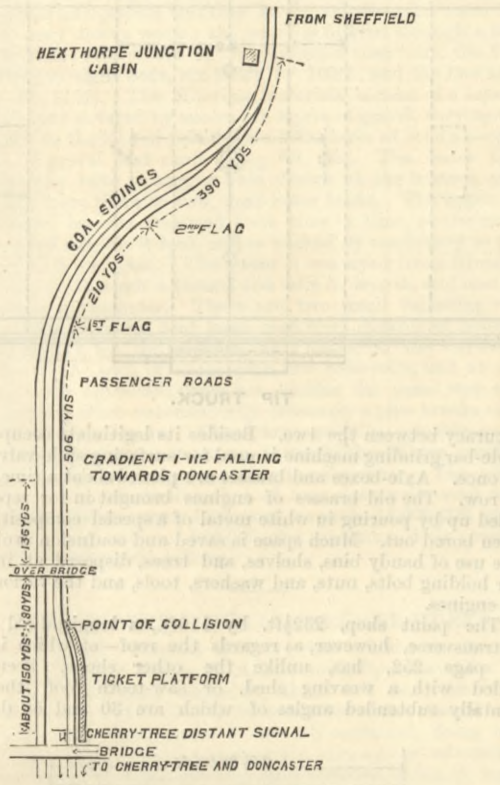
THE HEXTHORPE ACCIDENT.

THE main facts of the recent accident at Hexthorpe are very simple. A Midland excursion train from Sheffield consisting of six bogies and six ordinary carriages, and seating about 650 persons, was standing at a ticket platform which was only used during the Doncaster race week. This ticket platform was situated near the middle of a block section extending from Hexthorpe Junction cabin to Cherry-tree cabin. The distance between these points is 1 mile 53 chains, or 2926 yards, and the point of collision was 1106 yards from Hexthorpe cabin. Consequently, under ordinary circumstances, when the block system is in force, a driver passing Hexthorpe cabin would expect to find the line clear as far as Cherry-tree, which is the next cabin before reaching South Yorkshire Junction cabin, where the line joins the main line of the Great Northern, a short distance south of Doncaster passenger-station. The time usually taken by passenger trains in running from Hexthorpe cabin to the scene of the accident is about 50 sec., which corresponds to an average speed of about thirty-three miles per hour. The accompanying sketch plan will make the arrangement of the lines clear.

A through regular train from Liverpool, drawn by a Manchester, Sheffield, and Lincolnshire bogie engine, and consisting of nine passenger carriages and two brake vans, followed four minutes behind the Midland train. It appears that the Hexthorpe signals were kept at danger until the trains had slackened speed, and that then the home signal was lowered, and the trains were allowed to proceed, a green flag being waved to indicate that caution was necessary. Few, if any, of the guards, drivers, and firemen concerned appear to have been told officially, or to have known positively, that the block working was suspended between Hexthorpe and Cherry-tree, or that excursion trains would stop to take tickets at the seldom used Hexthorpe ticket platform. The fire-



man of the Manchester, Sheffield, and Lincolnshire train acknowledges having received the working instructions for the St. Leger week, but had not read them.

Unfortunately, however, this suspension of block working meant that a train standing at the ticket platform was only protected by two flagmen, neither of whom could see whether a train was standing at the ticket platform or not. A third man was, however, placed on the coal sidings, whence he could see the ticket platform, and inform the two flagmen whether a train was standing there or not. The two men with flags appear to have been standing on the fireman's side of an approaching engine, and therefore it is not difficult to understand that their signals might not be seen by the driver on the other side of the engine. In his evidence, the driver states that he did not see the flags, and that his fireman only told him about the flags after the accident; and at the inquest he denied that they were waved, or held so as to indicate danger.

This merely emphasises the primary rule for signals, that they should be elevated and, if possible, have a sky background, so as to be unmistakeably visible. Men standing with flags, on the inside of a curve and on the edge of a high embankment, would be invisible to an approaching driver standing on the outer side of his engine relative to the curve; the engine would effectually block his view. Elevated signals would, however, be plainly visible and unmistakeable, as they could be plainly seen above the boiler, even if the signals were the wrong side of the engine. In this case the driver appears to have slackened his speed at finding the Hexthorpe signals against him, and when the home signal was lowered he appears to have assumed that the line was clear to Cherry-tree, while the signal was only intended to mean that the road was clear to the two flagmen. Presently he and his fireman caught sight through the trees of the Cherry-tree distant signal—also termed the advance signal—which was lowered to allow the Midland train to proceed. As, however, this train, though standing at the ticket platform, was round the curve, and was therefore quite invisible to the driver of the Manchester, Sheffield, and Lincolnshire train, he naturally concluded that the signal was meant for him, and put on steam only to find, as he rounded the curve, that the rear of the Midland train was about 200 yards in front of him. He appears to have applied his continuous brake, the simple vacuum, and to have opened all his sand valves, two for the engine and one for the tender, and to have reversed his engine. The speed appears to have been considerably reduced when the collision occurred, but not sufficiently to prevent the loss of twenty-five lives and serious injuries to some seventy persons. The last vehicle of the Midland train, a bogie third and brake composite, was telescoped into the preceding vehicle, a bogie third, and the two preceding carriages were practically destroyed. The greatest loss of life appears to have occurred in the second vehicle, and apparently all the killed and a great majority of the injured were travelling in the four rear vehicles. The Manchester, Sheffield, and Lincolnshire engine lost its funnel, and the bogie was driven back under the motion, but the engine kept the rails, and few of the passengers complained of any injuries. The Midland train was not apparently moved by the first shock, but was driven forward some twenty yards by the rebound or second shock. The rear vehicle of the Midland train, in which many people were killed, is still lying near the point of collision bottom up, and stripped of wheels and bogies. Strange to say, however, though both ends and great part of the sides are gone, several panes of glass in the doors and windows are whole, and others but slightly cracked.

