boiler consists of sixty tubes 14·7ft. long and 3in. diameter, with an upper reservoir 4·5ft. in diameter and 19ft. long—see Fig. 6. Working pressure, 10 atmospheres; heating surface, 860 square feet; grate surface, 22·5 square feet. The feed water is led first through the upper boiler tube into a receiver, where it is partly freed from impurities. The horizontal grate is about 2ft. below the lowest tubes. By a special arrangement the air admitted to the combustion space is previously warmed. The whole of the boiler, including the upper reservoir, is set in masonry. The removal of the soot takes place through the doors at the ends.

OBJECT OF EXPERIMENTS.

The object of the experiments was to determine the following:—(1) The evaporating power of each boiler per unit weight of coal, taking the feed water at 32 deg. Fah., and steam at 212 deg. Fah. (2) Efficiency of each boiler, or percentage of water evaporated to heating value of the coal. (3) Efficiency of the combustion in each case. (4) Losses of heat: Firstly, in the burnt products from the grate; secondly, carried off to the chimney; thirdly, in the incombustible gases; fourthly, lost by radiation or soot, or otherwise unaccounted for.

To form a basis of comparison for the different boilers, from 12½ to 24½ lb. of Ruhr coal were burnt per hour per square foot of grate surface. Thus the boilers were not forced; the combustion of the coal and cooling of the hot gases was as complete as possible; and every effort was made to obtain the best evaporation. The quality of the steam was also determined, or the quantity of priming water in the steam in the different cases.

The chairman of the committee was the well-known Professor M. Schröter, of the Polytechnische Hoch Schule, Munich, and there were four members and eight assistants. Each experiment was personally superintended by one of the above. Every boiler was first tested for leakage, and a preliminary experiment made, to accustom the assistants to take the various observations. Two experiments, each of nine or ten hours, were then carried out, and the mean determined from both, all measurements and observations being made independently by two persons under the constant supervision of the director. The results may be classed under the following heads:—

(1) *Coal and residuum of combustion*.—One kind of coal only was used for all the six boiler tests. Although distinguished as "clean Ruhr nut coal," it contained a good deal of incombustible matter. It was easily kindled, and did not cake readily, nor did the ashes run together, but fell mostly through the grate bars; hence there was no difficulty in keeping the latter clean. The coal was carefully weighed in quantities of 154 lb. at a time. Before the beginning and end of each experiment the fires were kept as low as possible, the thickness of the layer of combustible being reduced to about ⅜in. The maximum error on this account was put at 1 per cent., to which should be added any slight error caused by the difference in the heating value of the combustible left on the grate.

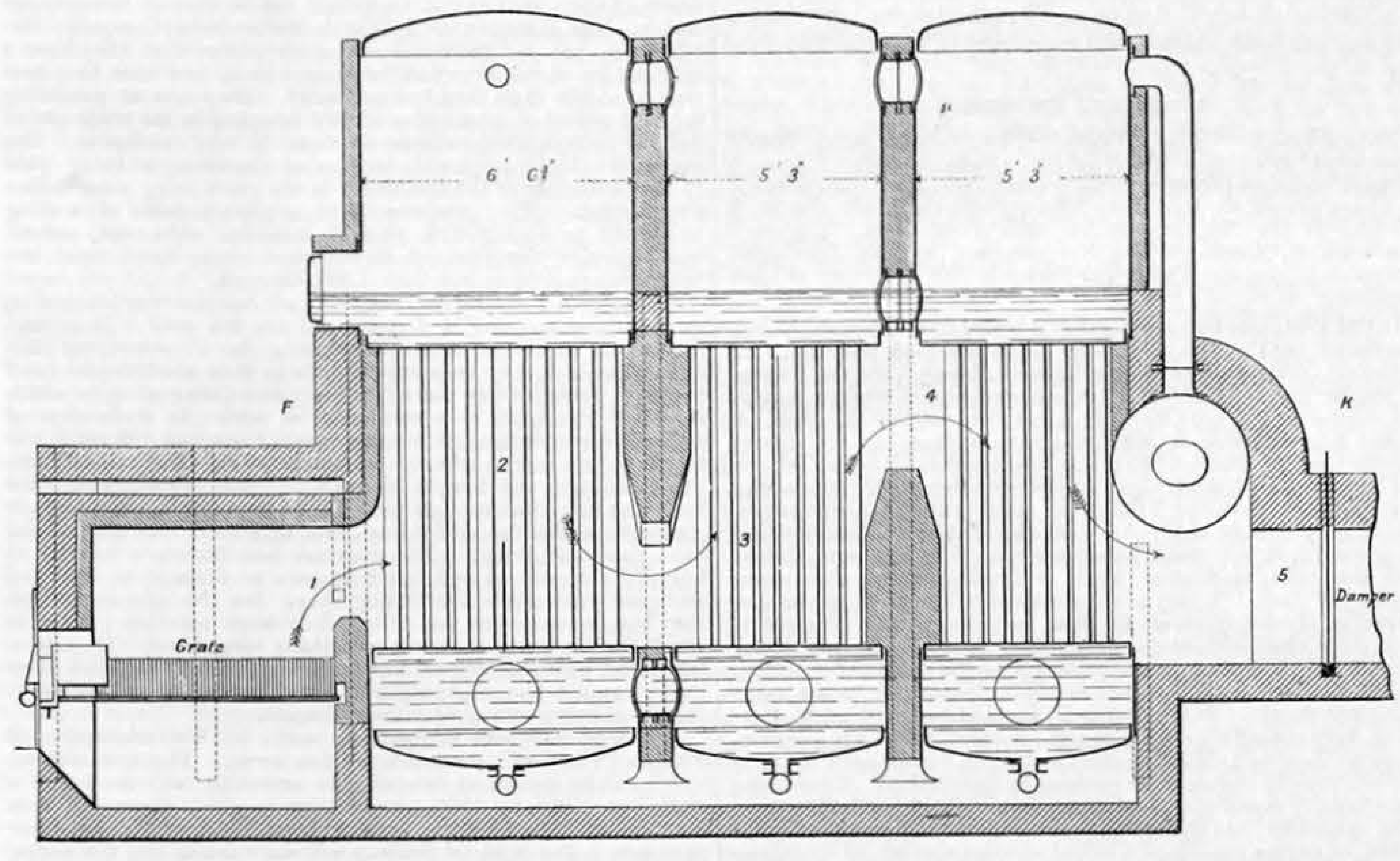


Fig. 4

The heating value of the coal was carefully determined by analysis of its chemical constituents, made separately for each experiment by Dr. Bunte, a part of whose report is appended. To obtain a fair average specimen of the coal, a small quantity was taken from each lot when weighed, and after mixing, a sample of 44 lb. was reserved for testing. To determine the percentage of moisture, a handful was withdrawn from the coal every two hours, and enclosed in a hermetically sealed glass vessel. The samples thus obtained during each experiment were placed, together with others from the residual products, in a box, and carefully labelled. For each trial the quantity of water and ash contained in the coal, and the amount of combustible in the residuum, were determined, as well as the composition of the latter. As the whole of the coal was delivered from one mine its composition was presumably the same, the only variation being in the percentage of water and ash; and this was found to agree with the results of the analysis.

The mean chemical composition of the combustible in the six experiments was:—C., 88·55 per cent.; H., 4·90 per cent.; sulphur, 1·45 per cent.; O (residuum), 5·10 per cent.: total, 100 per cent. The variations were so slight that this mean was used for all the experiments. The analysis of the constituent parts of the coal gave the following results as the mean of six experiments:—Fixed carbon, 74·263 per cent.; volatile substances, 19·323 per cent.; ash, 5·610 per cent.; water, 0·803 per cent.: total, 99·999 per cent. Percentage of coke 79·87. The heating value was obtained by calculating the mean heating value of the carbon, hydrogen, oxygen, sulphur, water and ash from twelve analyses, and was determined at 7618 calories = 13,712 T.U.

(2) *Feed water and steam*.—The feed water was measured in a tank placed on a weighing machine, in quantities of 1100 lb. to 1760 lb. The weight of water was noted, the time of weighing, and the beginning and end of each time of feeding. The quantities were strictly controlled by two observers. In some of the experiments the water was led directly from the tank to the boiler; in others it was first passed into a feed-water tank, the level of which was kept uniform at the beginning and end of every experiment. The temperature of the feed-water was always noted. To avoid, as far as possible, the error entailed by a difference in the quantity of water at

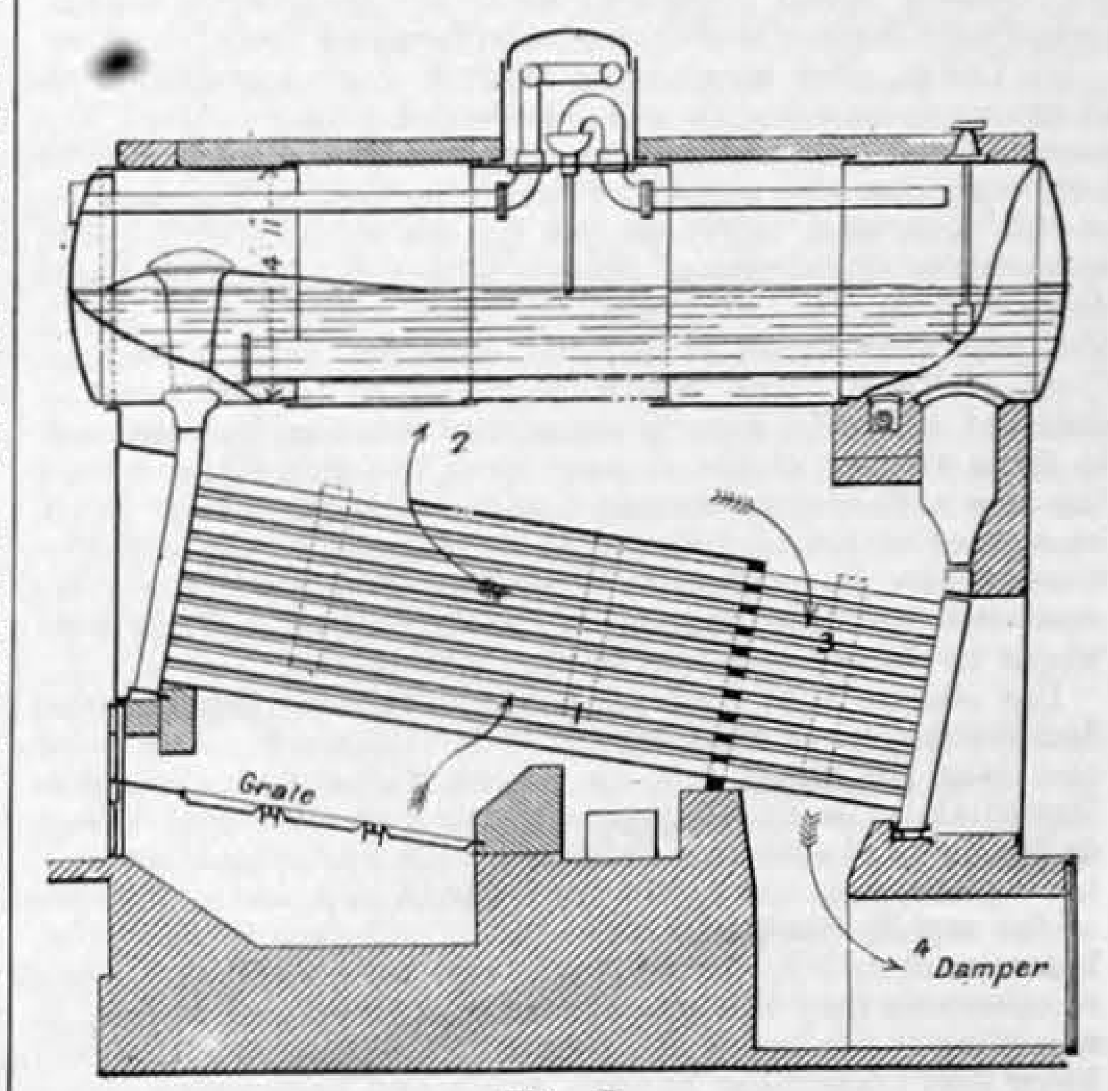


Fig. 5

the beginning and end of an experiment, no trial was concluded until the water level and steam pressure were the same as at the commencement. The fires were also lowered as much as possible to obtain uniformity of evaporation, and the boiler was supplied with a minimum of water, that the composition and temperature of the feed-water might be the same. Further, it was considered desirable that the experiments should begin and end at a time when little steam was required. By these means the level of water in the water gauge was the same, as also the temperature and amount of steam in the boiler water, and the possible error thus reduced to ½ per cent. All pipes being shut off except those in actual use, there was no outlet for water not evaporated, nor possibility of admitting water unless it was weighed. The heat of the steam was calculated from Regnault's formula, and the steam temperature taken from Fliegner's tables. The steam pressure was determined from the manometer on the boiler, checked by a tested standard gauge, and noted every quarter of an hour. Here the maximum limit of error was 0·18 per cent. Priming, or moisture in the steam, was determined independently of the evaporation. All the boilers were submitted to this test except No. V., in which, by request of the makers, it was not carried out. The experiment lasted about eight days for each boiler, and was made once a day. A solution of common salt was fed into the boiler with the feed-water, until the proportion was 1½ per cent. After the

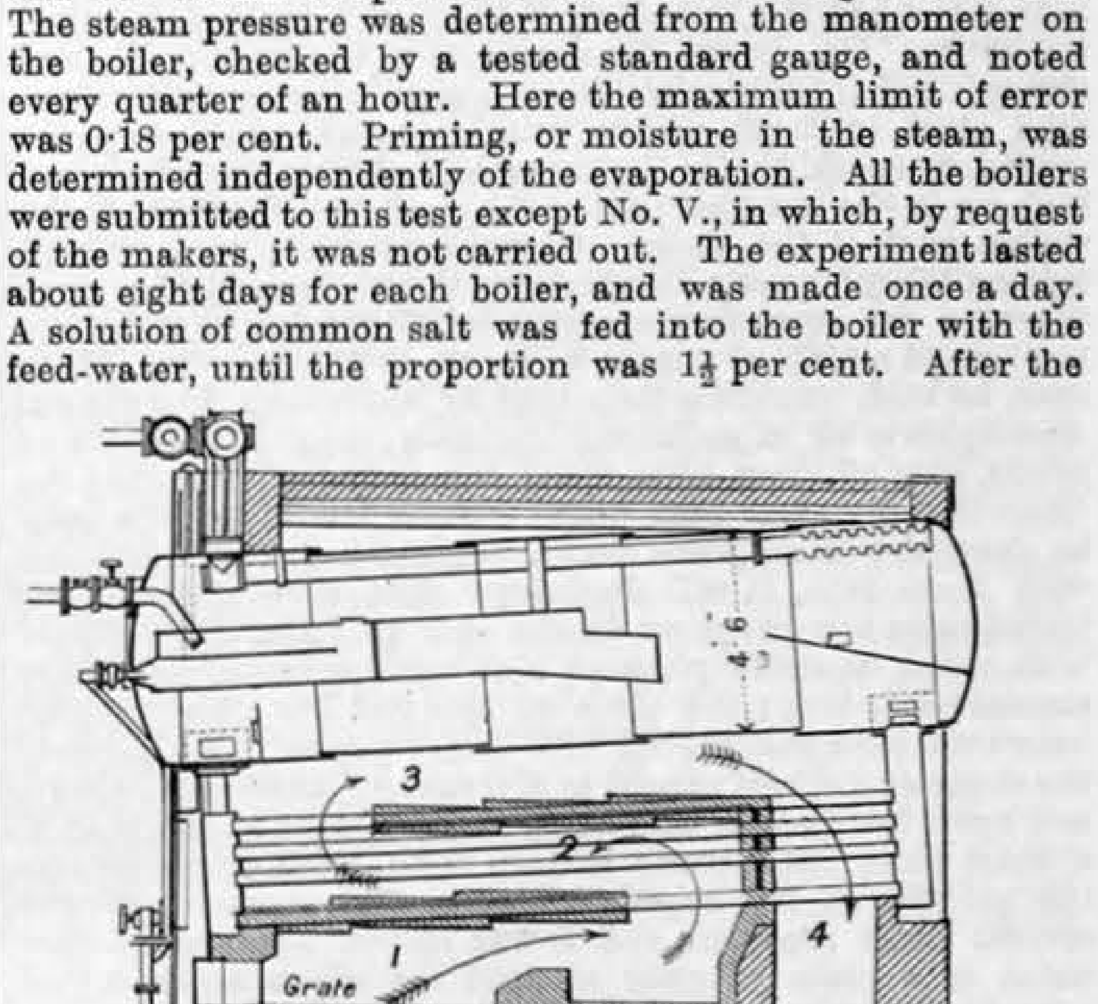


Fig. 6

boiler had been working for a day, and the salt and water were thus well mixed, two samples were taken from the water at the same time, one from the boiler near the upper evaporating surface, and one from the nearest water separator in the steam pipe. These samples were tested for their proportion of salt; the percentage of salt contained in the boiler water was also determined, and thus the

TABLE B.