The Midland train would seat about 650 persons, and the Manchester, Sheffield, and Lincolnshire train about 350 persons. As both trains were well filled, it is probable that 800 persons were in the two trains. The loss of life, though larger than in any accident for some years, is therefore small in proportion to the total number of persons in the trains.

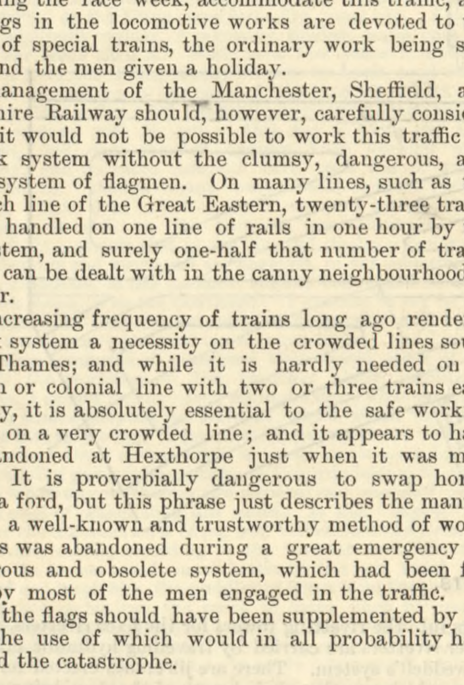
The ordinary traffic at Doncaster is very heavy. In the course of the day 103 regular passenger trains leave and a like number arrive, while several main line expresses rush through without stopping. In order to accommodate the extra trains during the race week, some special provision is necessary, and the amount of this extra traffic is shown by the fact that forty-three trains passed Hexthorpe between 9 a.m. and 1 p.m. on the St. Leger day, and on the Doncaster Cup day twenty-five trains passed between 9 a.m. and the time the accident happened. Special sidings near Doncaster station, only used during the race week, accommodate this traffic, and the sidings in the locomotive works are devoted to the stowage of special trains, the ordinary work being suspended and the men given a holiday.

The management of the Manchester, Sheffield, and Lincolnshire Railway should, however, carefully consider whether it would not be possible to work this traffic by the block system without the clumsy, dangerous, and obsolete system of flagmen. On many lines, such as the Fenchurch line of the Great Eastern, twenty-three trains are daily handled on one line of rails in one hour by the block system, and surely one-half that number of trains per hour can be dealt with in the canny neighbourhood of Doncaster.

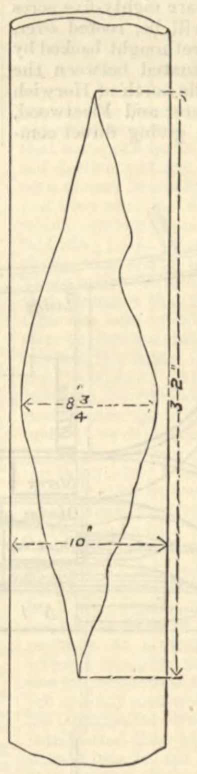
The increasing frequency of trains long ago rendered the block system a necessity on the crowded lines south of the Thames; and while it is hardly needed on an American or colonial line with two or three trains each way a day, it is absolutely essential to the safe working of traffic on a very crowded line; and it appears to have been abandoned at Hexthorpe just when it was most wanted. It is proverbially dangerous to swap horses crossing a ford, but this phrase just describes the manner in which a well-known and trustworthy method of working trains was abandoned during a great emergency for a dangerous and obsolete system, which had been forgotten by most of the men engaged in the traffic. In any case the flags should have been supplemented by fog signals, the use of which would in all probability have prevented the catastrophe.

THE EXPLOSION ON BOARD THE ELBE.