Name of boiler.	Feed-water used.	Salt in boiler water.	Salt in water from steam pipe.	Salt in feed-water.	Moisture in the steam.
		%	%	%	%
1. Essen, Cornish	Ordinary water Co.	1·524	0·00116	0·00146	0·076
2. Dortmund, Water-tube	Purified	1·229	0·00138	0·00195	0·112
3. Ratingen " "	Ordinary	1·146	0·00155	0·00148	0·135
4. Kaiserslauten " "	Purified	1·442	0·00122	0·00193	0·055
6. Nürnberg " "	Ordinary	1·610	0·00246	0·00164	0·151

amount of priming water in the steam. To prevent the evaporation of part of the hot water from the boiler and separator, and hence an increase in the percentage of salt in the sample, it was first led through a copper refrigerating coil. In both samples the proportion of salt was determined with a solution of nitrate of silver, monochromate of potash being used to indicate it. To check the results, the natural proportion of salt in the feed-water was obtained by the same process, and each time a sample was taken the level of water in the boiler was read off. This method of determining the priming in the steam was not considered absolutely free from error, but it was adopted for want of a better. The results obtained were as shown in Table B, preceding page.

To be continued.

THE ROYAL INSTITUTION.

THE WORK OF HERTZ.

On Friday night last, Dr. Oliver Lodge, F.R.S., delivered a lecture at the Royal Institution, on "The Work of Hertz." Mr. Ludwig Mond occupied the chair, and there was an exceedingly large attendance of members and their friends.

Dr. Lodge, after mentioning Fresnel, Carnot, and Clifford, as among those scientific men in whom a young and brilliant career came to an untimely end, said that they had now to add to the list the name of Hertz, who died on January 1st of this year, aged thirty-six, yet not before he had founded an epoch in experimental physics, which will hand his name down to posterity. Of the seed sown by those before him in the same department of research, none had done more than Clerk Maxwell. The popular estimate of the eminence of different scientific men is sometimes more or less amusing to those working at the same subject, but this has not been the case with Hertz, who well deserves his fame, and it would be a graceful act of tribute to his memory if the Physical Society saw its way clear to collect and publish all his scattered scientific papers. His students and those with whom he worked held him in high estimation.

His lecture that evening would consist of experimental demonstrations of the outcome of Hertz's work. As a stone cast into the water sets up ripples which do not subside immediately, in an analogous manner an electrical charge or discharge of sufficient suddenness communicated, say, to a brass globe, does not settle down easily, and the oscillations of the rapidly diminishing charge excite waves in the ether. If a wire should be handy, these oscillations will run along it, otherwise they will go forth into space, varying as they go according to the law of the square of the distance. Maxwell knew that there must be such waves, and knew many of the phenomena connected with them; their length was known from a thousand miles to a foot, and even how to make them; all this was believed with varying degrees of confidence, but Hertz supplied the experimental verification. The lecturer here showed how a Leyden jar discharged through a yard of wire, and near a similar jar with closed circuit, causes an overflow of electricity in the latter, which discharges itself through a small air-hole previously made in the glass, at the top of the tinfoil coatings. If the coatings of the jar be more separated a typical Hertz's oscillator is the result. The electrical oscillations soon cease, in consequence of the radiation of energy. The oscillator has to be "in tune" with the radiating source.

Hertz discovered electric synchrony; he also found the previously calculated lengths of the waves to be true in fact; he likewise observed that the secondary spark occurs more easily when it can "see" the light from the first spark, that is to say, when the light from the primary spark falls upon its knobs. Dr. Lodge illustrated this by experiment, and showed that the interposition of a piece of common transparent glass in front of the primary spark would stop the secondary sparking, for the rays which favour this effect are high up in the invisible part of the spectrum, far beyond the visible part of the violet. Glass stops these rays of high refrangibility; quartz does not stop them or but slightly stops them, so the secondary sparking continues during the interposition of a plate of quartz, as shown by the speaker. Fluor spar, he said, transmits them slightly better than does quartz. Atmospheric air in sufficient thickness, especially the air of towns, cuts off these ultra violet rays. Helmholtz made the important discovery that under certain conditions, if a body be charged with negative electricity, and then be illuminated with these rays, it will discharge. The lecturer here projected upon the screen an image of a gold-leaf electroscope, with which a small piece of zinc was connected by a wire several yards long; the piece of zinc had but a few minutes before use been well rubbed with emery paper. The leaves of the electroscope were caused to diverge by negative electricity, and upon the piece of zinc being then inserted in the path of a beam from the electric lantern with a quartz condenser, the gold-leaves fell together again. This experiment was several times repeated, and it was shown that the interposition of a plate of glass stopped the effect which would otherwise have been produced by the zinc.

Dr. Lodge drew attention to a large Hertz's vibrator, analogous in principle to a Leyden jar with its coatings very wide apart, and said that it would radiate waves about 30 metres long, giving about 10,000,000 electrical vibrations in a second, and that when excited, almost all the reasonably elongated conductors in the theatre would give off sparks. It would not work well that evening, however, because it had been necessary to hang it near a wall, in which when in action it produced an image of itself, which image tried to undo all that the vibrator was attempting to do. There is something analogous to this in singing flames, which will not sing so easily when placed near a wall.

Hertz found that his small sparks will start the current from a battery through a small gap in a circuit—a gap, for instance, like that produced by a bad contact in an oxidisable metal, such as iron, and Professor Fitzgerald had shown that a very delicate galvanometer would indicate when a spark passed in a Hertz's detector. The speaker here described the action of a considerable variety of detectors, and spoke of one devised by Professor Minchin, of Cooper's Hill, as being astonishingly sensitive; the instrument responds to the radiation from a star. By means of suitable vibrators and detectors, he—Dr. Lodge—at Liverpool had transmitted quite strong signals through a distance of sixty yards in the open air; he thought that the limit with that apparatus might be, perhaps, half a mile. A short spark does better than a long one to excite the vibrations. A tube of iron filings makes a suitable bad contact in an electrical circuit to be bridged over for the current by the Hertz spark, and Dr. Lodge made some use of this method in his experiments, employing also a delicate reflecting galvanometer to indicate the passage of the spark. All the brass knobs used in the experiments had to be highly polished.

Dr. Lodge showed that the radiant waves with which he was dealing would not pass through metal casing, which must be pretty complete. For instance, his detecting apparatus would not respond to the working of an ordinary electrical gas-lighter while its insulating handle was wrapped round with tinfoil; the brass tube covered the rest of the instrument, but when he tore away a piece of the tinfoil, and exposed a portion about as big as a shilling of the insulating handle, the detecting part of the apparatus helped to indicate the presence of the waves, when the gas-lighter was worked at a distance of several yards. The radiation coming from an oscillator in the library at the other end of the Royal Institution building was also indicated by the apparatus on the table. Very sensitive detecting and indicating apparatus, he said, will often be picking up such radiations coming from nobody knows where, sometimes perhaps from a thunderstorm a long way off.

When the vibrator is placed in a copper vessel, not much of the radiation will come out through round holes of moderate size in the vessel, but much more from a long slit in the metallic covering. In his later experiments he protected all parts of the whole apparatus with copper coverings, removing the copper from those places only at which he wished the radiation to escape. Not being a physiologist, he felt at liberty to indulge in the wildest speculations on that subject, so would suggest that the eye might act in subservience to some of the principles with which he had been dealing, and vision excited by means of apparatus containing gaps of badly conducting media.

With the radiations screened off by copper covers from all directions, except those in which he wished to use them, he showed that these radiations can be refracted by a block of paraffin, also that they can be reflected from any one of its faces; the paraffin prism he used had faces of about a foot square each. He also showed that the radiations can be polarised; the polariser and analyser he used each consisted of parallel copper wires all in one plane, and kept in position by a wooden frame, to which their ends were attached. When the two frames were placed so that the wires were crossed the radiations did not get through; they were at right angles to the plane of polarisation. He reflected the radiations also by a copper disc; a plate of glass did not reflect them because, he said, its surfaces were too close together. He also stated that the waves he was using were 9in. long. The copper plate formed much the best reflector.

The large attendance of many of the old friends of the Institution from among the most eminent scientific men of the day, not often now seen there together in such numbers, and the attention given to the speaker's words by all present, showed the widespread interest in this lecture, which, however, much needed wall diagrams to give precise information as to all the conditions of the experiments to those who were new to the subject.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Fleet engineers: Ivie A. Couper, to the Impérieuse, to date June 15th; and E. J. Comley, to the Cyclops, to date June 5th. Staff engineer: James J. Walker, to the Northampton, to date June 14th. Engineer: Frederick W. Austin, to the Northampton, to date June 14th. Assistant engineer: Victor de Paris, to the Benbow, to date June 4th.

Large Gas Engines and Scotch Anthracite.—Messrs. Robert MacLaren and Co., the well-known cast iron pipe founders, Port Eglinton, Glasgow, have just instructed Messrs. Tangyes Limited to fix for them a 60 nominal horse-power single-cylinder Tangye gas engine and a producer gas plant for working it. This gas engine is to replace about a dozen steam engines, and will have a regular working load of 100 brake horse-power. It is, we believe, the largest single-cylinder gas engine yet attempted. The engine is expected to develope 1 indicated horse-power with a consumption of only ·8 lb. of anthracite coal per hour, which will probably be about 1·2 lb. per brake horse-power, a result not yet attained with the most economical triple or quadruple-expansion steam engine yet made. It may not be generally known that the coal measures of the West of Scotland contain a vast quantity of anthracite coal suitable for the generation of the gas used in this type of engine, but up to the present time the demand for anthracite in the district has been but small in proportion to the possibilities of supply. In the North of England large gas engines are much more commonly employed and for a great variety of purposes, Messrs. Armstrong, Mitchell and Co. having, for instance, as many as twenty-eight such engines running in their works. Considering the quantity of suitable fuel which is closely at hand, it is somewhat surprising that Glasgow has not vied with Newcastle in the use of an engine which would afford a better market for its anthracitish coal, and thereby augment the commercial value of its great mineral resources.

Torquay Sewerage.—In a paper read before the Municipal Engineers at Torquay on Saturday, on the "Municipal and Harbour Engineering Works, Torquay," Mr. Henry A. Garrett, Assoc. M. Inst. C.E., borough and harbour works engineer, mentioned that the sewerage system of the town was designed and carried out by the late Sir Joseph W. Bazalgette, between 1875 and 1878. Its main features are a high and a low-level system of sewers. The outfall is at Hopes Nose, the eastern extremity of Torbay, and about two miles from the town. It is 7ft. in diameter, and its level is 4·16 below high-water spring tides; the total length of the high-level sewer is 17,030ft., and for a length of 11,387ft. it is 7ft. diameter. The fall is 1 in 1177. There are three tunnels, the Waldron, the Meadfort, and the Kilmorie. The Waldon is 1150ft. long, and is 5ft. 6in. high by 4ft. wide. It is bored through Devonian limestone throughout, the invert being lined with cement. The cost of this tunnel amounted to 36s. per lineal foot. The Meadfort tunnel is 4458ft. long and 7ft. diameter throughout; the nature of the ground through which it was bored varied considerably, part being limestone rock, part shale, and part very soft ground. Where the rock occurred, the invert and half the ring were lined with Portland cement, and the remainder throughout was lined with two rings of brickwork in cement backed with concrete. The average cost of this tunnel was 29s. per foot lineal. The Kilmorie tunnel and the Meadfort sea wall was, however, the most difficult portion to deal with. It was also necessary to construct a massive sea wall at the toe of the Meadfoot Cliff, 1900ft. in length, of random course masonry backed with rubble, behind which the sewer, 7ft. diameter, was constructed. The sewer consisted of a single ring of brickwork founded upon a concrete bottom carried down to the solid rock. The Kilmorie tunnel is 4564ft. long; the nature of the ground through which it is bored varied greatly, in some places argillaceous siliceous grit with bands of pure quartz, and in others soft shaly composition, and at its extremity near the outfall it is of pure limestone. In the rocky portion, the invert and half the ring only is lined with cement concrete, and in the soft ground the sewer is lined with concrete for its full circumference. In some places this ring of concrete is suffering a little from the crushing by the weight of the ground and prevalence of water in the shaly parts, and the author has found it necessary—as also did his predecessor—to cause the concrete to be cut out and brick linings to be inserted in several parts for distances varying from 9ft. to 35ft. each. The total cost of the tunnel was £14,358, or £3 2s. 11d. per lineal foot.

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

(From our own Correspondent.)

The iron market this week has been slightly improved in tone, this circumstance being occasioned by the better accounts from Cleveland. Ironmasters report that, compared with the end of the first half of last year, the work on the books at present is favourable. Marked bars were quoted this week £7 10s. per ton for ordinary makes, and £8 2s. 6d. for the L.W.R.O. brand. Second-class bars were £6 10s., merchant sections £6, and common bars £5 10s. Galvanised corrugated sheets of 24 w.g. were £9 15s. to £10, f.o.b. Liverpool. Black sheets are nominal at £6 7s. 6d. singles, £6 10s. doubles, and £7 5s. lattens. Steelmakers are quoting sheets for galvanising £7 doubles and £7 15s. trebles. Iron stamping sheets were on the market at £8 to £9, hoops £6 10s., small rounds £6 to £6 5s., and gas tube strip £5 15s. Pig iron is rather easy at 37s. 6d. for Staffordshire cinder, 42s. part mines, and 55s. all-mine hot blast. Midland sorts delivered here are this week 42s. Derbyshires, and 39s. to 40s. Northamptons.

The question of the applicability of this part of the kingdom to steel-making, upon which I last week remarked, is occupying much attention. It is pointed out that so long as steel could be only made on the acid process, there was a reason why Staffordshire as a manufacturing centre was out of the running, as the native pig iron contains more or less of phosphorus. But now that the basic process of steel-making renders the presence of phosphorus an advantage, there is every reason why steel should be made to a large extent here. With the splendid fuel of the district, comparatively free from sulphur, with unlimited supplies of ore especially suited for the manufacture of basic pig iron, there is, it is urged, no district in Great Britain better placed for the production of steel of the best qualities. We are reminded that one great advantage that the basic process possesses is the commercial value as a fertiliser of the slag. In point of fact, it is said that "at some works the slag itself produces a sufficient return to pay handsome dividends on the capital invested."

The re-construction scheme of the Round Oak Iron and Steel Works, formerly the sole property of the Earl of Dudley, is proceeding so satisfactorily that in a few days it is expected the scheme will be completed, and the works resume operation under the usual management. In the meantime, the large steel plant now being put in is progressing. Under the new arrangement, by which the Earl of Dudley takes more direct control of the works, Mr. Dalgleish, who has been chairman of the company since its formation, and another Lancashire director, both resign their seats, and three new directors have been appointed, namely, Mr. G. H. Claughton, Mayor of Dudley, and principal mine agent to the Earl of Dudley; Mr. Francis Grazebrook, of Netherton, and Mr. James Roberts, pipe founder, of West Bromwich. Mr. Claughton has been elected chairman.

By the laying down of the latest and most improved machinery, the local small arms and ammunition manufacturing firms are doing all they possibly can to induce the receipt of Government orders. The chairman of the King's Norton Metal Company, Birmingham, has just informed the shareholders that they have a splendid lot of machinery at the present time, and that they propose to add to it as they find necessary. They aim at possessing the best means of production of any company in the trade and at defying competition, which at date is very excessive. The works are fairly employed, and most attention is being paid to the perfecting of the machinery in the quick-firing ammunition department. The company have a plant capable of making 10,000,000 to 15,000,000 a year of cartridge cases and bullets, but owing to the want of Government work, the output last year was something less than 2,000,000 cases.

An important matter to machine tool builders was touched on at the annual meeting of Kynoch and Co. this week. In enumerating the important additions—costing in all something like £15,000—which they have of late made to their machine plant and premises, he said there was an entirely new fitting shop, in which they had about 200 men constantly at work. In these days of excessive competition all manufacturers knew how difficult it was to get in any way in advance of competitors. The moment any new machinery was bought through the ordinary channel, "the firm that was kind enough to sell it to them went round to one's competitors with the glad tidings, and suggested that they should have the same thing." The directors had therefore decided to keep their inventions and improvements to themselves, and turn them out inside their own fitting shop. He also announced that they had erected what was called their large machinery room, in which their military work was principally turned out. Likewise a large and complete set of copper rolling mills, from which they could turn out about seventy-five tons of rolled metal per week, the metal being entirely for their own use.