ONE of the most disastrous marine explosions recorded took place about 4 p.m. on Monday on board the Elbe. The main steam pipe gave way, and nine men in the stokehole at the time lost their lives, while a tenth, grievously scalded, lies in hospital. The Elbe is a vessel of about 3000 tons, the property of the Royal Mail Company. She was built seventeen years ago at Glasgow by Messrs. Elder and Co. Recently she has been overhauled by Messrs. Oswald, Mordaunt, and Co., of Southampton, and fitted with triple-expansion engines capable of indicating about 3500-horse power. Last month the ship



made a preliminary run in Stokes Bay. Some modifications were found to be necessary in the engines, and these were made, and on Monday she undertook her official trials. The cylinders are 32in., 50in., and 80in., or thereabouts, in diameter, the working pressure being 160 lb., and the revolutions about 60 per minute. The boilers, eight in number, are fired athwart ship, and arranged as shown in the accompanying sketch; and a transverse bunker cuts them off from the engine room. A straight steam pipe runs the length of the stokehole, united to each boiler by branch pipes and T-pieces, each boiler having a stop valve on it; the steam pipes are of copper. On Monday, during the first and second runs on the measured mile, the tail rod of one of the cylinders heated, so the trial was brought to an end for a time; the stuffing-box gland was taken out and filed larger in the hole by the staff on board, and replaced. The ship then went on the mile again, with results wholly satisfactory. When turning at the end of the fourth run, the main steam pipe burst at a point indicated in the sketch; the rent being as shown in form and dimensions. It was on the under-side of the pipe, so that the steam was all directed downward into the stokehole, access to which could only be obtained from the deck by three flights of most difficult, narrow, perpendicular ladders. As the rush of steam occurred right above the crooked passage through the transverse bunker, escape in that direction was cut off. The consequence of the tremendous rush of steam which followed was the death of those in the stokehole at the time—Mr. Thompson and Mr. Ewing, the first and second engineers; a boilermaker, Godber, one of Messrs. Oswald and Co.'s engineers, and three firemen and two coal trimmers. There was a large number of engineers and visitors in the engine-room at the time, but they suffered no inconvenience. Although the door in the narrow passage through the transverse bunker already named was open, it is a curious fact that through this door, and also down the windsails, a steady inrush of air was maintained all through, the steam rising in volumes from the gratings and fidley houses and blowing away to leeward. No one could enter the stokehole for nearly two hours. After about an hour, one brave fellow had himself slung on a rope and attempted to descend the aft stokehole ladder. He got down as far as the second landing, and there found poor Thompson dead. He had succeeded apparently in getting so far when he was overtaken and overpowered by the suffocating steam. The rescuer could do nothing, being nearly suffocated himself, and had to be hauled up. All this time the engines kept on turning, working on the vacuum. Tugs at last came alongside, and the bodies were sent on shore, while the ship was towed back to Southampton water.



It is, of course, impossible at present to express any opinion as to why the pipe burst. It was a brazed copper pipe, 10in. diameter, and No. 2 B.W.G., or just over $\frac{1}{4}$in. thick, corresponding to a stress of about 3200 lb. per square inch, so that there was a very large factor of safety. The pipe had been tested to double the working pressure more than once. The bursting strain on it per inch of section was 800 lb., and $\frac{800}{x}$, where x is the thickness of the pipe, gives the actual tensile stress. Thus, x being $\frac{1}{4}$in., the stress would be 3200. The strength of good copper is about 33,000 lb. per square inch, at a low temperature; but it must be borne in mind that it is exceedingly difficult to get good copper now, the market being flooded with a very brittle and inferior foreign copper. At high temperatures copper loses its strength very rapidly. The temperature of steam of 160 lb. on the gauge is 375 deg., and a pipe conveying this steam would lose about 15 per cent. of its strength. There is no trustworthy information available, so far as we are aware, concerning the strength of brazed copper pipes. We imagine that the results would be very variable, according to the skill of the brazier. Pending the Board of Trade inquiry it would be improper to suggest an explanation of the failure; we may, however, say that there is reason to believe that the factor of safety in the steam pipes of many vessels carrying very high pressures is, to say the least, quite as small as it should be; and it might be found advisable to test the strength of such pipes periodically by hydraulic pressure. There would be no difficulty in doing this by closing the stop valves on the engine and on the boiler.

It may interest our readers to say that this is by no means the first catastrophe caused by the failure of steam pipes. Mr. Jacob Samuda, brother of the eminent engineer and shipbuilder recently deceased, met his death on board the Gipsy Queen, a small paddle boat, on Tuesday, November 12th, 1884. Like the Elbe, the Gipsy Queen had made a successful trial trip, and was lying off the Brunswick Wharf, Blackwall. The safety-valves were loaded to 27 lb. on the square inch. The steam pipe was fitted with a stuffing-box expansion joint. The spigot lifted out of its box, and the rush of steam killed Mr. Samuda, who was in the engine-room at the time. Three others died a short time subsequently in the London Hospital. It appears that the pipe had originally been provided with a bead to prevent it from lifting out of the stuffing-box, and this had been chipped off.

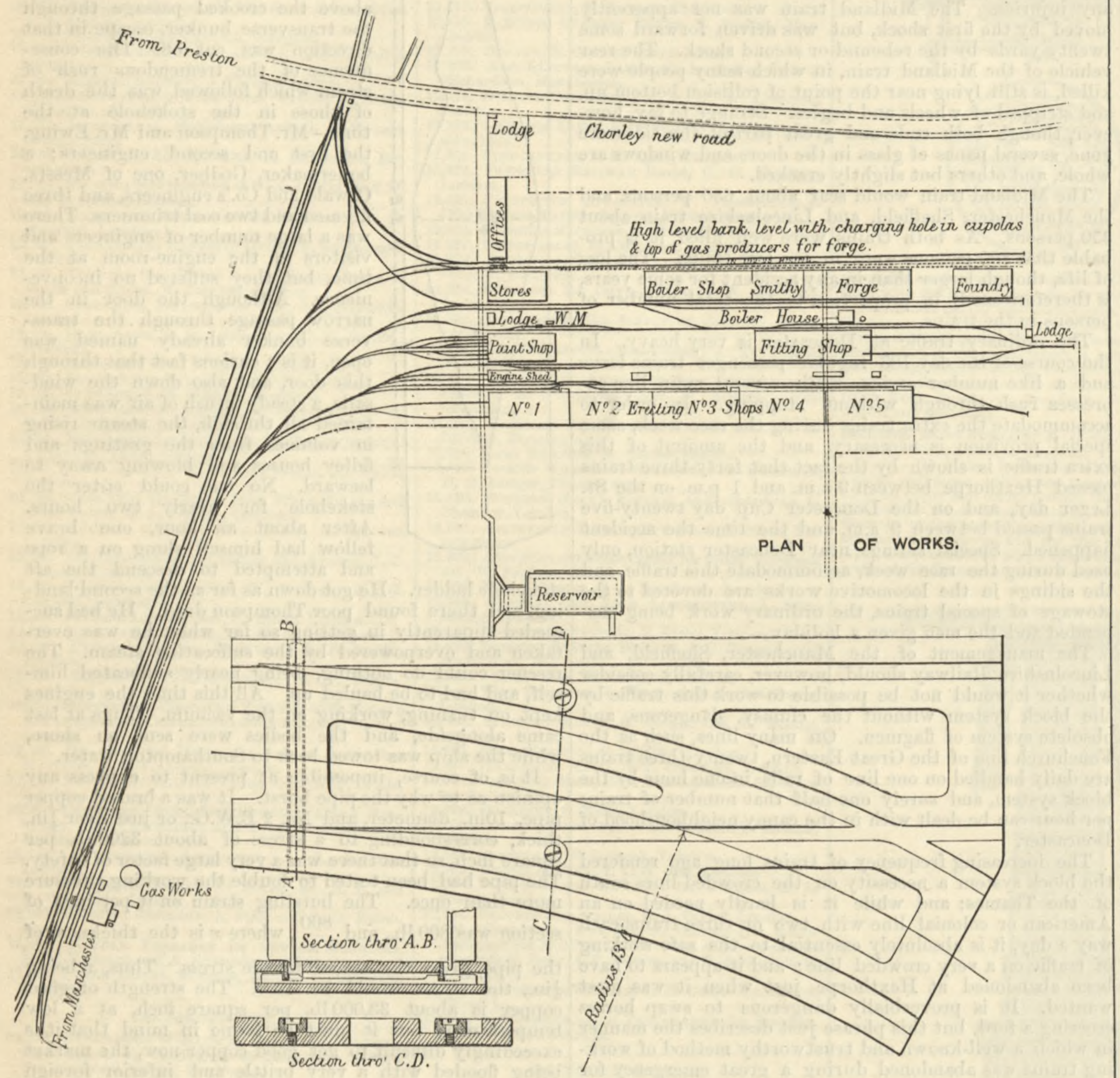
PORTSMOUTH AND RYDE FERRY BOAT.

IN THE ENGINEER for August 12th, p. 128, will be found a full description of this boat, the machinery of which is illustrated by the two-page supplement which we publish this week. The supplement contains horizontal, vertical, and longitudinal sections of the ship, showing the engines and boilers in their places, and likewise the steam and water pipe connections. Complete detail drawings have also appeared in THE ENGINEER for August 12th and 19th.

VISITS IN THE PROVINCES.

HORWICH AND RIVINGTON.

On the 8th inst., about a hundred of the members of the British Association joined the excursion to the new locomotive works of the Lancashire and Yorkshire Railway Company at Horwich, and the Rivington reservoirs, from which the water supply of Liverpool is derived. Leaving the Victoria-station, Manchester, by a special train provided by the Lancashire and Yorkshire Company, the visitors arrived at the Horwich works about eleven, having two hours to inspect them under the guidance of Mr. Aspinall, chief mechanical engineer of the company, and Mr. Hoy, the works manager. These, the latest locomotive works—of which a block plan is appended—are eighty-five acres in extent, of which eleven are, or shortly will be, roofed over, and have been laid out with the greatest forethought backed by experience gained at Crewe. They are situated between the Chorley New-road and Red Moss, about a mile north of Horwich Junction on the main line between Manchester and Fleetwood, a short fork line which avoids the junction giving direct com-



TRAMWAY POINTS.

munication with Manchester. Besides the lines of normal gauge there are 2¼ miles of 18in. tramway, with the simple and effective points and crossings shown in the annexed sketch, for transferring materials from one shop to another. This is worked by small locomotives of the ordinary type, but having disproportionately large domes, so as to ensure getting plenty of dry steam. The company had had made some open wagons with longitudinal seats back to back on purpose to facilitate the getting about from shop to shop by the ladies over the still unlevelled ground. Details are given of a handy tip-truck, the body of which also swivels, so that it may be tipped at any horizontal angle most convenient. The works were begun about three years ago, and are not yet completed, but the various shops are utilised as soon as possible, engines being already repaired in what will eventually be the erecting shop. The excellent manner in which the works are laid out is only equalled by the economy with which, judging by several adaptations that will be referred to in their place, there is little doubt they will be conducted.