The new electrical engineering works at Wolverhampton of Thomas Parker will cover four or five acres. The first section, which will be capable of considerable extension, will consist of a workshop 150ft. by 150ft., in addition to which there will be a foundry of 120ft. by 40ft., pattern shops 80ft. by 40ft., and other premises. The Midland Railway will run a siding into the works, the erection of which is to be commenced almost at once. The Council of the Institution of Civil Engineers has awarded Mr. Parker, the managing director of the new company, a George Stephenson Medal and a Telford premium for his recent paper on the electrical equipment of the Liverpool Overhead Railway.

Regarding the contract mentioned in my last, entered into by the Birmingham Corporation with Messrs. Morrison and Mason, Glasgow, for the construction of one of the sections of the new Birmingham Welsh water conveyance scheme, I may say that the total length of the aqueduct covered by the contract is 10½ miles, of which 6¾ miles is tunnel. The amount of the contract is £284,821, on the basis of the tunnel being lined throughout. The time allowed for its completion is five years, but for certain of the works the time is limited to a shorter period. The Elan works in connection with the scheme have now so far proceeded that the Water Committee think it will be well for the Corporation to visit them. The first section of the railway will shortly be completed. The committee propose that the Council should visit the works next month.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—The continued absence of improvement in the general outlook of trade as regards the engineering iron and coal industries of this district is producing a despondent tone as to the prospects for the remainder of the year. Here and there some hopeful anticipations are based upon the possibility that the revised American tariff, which is fully expected to be definitely settled before the close of the present month, may bring increased activity to the iron trade, but apart from this there seems to be practically nothing, at any rate in the near future, upon which to base any really confident expectations of reviving trade. Unless there is some improvement it seems more than likely that the wages question will again come to the front in the coal trade, and the probable outcome of the action taken by the Miners' Federation in Scotland is just now being watched with considerable interest in this district.

An altogether lifeless tone continues throughout the Lancashire iron market, and although there was a fair average attendance at the Manchester 'Change meeting on Tuesday, complaints on all sides were prevalent as to the absence of business of any weight coming forward. In pig iron consumers go on buying simply in the merest hand-to-mouth parcels, and even to secure these extremely low prices have to be taken by makers, whilst in the open market for orders of any moment there is exceedingly keen cutting to secure them. Lancashire makers are doing little or nothing in the way of securing new orders just at present, as except where they have specially favourable conditions they are altogether cut out of the market by the excessively low prices at which Lincolnshire iron can be bought. Local makers are still asking about late rates, but as they would have to come down considerably upon these to secure business, they are altogether nominal. Lincolnshire iron does not now average more than about 39s. net cash for forge, and at this figure moderate sales have here and there been made, whilst foundry qualities are quoted at 40s., with Derbyshire foundry iron about 45s. to 46s. net cash, and P.G. Lincolnshire foundry quoted at 43s. to 44s., less 2½, delivered in the Manchester district. For outside brands offering here prices are much the same as those quoted last week, good foundry Middlesbrough averaging 43s. 7d. to 43s. 10d. net cash, delivered Manchester, and Eglinton obtainable through second hands at about 45s. 6d. net prompt cash, delivered at the Lancashire ports.

In the finished iron trade business is reported to be worse than it has been for a considerable time past, very few makers booking new orders sufficient to keep their works going more than about half-time, and generally a very despondent tone is taken with regard to the future. Makers, however, seem determined not to give way further in their prices; in fact, there is not sufficient inquiry to tempt them to offer further concessions, and it is doubtful whether lower prices would bring forward any appreciably increased weight of buying. Delivered equal to Manchester or Liverpool, Lancashire and North Staffordshire bars remain at £5 10s. to £5 12s. 6d.; Lancashire sheets, £7 to £7 5s.; Staffordshire, £7 7s. 6d. to £7 10s., and Lancashire hoops, £5 17s. 6d. for random; and £6 2s. 6d. for special cut lengths.

In the steel trade business remains extremely quiet, with very low prices ruling; ordinary foundry hematites do not average more than 52s. 6d. to 53s., less 2½, and ordinary basic billets not more than £5, net cash; whilst steel boiler plates are quoted at £6 5s. to £6 7s. 6d., and ordinary steel girder plates at £5 15s. to £5 17s. 6d., delivered in the Manchester district.

There is still no material change to report as regards the engineering industries. Amongst boilermakers—as noted last week—there is an increased weight of work stirring, some of them having booked a fair number of orders recently, and one of the locomotive-building establishments in the district is pretty full of work for the present, but other establishments continue only very poorly off for orders. As regards machine tool makers the position is very much the same. Here and there, on specialities, some of them are tolerably busy, but generally they are only indifferently engaged, and general engineering work continues very quiet.

Messrs. Cunliffe and Croom, of the Broughton Ironworks, Manchester, have just completed a specially designed four-spindle drilling machine, which contains several improvements in tools of this class. The machine has been specially constructed for drilling the spindle rails in winding frames, but is applicable for many purposes where accurately pitched holes are required. The spindles can be arranged to be a definite distance centre to centre, or to vary, as may be required. The headstock carrying the drill spindles is fed down automatically, the spindles never leaving their bearing, and when the holes have been drilled the required depth the drills are withdrawn, automatically, ready for the attendant to traverse the head along the bed for the next set of holes. The machine has a bed 18ft. 6in. long, to drill four holes at once, 5in. centre to centre, in rails 15ft. long, and to clear 20in. between the uprights, and admit and drill rails, beams, &c., 8in. deep. The gear is of sufficient strength and power to drill four 1in. diameter holes at one operation, and the depth of self-acting feed is variable.

Amongst other special engineering work I may mention that Messrs. Hulse and Co., of the Ordsal Works, Salford, have just completed for Messrs. Jessop and Sons, of Sheffield, one of their largest size patent "Duplex" lathes for marine crank shafts. The general features of these lathes have already been described and illustrated in THE ENGINEER, but the lathe above referred to embodies several further improvements, the most noticeable being the introduction of quick power traverse motions for quickly placing the sliding carriages in any required position upon the bed. Amongst other machines in course of construction, the firm have quite a number with multiple spindles, for drilling the water-tube boilers for her Majesty's torpedo-boat destroyers, and others for boring and screwing various parts of the Belleville type of water-tube boilers, such as are being made for H.M. ships Powerful and Terrible. Other special work includes several heavy milling machines in various stages of progress, and a large break and pit lathe capable of operating upon any object in steel or iron up to 12½in. diameter and 3½ft. long, or up to 9in. diameter by 8ft. long. This lathe is composed of a heavy and powerful large headstock, with a large steel spindle and face-plate 9ft. diameter, geared on the back with internal and external teeth, through which is transmitted the driving power under a great variety of speeds. Supporting the headstock is a deep grooved base-plate, to receive the tool rests provided, and a sliding bed, which is movable along it, and carries the loose headstock. A novel feature is the introduction of another short-grooved base-plate, inlaid in the main base-plate, and having its upper surface at the same level, this inlaid plate being movable longitudinally within the bed surrounded by the main base-plate, and so arranged that it can be placed at any required distance in front of the base-plate. The lathe altogether covers a space of about 420 square feet, and weighs nearly fifty tons.

Only a very slow demand continues to be reported for all descriptions of round coal, and although very few of the pits are working more than three to four days per week, stocks go on accumulating. List rates in the Manchester district remain unchanged, and pit prices generally are as last quoted, averaging 11s. to 11s. 6d. for best Wigan Arley, 10s. to 10s. 6d. for Pemberton four-foot and second qualities of Arley, with common coal ranging from 7s. 6d. to 8s. for steam and forge qualities, to 8s. and 8s. 6d. for common house-fire descriptions. To meet, however, the keen competition in the important manufacturing districts on the east side of Manchester, where low-priced supplies have been coming in largely from Derbyshire, Staffordshire and Yorkshire, the Lancashire Coal Sales' Association have decided that their minimum delivered or station rates shall be reduced 6d. per ton, this concession embracing such important markets as Oldham, Ashton, Stalybridge, Stockport, right on to Disley and New Mills. For engine classes of fuel there is a very fair inquiry, and the limited supplies of the Lancashire collieries move off without difficulty; but there is plenty of cheap slack offering from other districts, and prices are scarcely so firm all through at full rates, concessions having been found necessary in isolated cases. At the pit mouth slack ranges according to quality from 5s. 6d. up to 6s. 6d.; ordinary burgy, 6s. 6d. to 7s.; and through-and-through coal, about 6s. 9d. to 7s. 3d. per ton.

The shipping trade continues in a generally depressed condition, and although the official minimum quotations are not changed from 8s. 6d. to 9s. for Lancashire steam coal, delivered at the ports on the Mersey, there are outside sellers who in some cases are offering at 8s. to 8s. 6d. per ton.

Barrow.—There is a very quiet business doing in hematite pig iron, although there is a generally firmer tone. Prices are firm at 44s. warrant iron sellers, net cash; and 43s. 11d. buyers. Makers are quoting 44s. 6d. to 45s. for mixed Bessemer numbers, net f.o.b. There are still thirty-six furnaces in blast, compared with thirty-five in the corresponding week of last year. There is very little trade indeed doing with foreign buyers of hematite pig iron, and the home demand is quiet—with the exception of local account, which is fairly maintained.

Iron ore is still in a very depressed state, and orders are scarce as well on local as on shipping account. Very little ore is now taken on the railways out of the district. Quotations are easy at 8s. 6d. per ton net at mines for ordinary qualities of metal.

In the steel trade there is a quiet tone in most departments. Heavy rails are in poor request. Orders are only held to a small extent, and they will not keep the mills going for many weeks. The new consignments which are on offer are keenly competed for. Heavy rails are quoted at £3 15s. per ton. Nothing is doing in light rails, prices being lower at £5 5s. per ton, and colliery sections are at £5 10s. per ton. There is a steady trade in steel shipbuilding material, and the mills in this district are well sold forward. In billets and tin-plates very little is being done in the Furness district, but makers are better off in the Cumberland district, and are keeping their mills fairly employed. In blooms, slabs, and wire rods there is nothing doing, but there is still a fair demand for heavy steel castings.

Shipbuilders and engineers are very briskly employed. Last week the Cork steamer Xema arrived at Barrow for new triple-expansion engines and very extensive repairs, and this week the Clan Ross, the first of three steamers building at Barrow for Messrs. Cayzer, Irvine, and Company, was launched. Much progress is being made with the Admiralty work in hand at Barrow. There is very little demand for new shipping tonnage, but some important orders are now receiving attention.

The coal and coke trades are very quiet, and business does not improve either on manufacturing or on shipping account. Prices are very steady.

There is still a large number of unemployed men in Barrow and on the West Coast generally.

The shipments of hematite pig iron from West Coast ports during the week have amounted to 2139 tons, compared with 6975 tons in the corresponding week of last year. The exports of steel last week were 2322 tons, compared with 7449 tons in the corresponding week last year. The aggregate shipments of pig iron to date this year have been 160,306 tons, and of steel 153,091 tons, comparing with 111,271 tons of pig iron and 190,796 tons of steel in the corresponding period of last year, an increase of 49,035 tons of pig iron and a decrease of 37,705 tons of steel. There have been no shipments of pig iron or steel this week to foreign ports.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE heavier trades are reported to be rather brisker at present. The boilermakers have recently been called upon for work of exceptional weights, and several of the principal firms have largely increased their productive powers. The tendency is to use exceedingly large boilers, and to work at high pressure and thus economise production. There is a better demand, too, for ironwork for buildings. The increased stringency of the Government requirements in factories and other similar establishments is favourably affecting this business, particularly in fireproof doors and similar appliances.

Manufacturers of grain rolls, ingot moulds, and plate rolling machinery generally, are receiving more orders than they did during last year. Very little, however, is at present doing in railway work, which cannot possibly become satisfactory until the colonial and foreign trade picks up. The iron firms are waiting for the autumn orders, which they expect rather earlier this season. These were entirely missing last year owing to the coal strike. The Germans will not find the conditions so favourable for them this season. Crucible steel is in very languid request, and the men are but poorly employed. Quotations for finished material still remain as before. Hematites are in light demand—West Coast, Nos. 1, 2, and 3, at from 51s. 6d. to 52s. 6d.; East Coast, about 1s. less; forge iron, 39s. 6d. to 40s., all delivered in Sheffield; bar iron, £5 10s. to £5 15s.; sheets, £7, both delivered in Sheffield; Bessemer billets, £5 7s. 6d. to £5 10s.; English dead-soft wire rods, £5 5s.; wire rods and carbon rods, £8.

The unseasonable weather has had a good effect on the house coal trade, but the demand has not been so great as might have been anticipated. The fact is, householders are more careful in their consumption of coal than they used to be. This is one of the lessons taught by strikes. With regard to gas and steam coal, Yorkshire and Lincolnshire owners appear to have had less difficulty than formerly in coming to arrangements to maintain the values. At the commencement of this year the railway companies were asked to pay 1s. 6d. per ton more than they had given for supplies during the previous half-year. This is the amount of the advance coalowners have been endeavouring to secure all round. The North-Eastern Railway Company is stated to have placed nearly all its coal contracts in South Yorkshire at about 8s. 9d. for 20 cwt., this being an advance of 1s. per ton on the rates of last June. The Midland Company is expected to bring its negotiations to a close in a day or two, and with the placing of supplies for these two great concerns, the coal trade will be placed on a firmer basis than it has been for some time. A good business has been done recently in steam coal—both for home and export purposes, a very large tonnage going to the Baltic ports. It may be useful for reference to note here the contract prices for steam coal since 1888-89. Then the quotations were from 6s. to 6s. 6d. per ton; in 1889-90, 8s. 6d.; in 1890-91, 10s. 6d.; in 1891-92, 10s. 6d. to 10s.; in 1892, 9s. 6d. to 9s.; in 1893 the price, 8s. 6d. to 9s., obtained in January, fell in June to about 7s. 9d. for 20 cwt., and rose last January to 8s. 9d. to 9s. for 20 cwt. It is anticipated that if the advance from 1s. to 1s. 6d. per ton can be obtained all round, we shall not have the wages trouble to disorganise business this season at all events. It is quite evident, however, that the quantity of coal raised is much in excess of what is required. A mere glance at the railway sidings, congested as they are with long lines of coal-laden trucks, is sufficient to convince any traveller that there is a glut of fuel in the market.

In the lighter trades a revival is reported in saws, circular and cross cut saws being in brisk request for the Russian and general continental markets. In files, too, there has been a distinct improvement, although competition is very keen and prices are not good enough to allow of a reasonable profit. The season for grass-cutting appliances, such as lawn mowers, &c., is now over, and is reported to have been a fairly good one. The cutlery trades remain as they have been reported for over a month; the American demand being still paralysed by the uncertainty attaching to the Wilson Tariff Bill, and the general business of the country is not up to the average. Probably the electro-plate manufacturers are even worse, gloomy reports being sent home by the travellers.

Some very fine samples of ornamental works in trophies, cubes, &c., have recently been produced by the leading Sheffield houses. The tendency has been of late for purer artistic creations than for showy goods, once so popular.

Mr. W. E. Harvey, assistant-secretary of the Derbyshire Miners' Association, addressed a crowded meeting of the Blackwell miners on Monday. Mr. Harvey was one of the delegates to the Berlin Congress, and he complains that the press reports of the "scenes" there have been very much coloured and exaggerated. Taking the conference as a whole there was nothing but praise to be afforded for the way in which the English representatives had been received by the Berlin Trades Council, and the public generally. By going to Continental Conferences they had effectually put an end to the "foreign competition bogie," and they had learnt much that would be to the mutual advantage of the mining communities. Referring to the Carlisle Conference, Mr. Harvey said that they now had between 30,000 and 40,000 members in the Scotch Miners' Federation. Scotland was not the only place where a reduction was being demanded. Cumberland was under notice for a 10 per cent. reduction, and in Somersetshire wages had also been attacked. Unless an amicable settlement was arrived at they would have from 70,000 to 80,000 men fighting against reductions. To maintain "the great principle of a living wage," they must have no reductions in Scotland or England. Of course the miners' leaders would be told that they were everlastingly setting masters and men at loggerheads, but he could only say that they knew their business best. Complete organisation was their only salvation as a labour class, and he was proud of the fact that there were many collieries in Derbyshire at which there was not a single non-unionist, whilst, notwithstanding all that had been passed through, the association were not only powerful in numbers, but powerful in finance, being worth thousands of pounds.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

SEVERAL circumstances have this week adversely affected the iron and allied trades, the chief among them being the unfavourable statistics that have been issued by the ironmasters, the extension of the labour troubles at the foundries and engineering works, and the threatened strike of colliers in Scotland. Prices have been kept rather firm, but buying has been checked, and now there are as few orders given out as there were before the holidays. Shipments are quieter than they were last month, and inland deliveries have further fallen off, because on account of the moulders' strike above mentioned operations have to be carried on at a slower rate at shipyards and engineering works, and consequently at the finished iron and steel manufactories.

At many of the engineering works operations have had to be so much curtailed that hands have had to be paid off until the strike is settled, as employment could not be found for them. It is over two months since the first batches of moulders came out on strike because the masters would not comply with their demands for a large increase of wages, as the state of trade did not justify it, the improvement having been in the number of orders distributed rather than in the prices paid for them. The pattern-makers and joiners have joined the moulders, and the prospects of an early settlement do not appear good. The employers are very determined in their attitude, and so far the men are equally averse to giving in, and the consequence is that much harm is being done to the trade; a good deal of work which cannot wait having to be sent out of the district for execution, and other orders that might have been placed in the district are given to other centres which are not troubled in the same manner as this district, and where prompt delivery can be counted upon. Mr. Christopher Furness, M.P. for the Hartlepools, whose firm is suffering through this labour difficulty, suggests that the whole question shall be referred to arbitration, but neither side apparently has arrived at the stage when they are desirous of calling in a third party to settle their differences.

The character of the Cleveland ironmasters' statistics for May on the face of them is very unsatisfactory, because there is a heavy increase in the production, and an equally heavy increase in the stocks of Cleveland pig iron, indeed if the make had not been increased there would have been a slight decrease in the stocks. Of Cleveland iron 127,664 tons were produced, 12,093 tons more than in April, and of hematite, &c., 129,011 tons, 1766 tons decrease, the total being 256,675 tons—10,327 tons increase. This is almost the largest output ever reported. In regard to the large increase in the production of Cleveland iron, this may partly be accounted for by the extra day in May over April, partly by the holidays, for during Whit-week some of the furnaces which had been producing basic iron were put upon Cleveland iron, and partly by the better working of the furnaces themselves—they have been driven harder, and have turned out a higher average quantity. There were only 93 furnaces at work as against 94 in April, and yet the output was increased. It is now certainly in excess of the requirements, but it is probable that it will not long continue so, because several furnaces are intended to be blown out shortly, in order that they may be relined, one having been in blast over twenty years. Advantage will be taken of the duller trade and the longer days to carry out the re-lining of the furnaces that need it, that being a work which is more effectually executed in the summer than when the days are short. The only furnace put out last month was one at Sir B. Samuelson and Co.'s Newport Ironworks, Middlesbrough, and at the close of the month there were fifty-two furnaces making Cleveland iron—one more than in April—and forty-one making hematite, &c., two fewer than in April, the output of the latter being reduced 1766 tons in consequence, a circumstance which has helped the price of hematite up 3d. this week. The stock return is very disappointing, as it shows in what is usually a very brisk period of the year, an increase of 11,185 tons. For some months people have been accustomed to see decreases recorded, and they do not take kindly to an increase. Almost invariably, a decrease is shown in May; thus, last year it was 2554 tons; in 1892—when the Durham colliers' strike was in progress—it was 80,233 tons; in 1891, 3406 tons, and in 1890, 12,342 tons. The excess of production over consumption has been due to the holidays, the greater make, and the strikes of moulders, which last must have reduced the consumption of pig iron by fully 8000 tons during the month. The total quantity of Cleveland iron held in stock is 154,488 tons, of which only 55,792 tons is unsold in makers' hands; but that is 14,334 tons more than they held on April 30th.

The pig iron exports from the Tees in May were heavier than were expected, having been very large in the last week; but still they were only 5092 tons more than in April, and were 12,724 tons less than in May last year. The shipments to foreign ports were only 47,420 tons last month, against 64,109 tons in the corresponding month last year; but large quantities of hematite pig iron were sent to Russia and Italy, and the export of hematite, &c., rose to fully one-sixth of the total pig iron shipments, viz., 14,228 tons, whereas in April they were only 8542 tons. The following are the totals of the exports from the Tees of pig and manufactured iron and steel last month, as compared with April and the corresponding month last year:—

	Pig iron.	Manufactured iron.	Steel.	Total.
	Tons.	Tons.	Tons.	Tons.
May, 1894	86,470	16,022	14,860	117,352
April, 1894	81,378	13,285	21,801	116,464
May, 1893	99,194	28,289	16,320	143,803

The above did not include all the Cleveland pig iron shipped, for the Skinningrove Iron Company sent 5464 tons last month all to Scotland.

Business in No. 3 Cleveland pig iron has this week been generally done at 35s. 3d. per ton for this month's f.o.b. delivery, and nothing less would be accepted for June or July. Cleveland warrants have mostly been kept at 35s. 5d. cash, but the close on Wednesday was at 35s. 4½d. Connal's stock of Cleveland pig iron on Wednesday evening was 97,812 tons, and their stock is now increasing. At May 31st they held 40,714 tons of hematite iron, 584 tons less than at April 30th, whereas in April their stock increased 3963 tons. No. 4 Cleveland Foundry pig is at 34s. 6d., and grey forge at 34s., both being more readily obtainable than for a long time past. East Coast hematite pig iron is advanced 3d. per ton this week, production and stocks having been reduced, while a better export demand has sprung up. Mixed Nos. cannot be bought under 44s. per ton. The Carlton Iron Company is likely to follow the example of the Seaton Carew Iron Company in granting the eight hours' day to its blast furnacemen. More men are needed per furnace certainly, but it is said that the cost of the pig iron made is raised scarcely at all, because the men have given up the extra pay they have been accustomed to get for Sunday work, and that goes to pay the extra hands. The Seaton Carew Iron Company is well satisfied with the change. In a few days the Cleveland Ironmasters' Association will decide whether there shall be a general adoption of the eight hours at the furnaces.

The finished iron and steel industries are very dull, prospects are poor, and prices weak. Some of the finished ironworks are running very irregularly, and even the bar trade is badly situated. Steel ship plates are quoted at £4 17s. 6d.; steel ship angles, £4 15s.; steel boiler plates, £5 17s. 6d.; iron ship plates, £4 15s.; iron angles, £4 12s. 6d.; common iron bars, £4 17s. 6d.; and heavy steel rails, £3 12s. 6d. per ton, all being on trucks at works and less 2½ per cent. discount, except rails, which are net.

Last week the North-Eastern Steel Company, Middlesbrough, shipped 450 tons of steel billets to Warrington, *viâ* the Manchester Ship Canal, and this week has sent 660 tons more. They have done business with that district before, but always had to dispatch the steel by rail, but the opening of the Manchester Ship Canal affords them a cheaper mode of transit, of which they have now commenced to avail themselves. Mr. John Price, who has been general manager of Palmer's Shipbuilding and Iron Co. for many years, has resigned his position, and when accepting the resignation the directors passed a resolution thanking him for his valuable services. Mr. Price has had a long connection with the shipbuilding industry of the North. He was engaged at one time under that well-known builder, Mr. John Pile, and then became connected with the Liverpool Underwriters' Association. After leaving them he took charge of Messrs. Palmer's establishment at Jarrow. Sir Charles Mark Palmer, M.P., has also resigned his position as managing director. Messrs Furness, Withy, and Co., Middleton Shipyard, Hartlepool, are about to build a new steamer of the "turret" type. She will be the first of the kind ever constructed at the port, and will carry about 4000 tons of cargo.

The adoption of the cable system of tramway communication is being seriously considered by the Newcastle Corporation, and Mr. Laws, their engineer, has strongly recommended it. He states that horse traction is becoming obsolete, and that some better system must be adopted if the growing needs of a large and important city like Newcastle are to be met.

The coal trade is very quiet and prices weak, notwithstanding the formation of the Association to keep up prices. This Association has now been fairly established, and is about to be registered under the Companies Acts as the Durham and Northumberland Coal Sales Association, Limited. Those unconnected with the organisation, however, undersell the members and secure a greater share of the orders passing. Some business in steam coal has been done this week with the United States, and 1000 tons will be shipped within the next few days. The North-Eastern Railway Company has accepted tenders for supplies of Barnsley hard coal for the ensuing six months at 8s. 9d. per ton of 20 cwt. This is 1s. more than was paid at this time last year, and is the same as was given in 1892.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron market has been somewhat firmer this week owing to the apprehended national strike of miners. The business done has not, however, been very extensive. The uncertainty of the situation induces operators to act with caution. Scotch warrants have sold from 41s. 6d. to 41s. 8d. cash, but Cleveland has gone rather back, the price being from 35s. 6d. to 35s. 4d. Cumberland hematite has been done at 43s. 10½d., and the nominal price of Middlesbrough hematite is 43s. 7d. cash.

The values of makers' pig iron are as follow:—G.M.B., f.o.b. at Glasgow, No. 1, 43s. per ton; No. 3, 42s.; Carnbroe, No. 1, 44s. 9d.; No. 3, 43s. 6d.; Clyde, No. 1, 49s.; No. 3, 46s.; Gartsherrie, No. 1, 50s.; No. 3, 47s.; Calder, No. 1, 51s.; No. 3, 47s.; Summerlee, No. 1, 51s. 6d.; No. 3, 47s.; Coltness, No. 1, 54s. 6d.; No. 3, 50s.; Langloan, No. 1, 60s. 6d.; Glengarnock, at Ardrossan, No. 1, 50s. 6d.; No. 3, 47s.; Eglinton, No. 1, 46s. 6d.; No. 3, 44s.; Dalmellington, at Ayr, No. 1, 46s.; No. 3, 43s. 6d.; Shotts, at Leith, No. 1, 53s. 6d.; No. 3, 49s. 6d.

The shipments of pig iron from Scottish ports in the past week have been 7190 tons, compared with 6629 in the corresponding week of last year. Of the total there was despatched to Italy 1940 tons, Germany 615, Canada 165, South America 130, India 122, Australia 83, France 175, Russia 10, Holland 840, Belgium 20, Spain 45, China and Japan 260, other countries 30, the coastwise shipments being 3174 tons, compared with 4287 in the corresponding week. The total shipments are 24,000 tons less than this time last year.

There is no change in the total number of furnaces in blast, although several alterations have taken place in their disposition. Ordinary and special brands are being produced by 48 furnaces, an increase of three on the week; 24 furnaces are making hematite, compared with 25 a week ago; and only one furnace remains on basic iron at the beginning of the week, but the number has since been increased to three. The probability is that the output of this class of iron will soon cease altogether.

Inquiries appear to show that in the future there may be a more widespread demand for hematite pig. Merchants have been asking for tenders for considerable quantities of hematite, and the requirements of home consumers show no abatement.

The steel trade has not been quite so busy, and there is little or no excitement resulting from the possibility of a strike, because in addition to the safeguards provided in the shape of strike contracts, the summer holidays are so near at hand that no scarcity of material is anticipated.

In the finished iron trade there has been a little more activity at some of the works, with the result of the necessity for early completion of particular orders, but the trade as a whole is in a comparatively easy condition.

The exports of manufactured goods continue very light, those of the past week embraced locomotives for India worth £2800; sewing machines, £9363; other machinery, £11,767; steel goods, £7422; and miscellaneous iron goods, £15,020.

A great deal of interest is felt in the present movement among the miners for getting back their recent reduction of wages. The men in the various mining districts appear to be more united than usual, and it would not occasion any surprise were a general strike entered upon before the end of the month. The miners' organisations are certainly not very strong either as regards membership or funds, but they have recently been acting with remarkable unanimity, and the fact that the Federation meeting at Carlisle last week voted in favour of a strike in Scotland and of a levy to support the men when they come out has certainly gone far to encourage the disaffected. A ballot of the miners in and out of the Union, open to all coal getters above sixteen years of age, has been taken this week, and the result is expected to be known without delay. A manifesto has been issued from the headquarters of the Scottish miners calling upon them to act with decision, and warning them that any district adopting a course opposed to that of the majority will be expelled from the Federation.

The coal market has been irregular owing to the uncertainty that exists as to the miners' vote regarding a strike, but the amount of business has been considerably larger for local and manufacturing purposes. The coal shipments are not so satisfactory, the total being 141,829 tons, compared with 158,949 in the preceding week, and 159,339 in the corresponding week of last year.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

ANOTHER good week in the coal trade has to be recorded, a week of well-sustained demands and firm prices, with a round total of exports from Cardiff of over 316,000 tons. This is now the second week for huge totals, and there is every prospect of a continuance. On one day this week large steamers were very conspicuous, 4000 tons going to Batavia, 4500 to Colombo, 3100 to Brindisi, 3200 to the Mauritius, 3200 to Jamaica, and a number at 2000 tons.

This activity in the coal trade is telling favourably on the mineral revenue of the Taff Vale. Last week's return showed an increase of £641, and the aggregate receipts, so far this year, are £8947 in excess of those of 1893. The vigilance in management cannot be too highly commended.

The healthy character of the Welsh coal trade is attracting a fair share of attention from the outside world, and rumours of transfers, purchases, and the formation of new syndicates are rife. One now on the carpet—it is reported in leading circles—is that a syndicate is being formed for the purchase of Lockett's Merthyr Steam Colliery, in the Rhondda Fach. This is an admirably laid out coalfield, and was first sunk by Mr. Mordecai Jones, of Brecon, and afterwards acquired by Lockett and Co. Lockett was one of the early pioneers of the Welsh coal trade. The colliery has been under the management of Mr. William Thomas, Brynmawr, and may be regarded as one of the most important of the Rhondda, with a good "lift" yet in reserve. Another large colliery, near Pontypridd, is stated to be changing hands. The Dunraven Colliery, which was withdrawn from the auction lately, only requires—in the opinion of leading authorities—a strong body of capitalists to pay well.

The latest coal prices on 'Change, Cardiff, this week were: Best steam, 11s. to 11s. 6d.; seconds, 10s. 6d. to 10s. 9d.; Monmouthshire, 10s. 6d. to 10s. 9d.; small steam, 5s. 6d. to 6s. House coals continue in moderate demand, best selling at 10s. to 11s.; No. 3 Rhondda, 10s. 6d.; brush, 8s. 6d. to 9s.; small, 6s. 9d. to 7s.; No. 2 Rhondda, 8s. 6d. to 8s. 9d.; through, 6s. 9d. to 7s.; small, 5s. to 5s. 3d. The demand for coke shows a slight improvement, and makers confidently look for a better condition; latest prices are: furnace, 14s. 6d. to 15s.; foundry, 16s. to 16s. 6d.; patent fuel, 10s. 6d. to 11s.; pitwood, 14s. 6d. to 15s. All the quotations are Cardiff. Swansea quotation for patent fuel is 10s. 6d. to 10s. 9d.; anthracite coal, 8s. 3d. to 12s. 6d., according to quality. Lowest figures for coke, Swansea, are furnace, 12s. to 12s. 6d.; best foundry, 17s. 6d. to 18s.; iron ores, Tafna, 11s. 6d., and Rubio, 11s. 9d.

An impression is abroad that iron and steel works are going to be busy, and certainly the principal works will be well equipped with foreign ore to meet even an extraordinary demand. Cyfarthfa, Dowlais, and Ebbw Vale, received large cargoes this week, giving increased animation to docks, railways, and works. Cardiff quotations for foreign ores vary slightly from those on the Swansea Exchange:—Best Rubio, 11s. 9d. to 12s.; Garucha, 11s. to 11s. 3d.; Porman, 10s. to 10s. 9d.; Tafna, 11s. 3d. to 11s. 6d., free on board—c.i.f.—either Newport or Cardiff. A large cargo of iron cinders, 1200 tons, left Newport again this week for Rotterdam.

There is little to report in connection with the iron and steel trades; business continues of an average character, with prices low enough to tempt, but in the case of steel bars another week or two must pass before the expected spurt takes place. As for rails, trade is by no means brisk, and until the expected orders come from India and South Africa, business is expected to remain in a feeble state, colliery rails and a few small railway orders being the bulk now required. The statement made current that the rails on the line from Ostend to Brussels, weighing 105 lb. to the yard, had been examined lately, and warranted, after five years wear, to last another hundred, has been keenly discussed. On ordinary lines, where there is no heavy gradient, the good steel rails now made have certainly a twenty years' life, so it is well for ironmasters to look for other sources of demand. Steel pit props have been suggested, and are coming in tardily in a few places. Cyfarthfa having excelled in turning out a sheet of steel much thinner than the finest tissue paper, it has been suggested that a market might be found for it, but the inventive mind has not yet said for what.

The exports of iron and steel for the first four months of the year from Wales have been:—Cardiff, 7336 tons; Newport, 4430 tons; Swansea, 474 tons.