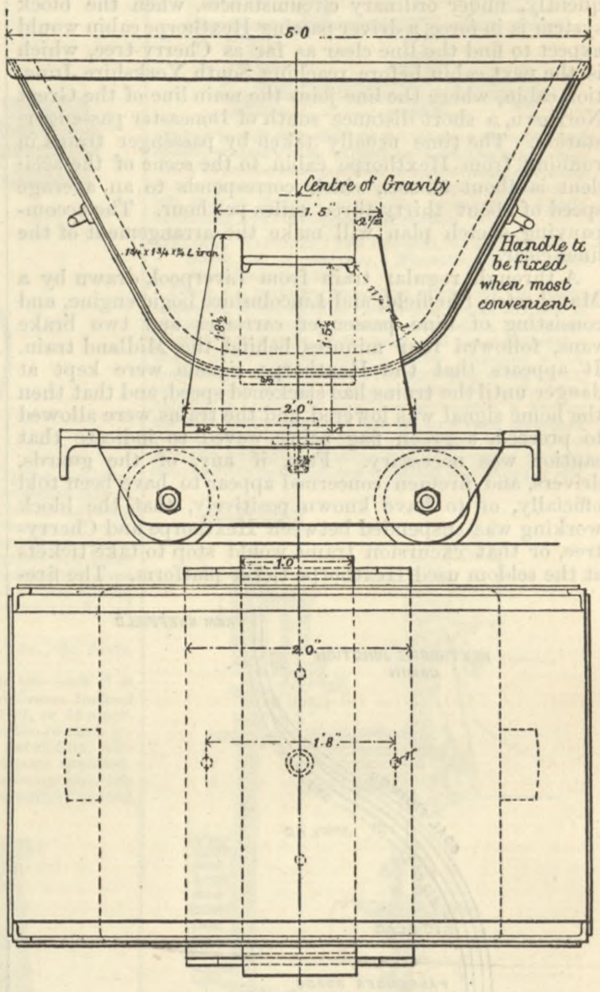
The iron foundry, 214ft. long by 111ft. wide, is provided with two cupolas of different sizes, fitted with air bell, and supplied with blast by a Roots' blower, combined with engine driving the two fans in opposite directions on Thwaites and Carbutt's method. Hydraulic power of 750 lb. to the square inch is provided for a 5-ton and four 1-ton jib cranes, besides a 15-ton and a 12-ton overhead travelling cranes, by Craven Brothers, worked by running rope off a Tangye Belfast horizontal engine. The boilers are those of superannuated locomotives, no longer safe at 130 lb., but capable of giving many years of good service at 100 lb. On account of the natural slope of the land, pig and coke are run in on wagons at the charging-hole level, while the tapping holes are at a convenient height above the floor. A great many chilled chairs for points and crossings were being cast, as well as some capstans for hauling trucks about at the Liverpool Docks, these being merely instances of the principle decided upon by the company of doing all that is possible at the works.

In the forge, 363ft. by 111ft., a 14in. roll train, by Ward, of Tipton, has been laid down to work up scrap, to be driven by an old locomotive, the driving-wheels of which have been fitted with heavy cast iron rims to act as fly-wheels. Two Siemens' regenerative furnaces are being built for heating billets, the Wilson gas producers being charged directly from the high level, while the ashes are drawn in tram wagons running on the floor level. An 8-ton steam hammer for forging steel crank axles is being erected, the blow of which can be intensified by steam at 50 lb. pressure being admitted on the top of the piston. Hydraulic machinery for flanging fire-box front plates and doing similar work is also being put down. The smiths' shop is a continuation of the same department, 210ft. long, provided with eight double and twenty-six single hearths, an engraving of which will be found on page 249. They are fitted with Morgan's dry tuyeres, and supplied with blast from a Roots' blower driven by belting off the shop shaft. A line of Ryder forging machines, for bolts, nuts, and other oft-recurring work, will be erected along one of the end walls, while spring and buckle-making machinery, driven by hydraulic power, will also be provided, the spring furnace being heated by gas. Massey's latest type steam hammers, 6 cwt., 8 cwt., and 15 cwt., are already in place, to be followed by circular saws for iron.