On 'Change, Swansea, mid-week, it was reported that a slight improvement had taken place in pig iron, that the export of tin-plate was showing a fair average, and that the final issue of the tariff being at hand better times may be expected. At present many tin-plate works are idle, and makers will not restart until something definite is known.

The last quotations show only a slight alteration from those of last week. Glasgow pig, 41s. 7d.; Middlesbrough, 36s. 4d.; hematites, 43s. 10½d.; sheets, steel and iron, £6 5s. to £6 10s.; Welsh bars, £4 15s. to £5; steel rails, heavy, £3 15s. to £3 17s. 6d.; light, £4 10s. to £5 10s.; Bessemer steel bars, £4 to £4 2s. 6d.; Siemens, best, £4 5s. to £4 7s. 6d.; seconds, £4 2s. 6d. to £4 5s.; tin plates, Bessemer, 10s. 3d. to 10s. 6d.; Siemens, 10s. 6d. to 10s. 9d.; charcoal, best, 11s. 9d. to 12s. 9d.; ternes, 20s., 21s. to 23s. 6d.; block tin, drooping, £70 17s. 6d. to £71. Cardiff quotations are better by 3d. all round for tin-plates. Swansea shipment of tin-plates last week was 64,524 boxes, receipt from works 58,910 boxes. Present stock 288,803 boxes.

I do not see much realisation yet of the anthracite movements, which were rumoured to be at hand early in the year. Still, it requires time to float great ventures, and it may only be a case of postponement. Activity is to the front at Port Talbot. The promoters now are so confident of success that operations have been commenced. The scheme, readers will remember, is to provide a port of shipment for the output of the collieries at Ogmore, Llynvi, and Garw Valley. At the latter place important sinking is going on successfully. If the new anthracite developments are tardy, Monmouthshire cannot be accused of being behind. The United National—Walls, Ward, and Co.—contemplate sinking a pair of pits at Cwmcam. Great Western Railway Company are asking for powers to extend Hall's railway so as to enable sinking operations to be carried on upon the Llanover property. At Six Bells, Aberbeeg, new pits are being sunk by Lancaster and Co. The Ebbw Vale new pits at Cwm are laid down on the double lift system, so as to increase celerity in output. Partridge, Jones, and Co., time-honoured names in the old house coal days of Monmouthshire, have won steam coal at Crumlin, and in the Eastern Valleys Tirpentwys have struck the famous black—steam—vein. All these things portend well for Newport, Mon.

In respect of Glamorganshire, and of Cardiff in particular, the principal object of the Bute Dock Bill is gained, and the fine dock of 42 acres on the foreshore, to admit of the finest steamers running in from the Channel, is now only a question of time.

The railway bill fight, the "East Glamorgan Railway," is now commencing, and will soon come to a point, and as I note that those friendly disposed are stating that, if unsuccessful this session, the usual Barry tactics of "pegging away" next year will be resorted to, it may be taken as assumed that the strong arguments of the Bute Dock, the Taff Vale, and the Rhymney railways are regarded as almost overwhelming, and the probability of getting it this year a remote one. But prophecy in regard to Parliamentary Committees is futile. We can only wait the chapter of events.

The members of the South Wales Institute of Marine Engineers had an excursion to Chepstow and Tintern on Saturday last. In the course of the proceedings Professor Elliot read an interesting paper on "Brunel, Railway and Marine Engineer," and favourably referred to Brunel's early association with Stephenson. He became chief engineer of the Great Western Railway in 1833, and was a great advocate of the broad gauge system. In the professor's opinion the narrow gauge had been developed to its utmost limit, and any saving of time could only be effected now at the expense of accommodation and comfort. The only alternative, if they wanted increased speed, was to revert to the broad gauge again, and run engines capable of developing 3000-horse power and a speed of eighty miles an hour. This would bring London within 2¼ hours of Cardiff.

The members of the Rhymney Branch of the South Wales Engineers, Stokers and Outside Fitters' Association tendered notices June 1st to terminate services in one month. The object is to increase the wages standard.

Disputes are on at Letty Shenkin, Aberdare Colliery, and at Caeran Colliery, Maeste. At the latter, colliers have been out for nine weeks. A struggle is on at Gorseingon Tin-plate Works.

The Departmental Committee upon the Undermanning of Vessels are to visit Cardiff.

The Bute Dock authorities are going to expend £40,000 in giving increased accommodation to the passengers landing at the Docks, Cardiff.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE iron trade in this country is, on the whole, progressing, a full employment and increasing production being noticeable in most departments. For the present, however, the improvement has been in the volume of business rather than in quotations; in some branches manufacturers are even worse off than ever as regards profit, because coal and raw materials have become dearer, while makers, on the other hand, have not been able to carry a corresponding advance in the prices for their articles.

In the Silesian district the situation of both the raw and the finished iron trade continues to improve. Export business to Russia has developed favourably, the greater part of the rolling mills reporting their order-books well filled. There appears to be a rather firmer tendency in prices, but a definite general improvement is not likely to take place so long as foreign competition remains as keen as at the present moment.

On the Austro-Hungarian iron market the increase in demand has led to a further advance in quotations. The pig iron trade is active, and continues to expand; makers report themselves pretty well satisfied with the prices they have realised. In the malleable iron branch, the mills are almost without exception briskly occupied, orders for bars and girders coming in very regularly. In the plate and sheet trade there is, likewise, a fair amount of business doing, and prices are stiffening. The railway and engineering department is in a very lively condition, there are plenty of contracts on the books, and the mills are kept fully going.

In France the tendency of the iron market is firm and satisfactory. A number of fair orders have been coming in upon the week, and regular employment is secured to the different branches of the trade. There is a specially brisk activity reported at the blast furnace works, some of them being so fully engaged that they were compelled to assign part of the orders received to Belgian firms. Quotations have undergone no change since former letters. In Belgium both raw and manufactured iron are weakly called for, so that buyers can easily place their orders at quotations below market prices. Girders form the only exception, being in lively request generally. Steel rails, on the other hand, remain much neglected. Comparing the list quotations of March and April of present year, no alteration can be perceived. Plates, No. 2, free Belgian station, rose from 127·50 on 130f. p.t.; No. 3, from 147 to 150f. p.t. Steel plates have well maintained the price of 140f. p.t.; sheets, 160f. p.t.; steel rails continue to be quoted 95f. p.t.

In the beginning of May there were twenty-nine blast furnaces in blow out of forty-two existing, thirteen with a daily production of 1120 t. forge pig, four with a production of 315 t. foundry pig per day, while twelve produced 1150 t. basic per day.

The following shows the production of pig iron in April and during the first four months of 1894 and 1893:—

	April.		January 1st to May 1st.	
	1894.	1893.	1894.	1893.
	t.	t	t.	t.
Forge pig	31,050	34,350	117,900	141,825
Foundry pig	9 450	6,600	30,600	26,400
Basic	34,500	21,300	137,000	84,315
Total	75,000	62,250	285,500	252,540

Belgian export to Russia has considerably increased since last year, owing in some measure to the tariff differences between Russia and Germany. During first four months of 1892 export in iron from Belgium to Russia was 865 t.; in 1893 it was 570 t. only; and in 1894 it amounted to 3169 t.

There has not been any remarkable variation in the state of the Rhenish-Westphalian iron trade since last week, the general tone of the market being favourable and much inclined to firmness. Iron ore continues in good request, quotations being firm and even rising; Spanish ore is still but moderately inquired for. The pig iron market remains comparatively quiet, buyers showing rather more reserve. Spiegeleisen continues in moderate request at the former price of M. 52 p.t. The malleable iron trade presents no new feature, except that the activity to which reference has already been made is increasing in some branches. Hoops, for instance, have been in decidedly better request this week than last. A regular demand is coming in for plates, but prices, unfortunately, remain a weak point. Much the same can be reported of sheets. The situation of the wire business is rather more favourable than during previous weeks, but still prices are in no proportion to the advanced quotations of steel billets. The shipbuilding and engineering trades continue dull, and there is only an irregular employment reported at the machine and wagon factories.

The Administration of the St. Gothard Railway has agreed on 7 per cent. dividend for 1893, against 6½ per cent. in the previous year. Statistics published by the French Minister of Public Work show output of pit coal and brown coal to have been during the last year as follows:—

	Production in tons.	Average price p.t.	Year.	
Great Britain and Ireland.	184,704,000	9·02	1892	= 5000 t. brown coal.
United States	155,871,000	8·56	1892	= 110,726,000 br. coal 45,145,000 pit coal.
Germany	86,612,000	8·84	1892	= 66,383,000 pit coal; 20,229,000 t. br. coal.
France	26,178,000	12·46	1892	= 25,697.200 t. pit coal; 481,500 t. brown coal.
Austria	25,431,000	8·46	1892	= 16,190,000 t. pit coal; 9,241,000 t. br. coal.
Belgium	19,583,000	10·28	1892	
Russia	6,233,000	7·92	1891	
Saxony	5,141,000	11·60	1892	= 4.213 000 t. pit coal 928,000 t. brown coal.
Australia	4,402,000	10·83	1891	
Hungaria	3,269,000	8·96	1890	
Canada	3,117,000	13·24	1891	
Japan	2,608,000	10·15	1890	
India and English possessions in Asia	2,366,000	5·92	1891	
Spain	1,288,000	8·43	1891	= 1,262,000 t. pit coal.
Bavaria	792,000	12·11	1892	= 777,000 t. pit coal.
New Zealand	679,000	14·10	1891	
Sweden	382,000	?	1892	
Italy	296,000	7·20	1892	
Cape Colony, &c.,	157,000	17·18	1891	
New Caledonia and Indo-China.	80,000	?	1892	
Tasmania	46,000	24·96	1891	
Portugal	12,000	15·13	1889	

AMERICAN NOTES

(*From our own Correspondent.*)

NEW YORK, June 1st, 1894.

THE rate of interest has fallen so low that certain wealthy financial institutions have withdrawn entirely from the loan market. Business of all kinds is at a low ebb. The month of August will witness some improvement. Stocks of mill, shop, and factory products are low. The range of values remains the same. In the iron trade less activity prevails. Furnaces are banked, and a great deal of rolling mill capacity is idle. The coal strike is general; 175,000 miners are idle. There is but little sign of an early settlement. Rail mills are doing well on girder rails. Merchant steel is gaining. Bar iron has improved, but only while so many mills are idle. The summer months will be better if the strike is settled. Every concern, big and little, that can go without material or supplies, is waiting. The makers of pig iron are holding stocks at 12 dollars for No. 1 Foundry delivered. Bessemer pig is scarce and out of reach. The adjournment of Congress will probably mark a sudden improvement in business in all lines.

LAUNCHES AND TRIAL TRIPS.

On Tuesday there was launched from the Cleveland dockyard of Sir Raylton Dixon and Co., Middlesbrough, a steel screw steamer, named the Cierbana, which has been built to Lloyd's highest class and to the order of Senor Ramon de la Sota of Bilbao. The vessel is of the raised quarter-deck type, the principal dimensions being:—Length, 234ft.; beam, 34ft.; depth moulded, 17ft. 6½in. and she will carry about 1900 tons at a light draught. The decks and deck erections are all of steel and iron, and provision is made for water ballast in the cellular double bottom which extends right fore and aft, and also in the after peak which is fitted as a ballast chamber. The engines will be fitted by the North-Eastern Marine Engineering Company, of Sunderland, the cylinders being 16in., 26in., 43in. by 30in., with one large single-ended boiler working at 160 lb. pressure per square inch. The construction of the vessel has been carried out under the supeintendence of Captain Ybarra.

On the 26th ult. the trial was made of the twin screw tug Cecil Rhodes, built by Messrs. R. and H. Green of Blackwall, and engined by Messrs. Alex Wilson and Co., Vauxhall Ironworks, Wandsworth-road, London. The vessel is for service at East London, South Africa, the dimensions of the hull being 104ft. long, by 21ft. beam, by 9ft. draught, and the conditions of the contract in regard to speed, draught and stability were of the most onerous nature in order to obtain the best possible results, and which necessitated the use of workmanship and material of the highest class for both hull and machinery. The hull is built of iron, as being less liable to corrosion than steel at a port where the opportunities for docking frequently are fewer than in a home port. This, however, did not apply to the boiler and machinery, which are of steel throughout, the propellers being of manganese bronze, both the vessel and machinery being also constructed under Lloyd's survey for the highest class. A speed of twelve knots was obtained throughout a six hours' run between Gravesend and the Mouse Lightship, the engines maintaining a uniform speed of 155 revolutions, indicating 700-horse power. The engines, which are two in number, are of the compound type, having cylinders 15¼in. and 30½in. diameter by 21in. stroke, with extra large cooling surface in the condensers, and are fitted with the circular balanced and double-ported valves which Messrs. Wilson have now used for a number of years with great success. The consumption of coal was, we are told, under 1½lb. per indicated h.p. per hour, which is extremely low for a compound engine, and was, the makers state, due to the high piston speed and high ratio of expansion, the valves being set to cut off at half stroke with the boiler pressure at 100 lb. The consulting and inspecting engineers were Messrs. John Thompson and Son, London-street, E.C., this being the seventh vessel built by Messrs. Green, and engined by Messrs. Wilson, under their supervision.

On June 5th, Messrs. Furness, Withy, and Co., launched from their shipbuilding works at Hartlepool a large steel screw steamer, built to the order of Messrs. Rankin, Gilmour and Co., of Liverpool. The vessel is a very substantial type of a modern cargo boat, measuring over 320ft. in length, and built throughout of Siemens-Martin steel, with a large measurement and deadweight capacity, and built to the highest class at Lloyd's. Following out the practice of the builders, the greater portion of the shell plating is in 24ft. lengths, and to still further increase the strength of the structure, some of the largest plates that have ever been rolled have been used in the construction of this vessel; in several instances some of the shell plates run up to 64ft. long by 5ft. wide. These enormous plates have been rolled by Messrs. Bolckow, Vaughan, and Company, Middlesbrough. A new design of bilge intercostal keelson is fitted in the holds—Sivewright's patent. By this new arrangement very much of the dunnage and damage to bag cargo is avoided, there being no pockets or receptacles for loose grain, coals, dirt, &c.; consequently these keelsons can be much more rapidly cleaned down when discharging cargo. The accommodation for the officers and engineers is on deck in two large deck houses, one at the fore part of the engine-room and the other at the after end of the bridge. This insures good ventilation in hot climates, and in the heaviest weather all the officers are likewise close to their work. The vessel will be rigged as a pole-masted schooner, and, to make her available for bridge and canal work, the topmasts are telescopic. The engines and boilers have been constructed by the well-known firm of Messrs. T. Richardson and Sons, of Hartlepool, and are of massive design, with every provision for economical working. The boilers are fitted with large suspension furnaces, and are supplied with the necessary auxiliary feed water by a Morison's evaporator. The ship and engines have been constructed under the personal supervision of Captain Davey and Mr. Reid, the marine superintendents of the firm. On leaving the ways the vessel was named Saint Jerome, by Miss Kathleen Watson, Dock House, West Hartlepool.

On the 5th instant there was launched from the yard of the Earle's Shipbuilding and Engineering Company, Hull, the twin-screw steel yacht Zoraide, of about 550 tons yacht measurement, which it has built to the order of Mr. T. J. Waller, of Baynard's Park, Horsham, the dimensions being as follows:—Length on load line, 162ft., breadth moulded 27ft., and depth moulded 17ft. 6in. She is built to Lloyd's rules for the highest class in the yacht register. The vessel has a squared stern and curved stem with handsome figurehead, a flush upper deck and top-gallant forecastle, and a complete lower deck forward and aft of the engines and boilers. On the upper deck is a range of deckhouses, containing a drawing-room, vestibule, and entrance to sleeping cabins, dining-room, pantry, galleys, engine and boiler casings, and captain's room. A water-ballast tank is fitted aft for trimming purposes. The ship is to be rigged as a fore-and-aft schooner. The Zoraide will be fitted by the builders with two sets of their triple-expansion three-crank engines, actuating two bronze propellers, and steam will be supplied from two steel boilers, of large size, to work at 175 lb. pressure.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

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

23rd May, 1894.

10,014. Sectional Air Tubes for Tires, G. A. Macbeth, London.
10,015. Raising and Lowering Sashes, W. Meakin, London.
10,016. Treatment of Sewage, W. D. Scott-Moncrieff, London.
10,017. Book Headbands, H. K. Stevens, London.
10,018. Extension or Floor Lamps, W. Soutter, Birmingham
10,019. Watering Can for Gardens, G. Prokofiew, London.
10,020. Knives and Forks, Deakin, Reuss, and Co., Sheffield.
10,021. Portable Electric Lamps, S. J. Maquay, London.
10,022. Liquid Meters, J. Thomson, London.
10,023. Air Pump, T. W. Bourn and J. B. Richardson, Newcastle.
10,024. Making Hair Frames, D. and E. I. Samuels, London.
10,025. Internal Fittings of Safes, &c., A. E. Price, London.
10,026. Bottle, A. J. Carter, London.
10,027. Garter Manufacture, J. and H. E. Burgess, London.
10,028. Railway and Tramway Wheels, H. Silvester, Manchester.
10,029. Compressed Fuel, R. Fegan, London.
10,030. Means for Transmitting Motion, C. K. Welch, London.
10,031. Skates, A. Heisz and E. Schade, London.
10,032. Electrolysis and Apparatus, E. Gautier, London.
10,033. Reservoir Pens, W. Plowright and T. Bowyer, Manchester.
10,034. Explosive Motor, H. J. Haddan.—(*Piguet and Co., France.*)
10,035. Paving Bricks, J. H. Fox, London.
10,036. Tubes for Propelling Steamers, J. H. Corthésy, Surrey.
10,037. Displaying of Advertisements, A. E. Rodgers, London.
10,038. Pumps, A. A. Delpeyrou and L. J. Rousselin, London.
10,039. Hackling Hemp, A. G. Brookes.—(*J. P. Strangman, Italy.*)
10,040. Drilling and Boring Apparatus, A. Taylor, London.
10,041. Driving Gear of Velocipedes, J. R. Topham, London.
10,042. Trimming Boots, J. W. Hale and G. Shipley, London.
10,043. Collapsible Boxes, W. R. Cuttle and H. Taylor, London.
10,044. Producing Changeable Writing, A. Theodoli, London.
10,045. Electric Motors, J. B. Ormsby and H. Banister, London.
10,046. Manufacture of Stencil Sheets, E. de Zuccato, London.
10,047. Pressure Gauges, C. F. Wood, London.
10,048. Detaining Clutch, O. C. Mootham and H. Marryat, London.
10,049. Improved Rubber Band, C. H. Davy, London.

24th May, 1894.

10,050. Beaters for Threshing Machines, C. Garfitt, Sheffield.
10,051. Potato Hoe, J. Crawley, jun., and C. S. Mossop, Lincolnshire.
10,052. Portland Cement, W. H. Hughan, sen., London.
10,053. Cutting Wheels for Clocks, W. C. Fischer, Glasgow.
10,054. Studs, W. E. Parsons, London.
10,055. Iron Fencing, W. Bayliss and R. Hield, London.
10,056. Vice, J. Case and E. Kain, Sheffield.
10,057. Appliances for Holding Paper, T. C. Beeley, Manchester.
10,058. Trawl Head for Fishing, D. A. Sheret, North Shields.
10,059. Covering for Stoppers, G. A. Shaw and Kay Brothers, Stockport.
10,060. Pneumatic Tires, H. P. Jones and E. Pierce, Manchester.
10,061. Appliance for Making Confections, E. Edwards, Leicester.
10,062. Window and Door Fasteners, T. C. Dowd, Wednesfield.
10,063. Gas Governors, W. H. Foster and F. Nunns, Halifax.
10,064. Sextant, T. Dobie.—(*J. G. Dobbie, India.*)
10,065. Wooden Shovels, J. Boyd, Glasgow.
10,066. Drying Dishes, R. Wood, Glasgow.
10,067. Means for Suspending Bottles, C. Tebbitt, Birmingham.
10,068. Military Breech-action Fire-arms, L. B. Taylor, Birmingham.
10,069. Device for Warming Plates, E. H. Paterson, Glasgow.
10,070. Dishes and Plates for Food, J. D. Whitaker, Scarborough.
10,071. Combination Pencil Holder, P. O. Dehn, Manchester.
10,072. Advertising, D. Whitehurst and O. Heggs, Manchester.
10,073. "Shell-out" Marking Board, F. Groves, London.
10,074. Fencing, R. R. Main, Glasgow.
10,075. Match-boxes, J. P. Hudsmith and J. H. Taylor, Birmingham.
10,076. Sewing Machines, J. R. Sykes, Halifax.
10,077. Pads for Upholsterers' Springs, W. Bayne, London.
10,078. Brushes, J. Francis, London.
10,079. Hollow Rims for Cycle Wheels, W. H. Eaves, Coventry.
10,080. Looms, T. Surprenant, Canada.
10,081. Kettle, H. W. Handcock, London.
10,082. Manufacture of Railway Chairs, A. E. Muirhead, Glasgow.
10,083. Metallic Casket, C. Gage, London.
10,084. Toy or Puzzle, T. Moore and T. H. Coates, London.
10,085. Making Ornamental Sheet Glass, A. Cay, London.
10,086. Bricks, J. J. Hamilton.—(*A. de Aguilar, Canary Islands.*)
10,087. Light-directing Devices, L. Lebrecht, London.
10,088. Devices for Printing Ink Cans, M. J. Smith, Liverpool.
10,089. Washing Machines, C. L. Braithwaite and E. O'Brien, Manchester.
10,090. Blacklead Boxes, R. Ripley, Liverpool.
10,091. Handles for Tools, F. W. Golby.—(*— Lannes, France.*)
10,092. Automatic Chain Lubricator, H. S. S. Young, London.
10,093. A New or Improved Torpedo, A. Harris, London.
10,094. Self-acting Draught Preventer, J. Wilson, London.
10,095. Tires of Wheels of Bicycles, R. J. White, London.
10,096. Rotary Pumps, E. A. Jeffreys, A. H. Johnston, and A. K. Rotherham, London.
10,097. Rackets for Playing Games, F. H. Ayres, London.
10,098. Three-way Cock, H. H. Lake.—(*E. Hopkins, Germany.*)
10,099. Impregnating Clothes, A. Lenneberg, London.
10,100. Tobacco Pipes, W. T. Neill, London.
10,101. Tool for Electric Light Fittings, G. Binswanger and W. E. Gibson, London.
10,102. Buffers for Rolling Stocks, H. B. T. Stanton and W. Tozer, London.
10,103. Stringed Instrument Attachments, H. J. Haddan.—(*The C. F. Zimmermann Company, United States.*)
10,104. Decreasing the Draught of Vessels, W. Pirrie, London.
10,105. Producing Alcoholic Beverage from Milk, A. Bernstein, London.
10,106. Producing Alcoholic Beverage from Milk, A. Bernstein, London.
10,107. Educational Appliance, M. R. Jewell, London.
10,108. Window Blinds, R. F. Bolton and W. Negus, London.
10,109. Powder Hoists, Sir Andrew Noble and R. T. Brankston, London.
10,110. Removing Deposits from Gas Retorts, R. Good and S. Spencer, London.
10,111. Furnaces, S. Oates, London.
10,112. Production of Homologues of Vanillin, S. Pitt.—(*The Chemische Fabrik auf Actien (vormals E. Schering), Germany.*)
10,113. Gas Motor Engines, H. P. Holt, London.
10,114. Incandescence Electric Lamps, B. Pell, London.
10,115. Electric Lamps for Surgical Purposes, A. C. Cossor, London.
10,116. Wheels for Vehicles, W. R. and P. J. Fauchon, London.
10,117. Ovens for Burning Porcelain, &c., E. M. C. Condouin, London.
10,118. Water Heaters, H. T. Wright, London.
10,119. Hygienic Bandage for Females, H. Zeitlinger, London.
10,120. Blast Pipe for Locomotive Engines, J. Angus, London.
10,121. Screw-propellers, A. O. and W. G. Chudleigh, London.
10,122. Type-writer, W. Edgecombe, W. E. Ellis, H. Schlesinger, and H. A. Jeune, London.
10,123. Steam Pumps, S. Pitt.—(*J. A. Nicol, France.*)
10,124. Revolving Apparatus, E. Edwards.—(*J. Hundhausen, Germany.*)
10,125. Railway Carriage Door Keys, W. A. Mathew and J. A. Craig, London.
10,126. Letter File, F. H. Browne, London.

25th May, 1894.

10,127. Bichromate Oxyhydrogen Compound, T. and S. H. Hawkins and G. Newnham, Portsmouth.
10,128. Slide Valve for Steam Engines, J. Parsons, Walton, near Liverpool.
10,129. Tin-plate Dusting Machines, S. Foster, E. Beard, and A. Taylor, Redbrook, near Monmouth.
10,130. Advertisement or Show Cards, D. Forbes, Bristol.
10,131. Bicycles, Tricycles, and the like, J. Haslam, London.
10,132. Zero Electrical Instruments, J. Edmondson, Halifax.
10,133. Carriage Door Fastener, J. B. Scarlett, Newhaven.
10,134. Device for Measuring Tea, &c., W. Shaw, London.
10,135. Elastic Tires, J. Moseley and B. Blundstone, Manchester.
10,136. Latches, J. Conlong, Manchester.
10,137. Tissue Improvements for Clothes, A. Trautvetter, Berlin.
10,138. Trigger, Weight, and Cap for Guns, R. Haynes, Derbyshire.
10,139. Spanners or Wrenches, T. Archer, Newcastle-on-Tyne.
10,140. Regulating Electric Currents, W. Hartnell, Leeds.
10,141. Burning Hydro-carbons, F. Woodcock-Rhyce, Birmingham.
10,142. Adaptable Bib Cock, &c., T. Powlesland, Plymouth.
10,143. Tie Fastener, W. E. Lewis and L. J. Mitchell, London.
10,144. Stands for Cards, C. W. and P. S. Faulkner, London.
10,145. Stands for Cards, C. W. and P. S. Faulkner, London.
10,146. Regulating Draughts, G. Barker.—(*The Taylor Improved Draught Company, United States.*)
10,147. Rope Clips, W. Marshall and T. Greenwood, London.
10,148. Pins for Entomological Purposes, H. Knaggs, London.
10,149. Supporting Electrical Conductors, J. Orme, London.
10,150. Boards or Hoardings, &c., A. R. Upward, London.
10,151. Treating Hides, E. T. Day and T. Matthews, London.
10,152. Method of Marine Propulsion, G. W. Mallet, Brighton.
10,153. Sweaters, &c., J. Charter and A. W. Gamage, London.
10,154. Cleaning and Softening Leather, H. A. Lamplugh, London.
10,155. Shifting Pulley Belts, F. Golby.—(*F. Kort, Germany.*)
10,156. Repairing Holes, W. J. Baliss and W. T. Hall, London.
10,157. Syphon Flushing Cistern, T. L. Templeman, London.
10,158. Soft Metal Tubes, W. Droeser, London.
10,159. Glass Tubes, N. Browne.—(*G. Kästner, Germany.*)
10,160. Carpet Sweeper, &c., J. Marsden, jun., London.
10,161. Device for Retaining Bed-clothes, J. G. Jones, London.
10,162. Fastening for Brooches, &c., W. Passfield, London.
10,163. Vessels for Cylinder Jackets, J. Miles, London.
10,164. Collars for Horses and Animals, J. Ralph, London.
10,165. Engine-room and other Telegraphs, V. Russ, London.
10,166. Corking Bottles, H. Stössler and I. M. Zellermayer, London.
10,167. Packing Types in Lines for Composing Machines, C. F. Hilder, London.
10,168. Appliances for Training Hops, J. Watkins, London.
10,169. Plates for Secondary Voltaic Batteries, G. R. Blot, London.
10,170. Pipe Couplings, J. E. Howard and J. C. Taite, London.
10,171. Writing Telegraphs, P. A. Newton.—(*E. Gray, United States.*)
10,172. Vehicles for Electric Railways, E. Hopkinson, London.
10,173. Coating Wire Ropes, S. O. Cowper-Coles and P. W. Walker, London.
10,174. Opening Bottles, N. G. Thornton, Newcastle-on-Tyne.
10,175. Oil-can, D. Porter, London.
10,176. Raising Beer from Cellars, T. W. Thorpe and W. H. Thomas, London.
10,177. Combination Match Holder, G. H. Herbert and J. B. Bush, London.
10,178. Connection for Coupling Hose Pipes, J. L. A. Aymard, London.
10,179. Treatment and Preparation of Hay, D. A. Fyfe, London.
10,180. Bearings for Shafts, L. Gülzow, London.
10,181. Wheels of Vehicles, J. H. Page, London.
10,182. Clutch, E. J. Clubbe and A. W. Southey, London.
10,183. Ink and Pencil Erasers, C. S. Cohen, London.
10,184. Looms, A. J. Boult.—(*E. Delacuvellrie and Co., Belgium.*)
10,185. Obtaining More Perfect Combustion in Furnaces, &c., W. Esplen and W. Wheatley, Liverpool.
10,186. Self locking Cleats for Wires, E. Nashold, London.
10,187. Rotary Engines, &c., W. P. Thompson.—(*A. Dongé, France.*)
10,188. Insecticides, A. J. Boult.—(*F. Haase, Germany.*)
10,189. Sliding Sashes for Windows, G. Charlier London.
10,190. Baling Hay, J. H. Howard and E. T. Bousfield, London.
10,191. Furnaces for Producing Hot Air, W. A. Gibbs, London.
10,192. Brushes, A. Dumas-Gardeux, London.
10,193. Toilet Preparation, H. Priester, London.
10,194. Dyes, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
10,195. Puncture-proof Bands or Pads, J. Andrews, London.
10,196. Stoppers, H. H. Leigh.—(*M. Rubin, United States.*)
10,197. Metallic Sodium and Potassium, C. T. Vautin, London.
10,198. Constructing Wheels and Pulleys, R. Hudson, London.
10,199. Electrotyping, J. W. Naughton, London.
10,200. Screens or Shields for Lenses, M. Stodart, London.
10,201. Boot Jacks, H. K. W. Jonas, London.

28th May, 1894.

10,202. Photography in Colours, G. Teasdale-Buckell, London.
10,203. Coal-cutting, &c., Machinery, J. B. Alliott, London.
10,204. Valves for Pneumatic Hammers, E. Skinner, Sheffield.
10,205. Recreational Appliance, J. Read and W. Atley, Sheffield.
10,206. Syphon Cisterns, J. West, Sheffield.
10,207. Size Boiling Apparatus, M. and W. T. Bury, London.
10,208. Adjusting Mechanism, R. Harrington, Wolverhampton.
10,209. Shot Firers for Use in Mines, J. Wood, Birmingham.
10,210. Waste-preventing Cistern, S. H. Brierley, Birmingham.
10,211. Cash Tills, W. H. Jackson, Halifax.
10,212. Water Bottles, J. Y. Johnson.—(*F. W. Thomson and J. Lamb, India.*)
10,213. Self-acting Mules and Twiners, J. Wood, Derbyshire.
10,214. Gas Engine Exhaust Purifier, W. Habgood and S. C. Smith, Bucks.
10,215. Hardening Points of Serrated Wire, J. Platt, Halifax.
10,216. Loading Guns, Sir A. Noble and C. H. Murray, London.
10,217. Supports for Furniture, &c., H. Heal, London.
10,218. Treatment of Phenols, A. Zimmermann.—(*The Chemische Fabrik auf Actien (vormals E. Schering), Germany.*)
10,219. Valve Gear for Gas Engines, H. J. M. Mellor and J. Taylor and Sons, Ld., Nottingham.
10,220. Pumps for Forcing Fluids, R. B. Clarke, Manchester.
10,221. Excluding Draughts in Doors, W. Nicol, Glasgow.
10,222. Ascertaining the Fluidity of Oils, H. J. Phillips, Ebbw Vale.
10,223. Pumping Engines, J. Bickle, Hayle.
10,224. Paper Covering for Closet Seats, K. Schauer, London.
10,225. Spraying Nozzle with Swivel Joint, G. F. Strawson, London.
10,226. Pedal Grip for Cycling Shoes, H. Prince, London.
10,227. Pumps, J. J. Stott, Manchester.
10,228. Deodorising, &c., Sewage, W. H. Hill-Hartland, Sheffield.
10,229. Central-draught Lamps, A. H. Griffiths and T. B. Smith, Birmingham.
10,230. Material for Polishing, E. J. T. Digby, Liverpool.
10,231. Attaching Buttons to Door-plates, E. Taylor, Birmingham.
10,232. Lugs of Rain-water and Vent Pipes, J. Robson, London.
10,233. Fastening Leather Straps, T. Rosethorn, Manchester.
10,234. Tires for Wheels of Cycles, W. McPhail, Wicklow.
10,235. Bosses and Parts of Cycle Saddles, J. B. Brooks, Birmingham.
10,236. Fixing Buckles to Leather, T. Laycock, Wellingborough.
10,237. Pedals of Pianofortes, H. St. Martin and J. J. Harris, London.
10,238. Saddles for Spinning Frames, R. H. S. Reade and H. McKibbin, Belfast.
10,239. Asbestos Packing, W. F. Hobdell and L. N. Way, London
10,240. Advertising Apparatus, J. G. A. Kitchen, Manchester.
10,241. Divided Jars and Glasses, &c., F. Delahay, London.
10,242. Electric Switch, W. Hearn and C. Gatehouse, London.
10,243. Street Pavements and Flooring, R. D. Bailey, London.
10,244. Harness and Horse-shoes, R. D. Bailey, London.
10,245. Lace, &c., T. S. Birkin and E. Cresswell, London.
10,246. Grinding Convex Surfaces, F. C. Askham, Sheffield.
10,247. Cutting India-rubber, G. Kay and The Ancoats Vale Rubber Company, Ld., Manchester.
10,248. Vapour Condensers, W. D. A. Bost, Glasgow.
10,249. Obtaining Gold from Ores, G. Thomson, Glasgow.
10,250. Preserving Appliances for Fish, D. Scott, Glasgow.
10,251. Cranks for Velocipedes, H. P. Cook and J. Cox, Birmingham.
10,252. Shuttle Guard, C. Marshall, Bolton.
10,253. Velocipedes, E. T. Pike, London.
10,254. Self-acting Catch for Doors, G. J. Cole, Hull.
10,255. Toy, F. Jones, Worcester.
10,256. Lathes, J. P. Lea, London.
10,257. Two-line Capitals, M. H. Whittaker, Scarborough.
10,258. Tires and Rims of Cycles, &c., R. Watt, Glasgow.
10,259. Machines for Embossing Wood, A. E. Frisby, Nottingham.
10,260. Pipes for Drain Purposes, T. F. Strutt, London.
10,261. Tubes, Belfast Flax Spinning and Weaving Co., Ld., and S. McDowell, Belfast.
10,262. Pedals, W. Bown, J. W. Flavell, and G. Capewell, Birmingham.
10,263. Mattresses, J. and J. Edgar and G. Crerar, Glasgow.
10,264. Stockings and Half Hose, C. O. Dixon, Nottingham.
10,265. Smoke Burner, A. McGillivray and P. McMahon, Edinburgh.
10,266. Shedding Operating Mechanism, A. Lockwood, Keighley.
10,267. Heating Surfaces of Kettles, T. Russom, Leeds.
10,268. Brushes, E. Hales, Birmingham.
10,269. Paper Bag Making, N. Chandler and G. Mellor, Hednesford.