The boiler shop, also a continuation of the same building, 364ft. long, is provided with a pair of hydraulic pumps and an accumulator at 1500 lb. to the square inch, for the large fixed hydraulic rivetters, and three others, movable, for heavy, medium, and light work, all on Tweddell's system, and made by Fielding and Platt, of Gloucester. There are two 12-ton hydraulic overhead cranes and two swing jib cranes, all the motions of which are given by hydraulic power, for lifting boilers into the rivetting towers for the fixed rivetters, while the smaller rivetters are carried by travelling hydraulic cranes, also on Tweddell's system. There are jib cranes erected on movable towers, which run the whole length of the shop, being arched to allow a pair of wheels to pass underneath. The rivetters have a reducing valve for regulating the pressure; but these valves do not always act after having been unused for some time, and it would be preferable to have means, ready to the rivetter's hand, for actually reducing the pressure at the accumulator. While the portable rivetters are supported by their jaw frame the working portion may be adjusted to any angle by a worm and wheel. Boilers, mounted on two four-wheeled trucks, which thus act as bogies, are run by the small locomotives already mentioned, from the boiler shop to the erecting shops.

This department, consisting of five separate shops, including the locomotive repair shop—see general plan—is 1520ft. long by 117ft. wide, and, as will be seen by the cross-section on p. 248, consists of two bays 46ft. wide, with one of 17ft. in the middle. There is room for 200 engines, which are run out at the ends, or shifted from one pair of rails to another by two traversers worked by chain and driven by the wall engines that drive the shafting. There are also twenty 30-ton overhead travelling cranes by Hetherington and Sons, having the driver's seat suspended, so that he can command a view of the whole shop. Two of these cranes, worked by running rope from the wall engines pick up a fully erected locomotive by hooks placed under the buffer beams, run it along or across the shop and drop it wherever desired. They also have a quick-motion hook and chain for light work. The wall engines, of which there are six altogether, are old locomotives, with the link motion removed, turned up on end and provided with cast iron frames. The middle bay is provided with line shafting and cast iron girders to carry the counter-shaft brackets for various machine tools, and also with 20-cwt. hand-worked travelling cranes. Several wheel lathes are disposed about the shops for conveniently turning up the wheels removed from engines under repairs. The cylinders of such engines are bored in place by a machine, made at the works, driven by cotton cord. The fittings, stripped off engines coming in for repairs, are run away at once by trucks instead of being allowed to accumulate.

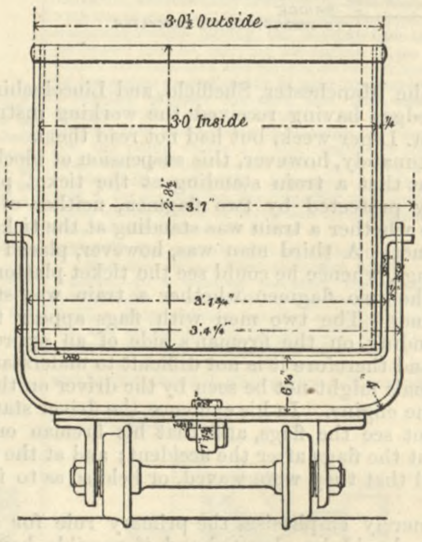
Between the erecting shops on one side and the foundry, forge, smithy, and boiler shop on the other, is the fitting shop, 400ft. by 110ft., provided with four ranges of longitudinal shafting driven by bevel gear, off two wall engines of the type already referred to, and also with two walking cranes driven by cotton cord, which will traverse the shop from end to end. For the benefit of those unacquainted with these cranes it may be mentioned that they are of the jib variety, mounted on suitable carriages travelling on a single rail, the upper portion of the post turning in a cradle, which is guided by channel bars bolted to the principals of the roof. These cranes are for lifting heavy work in and out of the machine tools, including large milling machines for cutting out the webs of crank axles, crank axle lathes, and planing and slotting machines. A large vertical milling machine, by Smith and Coventry, has a small pump for pouring a constant stream of soapy water on to the work. It is found cheaper to finish piston-rods by a traversing emery grinder than to turn them in the lathe, the rod being made to revolve by its piston serving as a pulley, thus ensuring absolute



TIP TRUCK.

accuracy between the two. Besides its legitimate occupation, a slide-bar grinding machine is used for surfacing slide-valves, four at once. Axle-boxes and brasses are planed six at a time, placed in row. The old brasses of engines brought in for repairs are filled up by pouring in white metal of a special composition and then bored out. Much space is saved and confusion avoided by the use of handy bins, shelves, and trees, disposed at intervals for holding bolts, nuts, and washers, tools, and the various parts of engines.

The paint shop, 232½ft. by 110ft., a longitudinal section—transverse, however, as regards the roof—of which is given at page 252, has, unlike the other shops, been provided with a weaving shed, or saw-tooth roof, the horizontally subtended angles of which are 30 and 60 deg. In



TIP TRUCK.

this respect, as in many others, the arrangement at Crewe has been followed, but with this difference in the present case, that the bays run transversely instead of longitudinally, so that the direct rays of the sun are intercepted, and a soft uniform light is distributed over the entire shop. In front of one end is a counter for giving out paint as required, and behind it will be erected the grinding and mixing machinery. This shop, like the stores and erecting shops, will be warmed in winter by pipes supplied with hot water from old Lancashire boilers, bought as scrap, having their flues connected by a dished plate rivetted on to one end, and heated by exhaust steam, or live steam at need, passing up one flue and down the other. The general stores, 198ft. by 111ft., are being provided with hydraulic lifts to raise heavy materials to the gallery which runs round the four sides. The offices, 325ft. by 58ft., extend along the north-east end of the works, adjoining the Chorley-road, and for two storeys, with the principal rooms on the upper floor and the manager's office, testing-room, and store-rooms in the basement. A running shed, 232½ft. by 35ft., is provided for the engines used about the shops and yard. Gas works, at the lowest level of the ground, will provide gas for lighting the works and also the premises, including extensive carriage sheds, at Horwich Junction. A Mechanic's Institute, with reading-room, library, and class-rooms, will soon be built. The growth of the town since the works were started is shown by the fact that between October, 1885, and January of the present year, plans for more than a thousand shops and houses were sent in to the Local Board.

After inspecting the works, the visitors were entertained by the directors at lunch, elegantly served in the reading-room, after which an engineer and member of the British Association proposed a vote of thanks to the directors for their courtesy and hospitality, but in so doing remarked incidentally that the splendid works were wrongly placed. The vote was seconded by Mr. Thomas Ashbury, who congratulated the company on having the veteran locomotive superintendent, Mr. Ramsbottom, on the Board of Directors, and on having secured the services of so eminent a mechanical engineer as Mr. Aspinall. In the absence of the chairman, Mr. Turnstill, deputy chairman, in acknowledging the vote of thanks, said that the directors had not studied the interests of any particular town, but, in the interest of the shareholders, had gone where they could get cheap land.

After Mr. Ramsbottom and Mr. Aspinall had responded, the party, under the guidance of Mr. J. Parry, engineer in charge of the Rivington Works then drove in brakes round the reservoirs, which have been constructed at a cost of £1,250,000, including water rights, for the gathering water from about 10,000 acres of moor and mountain land for suppling Liverpool with water.

The following are the names of the reservoirs beginning from the highest and furthest from Liverpool:—

Reservoirs.	Area in acres.	Greatest depth in feet.	Capacity in millions of gallons.
Upper Roddlesworth ..	38	64	180
Lower Roddlesworth ..	16·4	78	100
Rake	13·8	78	80
Anglezark	191·6	35	1019
Chorley	10·1	39	48
Rivington (two)	275	40	1841
Yarrow	73	—	840
Total	618	—	4108

The works designed and carried out by Mr. Thomas Hawkesley, C.E., were begun in 1850 and completed in 1857, two reservoirs having been added by the late T. Duncan in 1874. Some of the embankments and puddle trenches for impounding the water have proved very heavy work; the water is filtered through a series of beds at the foot of the Lower Rivington reservoirs, the filters consisting of eight beds, six 300ft. by 100ft., and the two added 315ft. by 115ft. The filtering materials consist of a layer of broken stone covered by successive layers of gravel, varying from 1in. cube to the size of peas with a 30in. layer of sand above, the depth of gravel and sand being 6ft. 6in. The water filters through the beds to dry rubble drains at the bottom, and is delivered from them to two clear-water tanks. The upper part of the sand layer is removed from time to time, as the matter intercepted renders it foul, and is washed by machinery so as to be ready for use again. The water is conveyed from Rivington to Liverpool through a tunnel one mile in length, and cast iron pipes 44in. in diameter. There are two small balancing reservoirs on the pipe line, and large reservoirs capable of holding a week's supply for the district, at Prescot, in the environs of Liverpool. At each of these pipe-line reservoirs, and at other points in the aqueduct, there are, besides the usual stop-cocks, valves which close automatically whenever a pipe breaks or any serious leakage occurs. These are specially valuable on the Rivington pipe-line, as it passes through the Wigan coalfields, where leakages are frequent owing to subsidence. The average volume of water, including that of four deep wells sunk to the new red sandstone near Liverpool, exceeds 18,000,000 gallons daily for a population of 800,000, the maximum daily consumption being 23,000,000 gallons.

THE ASHBURY RAILWAY CARRIAGE WORKS.

Although Mr. Thomas Ashbury has withdrawn from the Ashbury Carriage Company, Ashton-road, Openshaw, for some years past, the works, employing about 900 men, continue to bear his name. What is chiefly noticeable about them is that they are very comprehensive and self-contained, doing everything "at home," even to making the iron, a great advantage in the early days of wagon and carriage building, when it was not always easy to get the parts required, but a dubious one at the present day, when the direction of production is toward specialities, and keen competition has reduced prices to the lowest limit. Wagon wheels are chiefly made by bending special bars, thicker in the middle than at the ends, into the form of a sector, fitting them together in a ring or hoop, so that the thick portions form the rim, and two thin portions a spoke, and then running in metal to form the boss, the hole for the axle being cored out. There are at present in the shops some long two-decked cars, the body supported on two four-wheel bogies, for the Accrington Steam Tramways.