10,270. SPEED GEARING, W. Bostock and A. Nicholson, Nottingham.
10,271. DROP HANDLE, S. Skerritt and J. W. Ogden, Sheffield.
10,272. DRAUGHT INDICATOR, T. G. Barron, West Hartlepool.
10,273. BOILER CIRCULATING APPARATUS, T. P. Statham, Bristol.
10,274. GLAZING ROOFS and SURFACES, H. C. Board, Bristol.
10,275. FLUSHING WATER-CLOSETS, &c., J. H. Vidal, Sunderland.
10,726. PACKING PISTONS and SPINDLES, G. W. Dowell, Derby.
10,277. HAT DISHES, J. Rowley, Manchester.
10,278. GUARDS for DOORS, E. R. Baller, Southport.
10,279. BICYCLES, R. Scott, Newcastle-on-Tyne.
10,280. DRYING CACAO BEANS, C. Hodson and W. Dawson, Derby.
10,281. FIRE-LIGHTERS, A. Reid, Glasgow.
10,282. CYCLE HANDLE-BARS, W. Pilkington, C. T. Bishop, and A. Brownsword, Birmingham.
10,283. DRESSING-BLADES, J. Gröger, Cologne.
10,284. SPONGES, V. Rose, Cologne.
10,285. IMITATING the VEINS of WOOD, F. W. D. Cohner, Germany.
10,286. WIRE SPRING BANDS for BELTS, P. A. Martin, Birmingham.
10,287. EGG WHISKS, T. Taylor, Birmingham.
10,288. MACHINES for WORKING DOUGH, J. H. Mitchell, Glasgow.
10,289. PUMP, D. Davies, Swansea.
10,290. CAP, S. L. Pryor, London.
10,291. JOINTS for TUBES, J. W. and W. W. Bristol, Birmingham.
10,292. ILLUMINATING WATCHES, J. Manger and E. Mojon, London.
10,293. ELECTRIC LAMP, J. Manger and E. Mojon, London.
10,294. SUSPENDING HATS and CAPS, G. M. Tarrant, London.
10,295. GEARING for CYCLES, L. Watkins, London.
10,296. FOOT-REST for CYCLES, P. R. J. Willis.—(*M. Smith, United States.*)
10,297. FURNACE, W. H. Bradley, London.
10,298. PROTECTORS for BOOTS, &c., R. H. Bishop, London.
10,299. INDIA-RUBBER ERASERS, H. P. Mitchell, London.
10,300. APPARATUS for MAKING ICE, A. Glasson, London.
10,301. CRANKS of BICYCLES, &c., T. and J. Hooper, London.
10,302. BEARINGS, G. J. Glover, London.
10,303. OBTAINING GOLD from SEA-WATER, H. C. Bull, London.
10,304. TYPOGRAPHIC PRINTING SURFACES, F. Sternberg, Herts.
10,305. KEY-HOLES and ESCUTCHEONS, E. Boult, London.
10,306. LEAKAGE INDICATOR for DRAINS, F. H. Harvey, London.
10,307. SPRING, B. Cockin and G. E. Stringer, London.
10,308. OIL STOVES, E. Rippingille and W. Porter, London.
10,309. OIL STOVES, E. Rippingille and W. Brandon, London.
10,310. OIL STOVES, E. Rippingille and W. Brandon, London.
10,311. CASTORS, A. T. Eloure, London.
10,312. TIRES for BICYCLE WHEELS, R. J. White, London.
10,313. VASTATIONS in SEWAGE, W. H. Hughan, sen., London.
10,314. GAME, T. E. Franklyn, London.
10,315. BALL BEARINGS for CASTORS, H. M. Nicholls, London.
10,316. NOVEL MEANS of ADVERTISING, G. S. Thompson, London.
10,317. CYCLE PNEUMATIC TIRES, J. C. Montgomerie, London.
10,318. EYE-GLASS, J. J. Thorpe and W. H. Andrews, London.
10,319. BLOWERS, G. W. Poole, London.
10,320. VENTILATION of SEWERS, &c., G. W. Baker, London.
10,321. COOKING UTENSILS for FOOD, M. A. Brawn, London.
10,322. EXTRACTION of METALS, J. P. van der Ploeg, London.
10,323. FEED TROUGH for CATTLE, &c., J. H. Denison, London.
10,324. CASH REGISTER, P. R. J. Willis.—(*J. Hare, United States.*)
10,325. REMOVING BOILER SCALE, J. C. A. Marckmann, London.
10,326. MILLS, O. Zimmermann and G. Hagemann, London.
10,327. LOOMS, E. Schrabetz, London.
10,328. DISINFECTOR, H. K. Andersson and D. Sjöström, London.
10,329. TAP, T. R. Atkins and A. Krüger-Velthusen, East Molesey.
10,330. PROTECTIVE APPLIANCE for HATS, J. Ayres, London.
10,331. ELECTRIC CONDUCTORS for VEHICLES, F. B. Behr, London.
10,332. ARC LAMP REGULATING DEVICE, S. J. Suter, London.
10,333. NEW COLOURING MATTERS, J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran, London.
10,334. APPLYING the BRAKES on TRAINS, C. Adler, London.
10,335. TYPEWRITERS, P. M. Justice.—(*The Typewriter Attachments Company, United States.*)
10,336. LAMPS, E. A. Jeffreys, London.
10,337. WATERPROOFING, H. Cohrs and J. Oesterreich, London.
10,338. DENTAL DRILLING MACHINES, T. Dill-Richard, London.
10,339. STEAM MOTIVE POWER ENGINES, W. W. Dunn, London.
10,340. BOILERS, W. W. Dunn, London.
10,341. SYPHON, D. Clerk.—(*Guéret frères, France.*)
10,342. ACCORDIONS or SIMILAR INSTRUMENTS, W. Zielke, London.
10,343. FILTER, H. A. W. Hülsmann, London.
10,344. EXTRACTING GOLD from ORES, C. M. Pielsticker, London.
10,345. TRANSPORTING EARTH, J. S. and J. Hobrough, London.
10,346. GAITERS, A. Hess, London.
10,347. HEATING STEAM GENERATORS, &c., W. Kneen, London.
10,348. TYPE SUPPORTS, V. Calendoli and A. Savarese, London.
10,349. SETTING-UP TYPE, V. Calendoli and A. Savarese, London.
10,350. DRINKING TROUGHS for CATTLE, R. Kraatz, London.
10,351. NAIL BRUSHES and the like, H. A. Wanklyn, London.
10,352. COCKS for BATH PURPOSES, &c., E. Bluhm, London.
10,353. FITTINGS for ELECTRIC LAMPS, J. Morris, jun., London.
10,354. TRUNKS, &c., A. J. Boult.—(*G. L. Lippold, Germany.*)
10,355. OBTAINING COMBUSTION in BOILERS, H. I. Roberts, Liverpool.
10,356. VALVE MECHANISM, J. S., T. A., and E. R. Walker, London.
10,357. SWEAT-BANDS and LEATHERS, A. Higginbottom, Manchester.
10,358. SADDLE TREES, A. J. Boult.—(*—. Plüer and —. Thorring, Germany.*)
10,359. CLOTHES' WASHING APPARATUS, J. Roberts, Liverpool.
10,360. DUST BINS, F. S. Salberg, London.
10,361. APPARATUS for BOILING SIZE, F. Scarisbrick, Manchester.
10,362. SPRING SCALES, A. J. Boult.—(*E. Keinholz, Germany.*)
10,363. FURNACES and FLUES, G. A. Newton, Liverpool.
10,364. ELECTRIC MOTORS and the like, E. Dragoumis, London.
10,365. TIRES for BICYCLES, &c., W. Ashburn, Manchester.
10,366. RECORDING APPARATUS, A. J. Boult.—(*E. A. Meyer, Germany.*)
10,367. BOOTS or SHOES, A. Gilmour, Liverpool.
10,368. STOPPERING BOTTLES, A. J. Boult.—(*F. Wegener, Germany.*)
10,369. PHOTOMETER for PHOTOGRAPHIC PURPOSES, J. Barnes, Manchester.
10,370. MILK-BOILING APPARATUS, A. J. Boult.—(*F. Goldmann, Germany.*)

29th May, 1894.

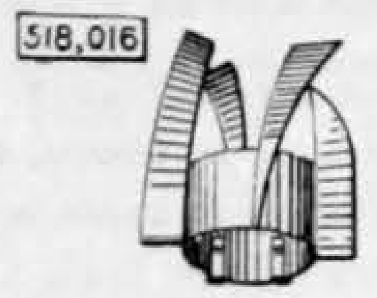
10,371. AXLE-BOXES for ROLLING STOCK, G. Wilson, London.
10,372. CIGARETTE and other HOLDERS, R. Rapson, Margate.
10,373. CIGAR TRIMMER, C. and C. T. Edwards, Leamington Spa.
10,374. PHOTOGRAPHERS' DESKS, &c., J. W. Beaufort, Birmingham.
10,375. MALT, E. Manbré, J. L. Barrett, and C. N. Pochin, London.
10,376. CYCLE PEDALS, O. Pihlfeldt, Birmingham.
10,377. CENTRIFUGAL MACHINES, W. J. Munden, London.
10,378. CASE for USE in ADVERTISING, T. R. Seymour, Bristol.
10,379. STEAM CYLINDERS, S. Platt and J. Tricot, Halifax.
10,380. LOOM PATTERN CHAINS, W. A. and D. Crabtree, Keighley.
10,381. PICKING MOTIONS for LOOMS, J. Hibbert and J. Marsden, Manchester.
10,382. The PILE HAND SCREW-DRIVER, W. Cree, Worksop.
10,383. BLIND ROLLERS and the like, S. O. Taylor, Leicester.
10,384. CARBON for ELECTRICAL PURPOSES, G. S. Orson, Belfast.
10,385. NON-SLIPPING SPLICE for FISHING-RODS, A. Grant, Glasgow.
10,386. CLOCKS for OPERATING ELECTRICAL ALARMS, F. Fritz, Manchester.
10,387. READING LAMPS, E. E. T. B. Greville, Edinburgh.
10,388. A CYCLE, J. Pledger, London.
10,389. SEPARATING GREASE from the EXHAUST STEAM of ENGINES, G. E. Hudson and W. J. Baker, Scarborough.
10,390. PNEUMATIC TIRES, E. H. Seddon, Manchester.
10,391. APPARATUS for DYEING TEXTILE MATERIALS, F. A. Blair, Glasgow.
10,392. APPARATUS for DYEING YARNS, J. Pritchard, Glasgow.
10,393. ARC LAMPS and APPLIANCES, E. A. Claremont, Manchester.
10,394. TARGET REGISTER HOLDER, W. S. Burton, Aldershot.
10,395. ADJUSTING CARRIAGE DOORS, L. E. G. de Woolfson, Shrewsbury.
10,396. CUP HOLDING STANDS, E. Thompson, C. Colver, and J. W. Dixon, Sheffield.
10,397. PIPE CASTING MOULDS, T. and G. A. Chambers, Sheffield.
10,398. CYCLE GEARING, J. Allinson, Sheffield.
10,399. CASH RECKONER and TELLER, H. P. Babbage, Cheltenham.
10,400. STEAM BOILERS, M. Rankin, Glasgow.
10,401. STEAM BOILERS, P. Pinckney, Portsmouth.
10,402. CYCLE SADDLE CLIP, A. T. Austin, Birmingham.
10,403. ROLLED METAL BOILER PLATES, J. Shepherd, Cheshire.
10,404. SPINNING FRAMES, J. H. Hamilton and F. W. Finlay, Belfast.
10,405. CYCLES, A. Pickard, Harrogate.
10,406. TEA and COFFEE INFUSER, W. A. Cornwell, Birmingham.
10,407. LOCKING CYCLES, T. Clarke, Birmingham.
10,408. LASTING BOOTS and SHOES, F. Cutlan, London.
10,409. FODDER COMPRESSING PROCESS, M. K. Westcott, Liverpool.
10,410. CYCLE GEAR, R. Campbell and W. Railton, Liverpool.
10,411. GAME, L. A. Pilley, London.
10,412. SMOOTHING SLATES, O. J. Owen, Liverpool.
10,413. SHIRT CUFFS, T. Stirling, Liverpool.
10,414. FELTING MACHINES, V. Coq, Liverpool.
10,415. RAILROAD SIGNALLING APPARATUS, W. L. Wise.—(*F. A. Fox and D. H. Roberts, United States.*)
10,416. KILNS for BURNING LIMESTONE, &c., J. Briggs, Lancashire.
10,417. SELF-LOCKING SKIRT GRIP, S. J. Herts, London.
10,418. LETTER ENVELOPE OPENER, D. Young.—(*W. Dryland, France.*)
10,419. MACHINE for TURNING CUFF BLANKS, G. E. Norris, London.
10,420. STEAM ENGINES, B. F. Sparr, London.
10,421. HOT-WATER HEATING APPARATUS, C. J. Balthasar, London.
10,422. COOKING RANGES and BOILERS, T. J. Cornish, London.
10,423. DESIGN PAPER for WEAVING PURPOSES, H. Wilisch, London.
10,424. MANUFACTURE of PLUMBAGO, P. F. Johnson, London.
10,425. ELECTRICAL TRANSFORMERS, J. A. Kingdon, London.
10,426. DYNAMO-ELECTRIC MACHINES, J. A. Kingdon, London.
10,427. COMPOSITION for INCANDESCERS for LAMPS, F. H. Medhurst.—(*L. Chandor, Russia.*)
10,428. FORMING, &c., WIRE STAPLES, E. T. Greenfield, London.
10,429. FORMING, &c., WIRE STAPLES, E. T. Greenfield, London.
10,430. DOOR CHECKS, T. Curley, London.
10,431. HARNESS, A. G. B. Ashton, London.
10,432. PNEUMATIC TIRES, P. L. Renouf and L. Stroud, London.
10,433. SEED DRILLS, F. Melichar, London.
10,434. SKIRT RETAINER, J. Taylor, London.
10,435. SUPPLY of AIR to FURNACES, A. P. Campbell, London.
10,436. TIRES, P. E. V. Hardy, London.
10,437. TIRES, P. E. V. Hardy, London.
10,438. MAKING ARTIFICIAL FUEL, G. S. and C. Cory, London.
10,439. MAKING INGOTS, A. H. Moore and G. Whitlock, London.
10,440. HAT-RACKS, C. E. Cochrane, London.
10,441. FIRE-PAILS and ATTACHMENTS, F. B. Comins, London.
10,442. MACHINES for MAKING BARBED WIRE, S. Swanbum, London.
10,443. APPARATUS for SAVING LIFE at SEA, F. Barathon, London.
10,444. PERMUTATION LOCKS, W. R. Lake.—(*D. J. Cable, United States.*)
10,445. FUMIGATORS, C. T. Kingzett, London.
10,446. ROCKING CHILDREN'S CRADLES, V. A. P. Louis, London.
10,447. GAS HEATING STOVES, J. Grundy.—(*H. Heim, Austria.*)
10,448. RIMS for USE with PNEUMATIC TIRES, E. A. Bale, London.
10,449. CENTRE SPRING STAY BUSK, J. B. Davis, London.
10,450. LACE, H. F. Moreau and L. Canevet, London.
10,451. TRAMWAY and similar ENGINES, E. F. Piers, London.
10,452. ENGINES, E. F. Piers, London.
10,453. HAIR-PIN, R. H. Parfitt, London.
10,454. STITCHING SHEETS of SIGNATURES, J. T. O. Ortloff, London.
10,455. CHURNS, J. H. H. Duncan, T. Nuttall, T. Bevington, and F. H. Favell, London.
10,456. WATCH POCKET, G. W. Carter, London.
10,457. VACUUM BRAKE APPARATUS, A. Spencer, London.
10,458. ROTARY ENGINES, H. A. House, H. A. House, jun., and R. R. Symon, London.
10,459. BRAKES, T. H. Allen, J. Gray, G. Hastings, G. F. Shepley, and H. Marsh, Canada.
10,460. STEAM GENERATORS, C. S. Galloway, London.
10,461. CAMERAS, S. D. Williams, Newport, Mon.

SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

518,016. STEAM GENERATOR, *G. Zahikian, London, England.—Filed May 22nd, 1893.*

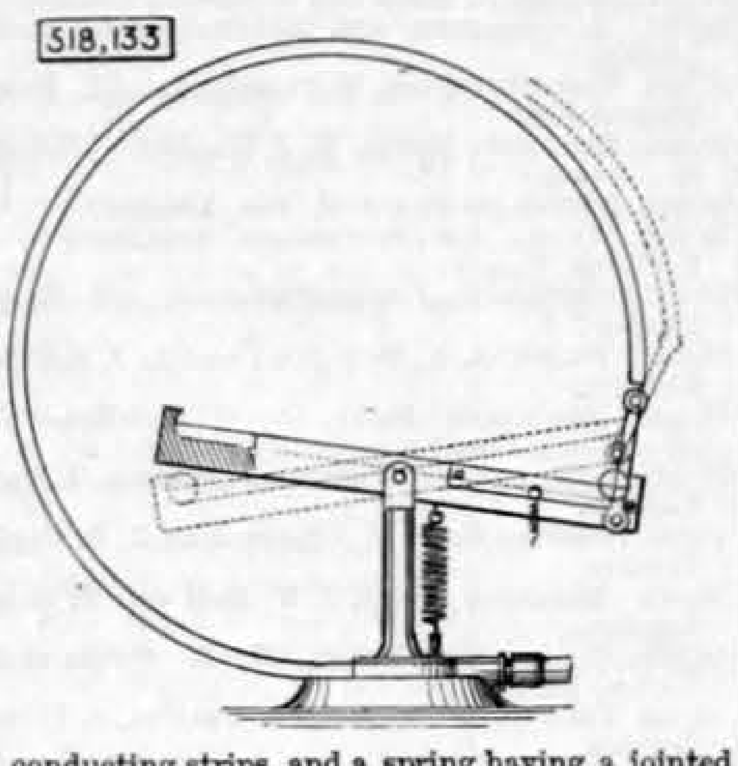
Claim.—In a steam generator of the character described, the combination, with a water tube receiv-



ing water at one end, and discharging it wholly or partly evaporated at the other end, of a device consisting essentially of a plurality of helicoidal blades set transversely in said tube, and clips adapted to engage said tube and hold said device in position, substantially as described.

518,133. ELECTRICAL CONTACT MECHANISM, *J. F. Blake, New Haven, Conn.—Filed January 25th, 1894.*

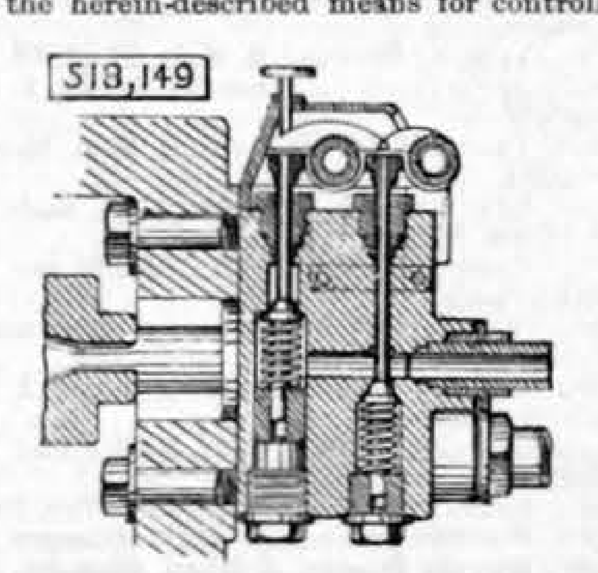
Claim.—(1) An electrical contact mechanism, consisting of a pivoted lever or arm provided with an insulating portion and separated conducting strips, electrical terminals connected to said conducting strips, a rolling contact adapted to travel on the pivoted lever or arm and electrically connect the



said conducting strips, and a spring having a jointed connection with the lever or arm for operating the latter, substantially as described. (2) An electrical contact mechanism comprising a lever or swinging arm provided with electrical terminals and with an insulating portion, a rolling contact adapted to travel between the terminals and isulating portion, and a hollow spring connected to said lever and adapted to receive pressure for actuating the lever substantially as described.

518,149. CONTROLLING VALVE FOR HYDRAULIC PRESSURE, *A. Kampf.—Filed January 28th, 1893.*

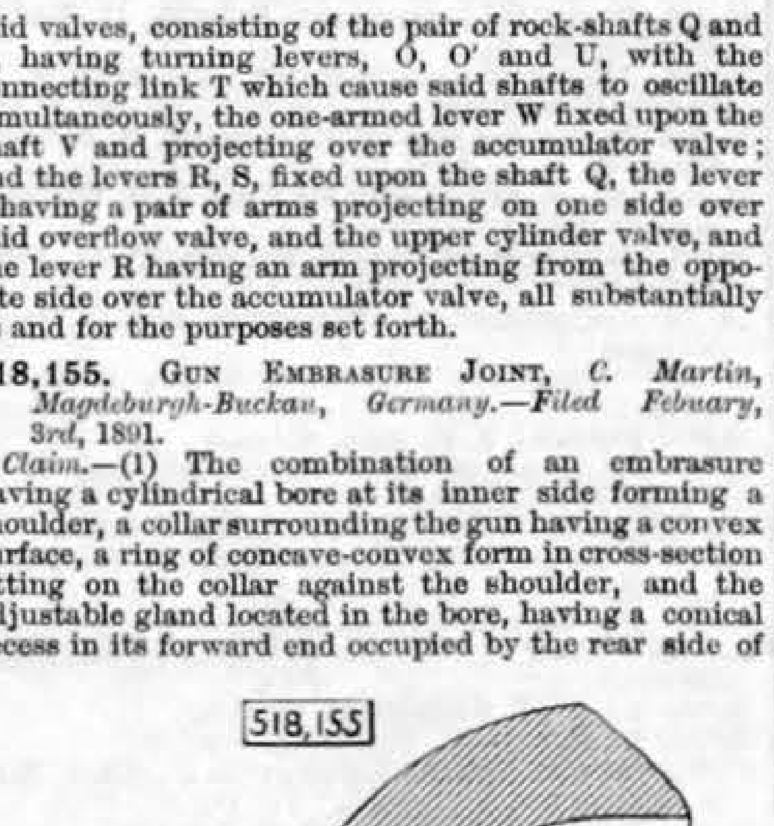
Claim.—(1) In combination with the accumulator passage, the upper and lower cylinder passages communicating with the accumulator passage, the overflow also communicating with the upper cylinder passage, and the accumulator, the overflow and upper cylinder valves, respectively controlling the accumulator passage, the overflow passage and the communication between the upper cylinder and accumulator passage; the herein-described means for controlling



said valves, consisting of the pair of rock-shafts Q and V, having turning levers, O, O' and U, with the connecting link T which cause said shafts to oscillate simultaneously, the one-armed lever W fixed upon the shaft V and projecting over the accumulator valve; and the levers R, S, fixed upon the shaft Q, the lever S having a pair of arms projecting on one side over said overflow valve, and the upper cylinder valve, and the lever R having an arm projecting from the opposite side over the accumulator valve, all substantially as and for the purposes set forth.

518,155. GUN EMBRASURE JOINT, *C. Martin, Magdeburgh-Buckau, Germany.—Filed February, 3rd, 1891.*

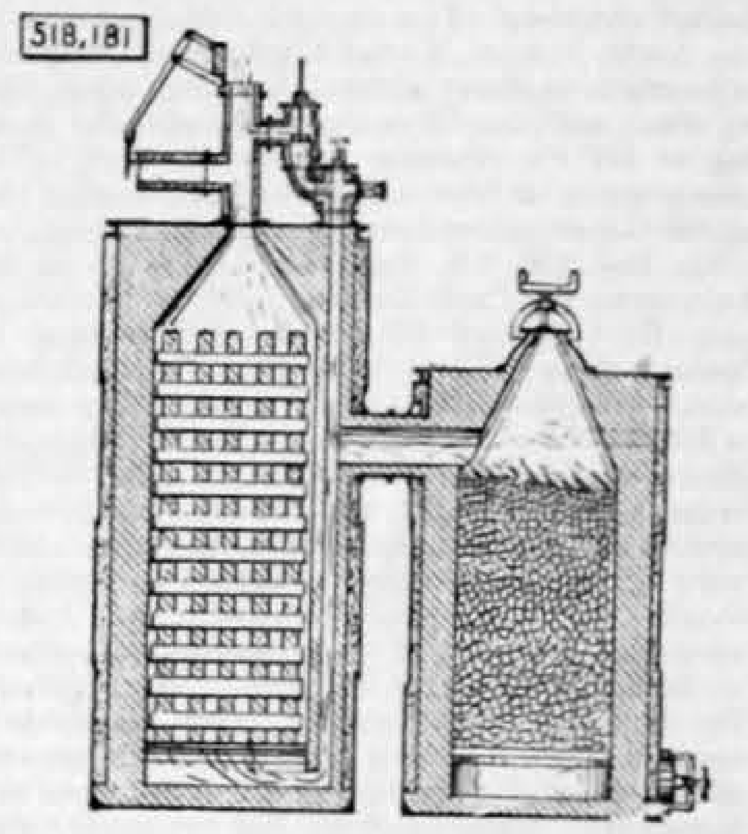
Claim.—(1) The combination of an embrasure having a cylindrical bore at its inner side forming a shoulder, a collar surrounding the gun having a convex surface, a ring of concave-convex form in cross-section fitting on the collar against the shoulder, and the adjustable gland located in the bore, having a conical recess in its forward end occupied by the rear side of



the ring; the shoulder, embrasure, ring, and gland forming a space between them into which the powder gases enter from the front side of the ring and force the latter against the collar and into the recess of the gland, substantially as described. (2) The combination of an embrasure having a cylindrical bore at its inner side forming a shoulder, a collar surrounding the gun having a convex surface, a ring of concave-convex form in cross-section, divided circumferentially and fitting on the collar against the shoulder, and the adjustable gland locatedin the bore, having a conical recess in its forward end occupied by the rear side of the ring; the shoulder, embrasure, ring, and gland forming a space between them into which the powder gases enter from the front side of the ring and force the latter against the collar and into the recess of the gland substantially as described.

518,181. GAS APPARATUS, *T. Curley, Wilmington, Del.—Filed November 23rd, 1891.*

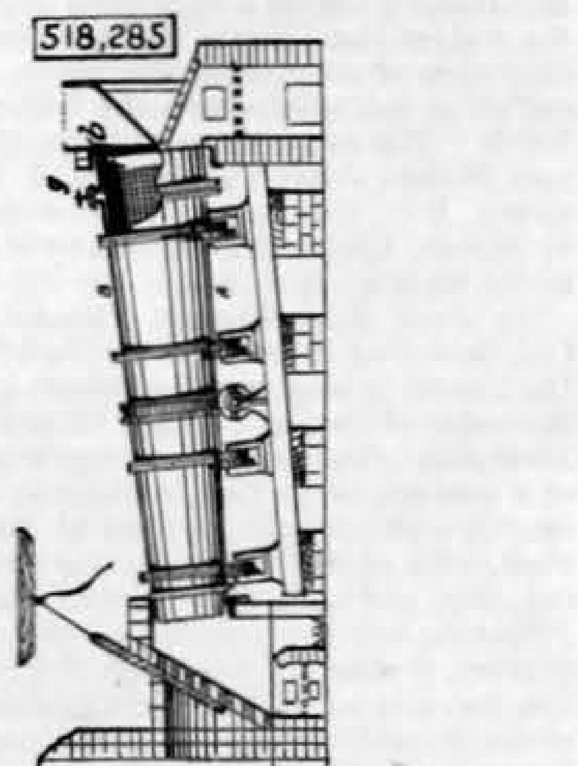
Claim.—The combination of the generator and superheater of a gas apparatus, the discharge pipe at the top of the superheater, a flue or passage in said superheater extending from top to bottom of the same, and communicating with the combustion



chamber of the generator, and with the lower end of the superheater chamber, and a by-pass connecting the upper end of said flue with the discharge pipe of the superheater, said by-pass having an adjustable valve for regulating the flow through the same, substantially as specified.

518,285. FURNACE FOR TREATING REFUSE OF CITIES, *J. J. Storer, Helena, Mont.—Filed March 19th, 1892.*

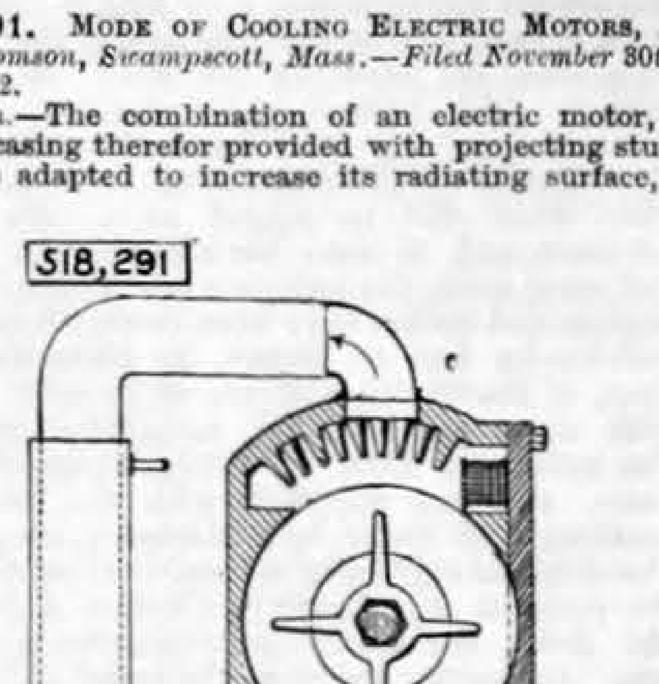
Claim.—(1) In a furnace, the combination of a revolving cylinder, a fireplace at the receiving end thereof, and a chimney at the other end, with a gas combustion chamber located outside of the chimney, and a perforated wall facing the discharge end of the cylinder and arranged between it and the chimney, substantially as described. (2) In a revolving cylinder furnace, the combination with the inner shell A, of an outer shell B, having flanged sections with opposing flanged offsets *d*, immovable ring *g*, with inserted



water pipe *g'*, and end rings *b*, the whole being fitted and arranged and operating substantially as herein shown and described, and forming a water jacket or space for the purpose set forth. (3) In a water-jacketed revolving furnace, the combination with the outer shell provided with a water discharge opening, of a grooved ring encircling said shell and having an orifice coinciding with the discharge opening thereof, constructed and arranged substantially as and for the purpose described.

518,291. MODE OF COOLING ELECTRIC MOTORS, *E. Thomson, Swampscott, Mass.—Filed November 30th, 1892.*

Claim.—The combination of an electric motor, a closed casing therefor provided with projecting studs or lugs adapted to increase its radiating surface, a



pipe communicating with such casing, and a water jacket surrounding a portion of the pipe, all arranged, substantially as set out herein, to provide a waterproof inclosing casing for an electric motor, adapted to dissipate the heat generated therein.