THE METALLURGICAL DEPARTMENT OF KING'S COLLEGE, LONDON.—The syllabus of these classes for 1887-8 has just appeared, and from it we gather that the work of the approaching session commences on the 5th of October for the day classes, and on the 10th for those held in the evening. In addition to Professor Huntington's Monday and Friday afternoon lectures, there will be two courses of lectures given on Monday evenings:—One from 8 to 9, on "The Properties of Metals and their Alloys, and their Uses in the Arts," in which the general characteristics and properties of the more important metals will be dealt with collectively and individually, with special reference to their useful applications in the arts; and one from 7 to 8 on "Fuels: Their Uses and Economy," by the Demonstrator, Mr. W. G. McMillan, F.I.C., in which the respective advantages and disadvantages of the different solid, liquid, and gaseous fuels will be discussed, together with the methods employed for preparing, valuing, and burning them. The course will open with a free public lecture, entitled, "A Brief Retrospective Glance at the History of Artificial Heating," at 7 p.m. on Monday, October 10th. A special course of ten evening University Lectures on "The Manufacture and Use of Iron and Steel" will also be given by the Demonstrator on Thursday evenings from 7 to 8. The first lecture will be free, and will be delivered on October 13th, at 7 o'clock, the subject being "The Ores of Iron and the Primitive Methods of dealing with them;" the title of each lecture is given in the syllabus. The metallurgical laboratory for the study of assaying and the properties of metals is also open in the evening on Fridays from 7 to 9. The subject for the essay required from students desiring to compete for the Siemens gold medal and prize, founded by the late Sir William Siemens to encourage the study of metallurgy at King's College, will be "Gaseous Fuels: Their Manufacture, Composition, Properties, and Uses." The award will be made at Midsummer, 1888, and will depend partly on the essay, partly on the college examination in metallurgy, and partly on the work done in the laboratory.

LETTERS TO THE EDITOR.

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

TECHNICAL EDUCATION IN ITS BEARING ON FOREIGN COMPETITION.

SIR,—After the publication of your late excellent articles on the subject of technical education and the new Bill relating to it laid before Parliament, I was in hopes some of your abler correspondents would have treated the matter differently and from a practical standpoint more than has yet been the case. When a doctor is called in to cure a disease the first thing he does is to form a diagnosis of it, or else he will fail in his endeavours, and it strikes me the general well meaning public—not you, Sir, and a few others who seem to better understand the complaint we are or should be about to cure—have not made the proper diagnosis for the complaint we are in reality suffering from, which I take to be foreign competition, for which this technical education scheme is supposed to be the panacea.

Now, I have had an exceptionally long and very intimate connection of forty-five years with the industry of several continental countries, and as a matter of course come into every-day contact with the engineers and technical workpeople of very many branches of industry, old as well as new, and I can confidently maintain that in every branch with which I have had to deal, or am otherwise acquainted with, the Englishman, whether engineer or artisan, is superior practically, technically considered, to his continental rival—of course there always being exceptions to every rule. I ask therefore what is the technical education of the English workman going to accomplish? I am persuaded from experience that school technical teaching will not improve him as a manipulator, for even now, in conjunction with his superiors—all supposed by the crazy English public to be less well educated technically than their continental rivals—he can produce better, and, quality for quality, cheaper machines, for instance, than his competitor. I speak from my own experience and that of parties in this country. I have had engines and machines at work almost on the same plant, made in England, Germany, and Belgium, and prefer the first for several trifling reasons, and particularly because they are like the English horse, as compared to one of the indigenous race; they can always be depended upon at a push, and wear better, besides being more economical at work, and cheaper in the end. Again, it is well known that Borsig made the best locomotives on the Continent, yet the late chief superintendent of the traffic department of the best managed railroad in Germany told me that it was much more satisfactory and pleasant to stand on the footplate of an English-made locomotive than a German one; and it is well known that for textile manufactures the English machines are not only better made, more agreeable to work, and always of newer and more practical design than foreign ones, all due respect being paid to Jacquard's ingenious invention at the time; further, that, if protective duties did not stand in the way, foreign textile manufacturers, where prejudice did not intervene, would prefer buying English in preference to foreign machines. Another excellent illustration can be cited. There were two companies of steamboats started on the Rhine some forty-five years ago. A company had foreign-built engines, B company English made ones; but B had fewer boats than A. Well, in a few years B would have driven A from the Rhine, simply because its boats used less fuel, and were not laid up 10 per cent. of the time for repairs. The A company, being the most powerful pecuniarily, made an amalgamation contract with B; but to this day B boats pay the best dividend, and even the old engines keep working well and regularly, and do more constant work than the A company's boats can do, though many have been renewed with new engines. This does not look as if we were behind our rivals in design or skill on the part of our workmen. Again, can anybody maintain that in our iron and steel works not quite as good chemists and mechanics are engaged, in our collieries as good mining engineers, in our machine, engine, boiler, and constructive ironwork shops, as on the Continent? I venture to say on my own experience that they are not only as technically well up to the mark, but are more practical in every particular; and I could give numberless examples if space and time would allow of it. As regards the workmen in the branches above mentioned, for instance, I cannot for the life of me understand what technical part of their trades they are to learn at school which they will not acquire infinitely better in practice as apprentices in their respective trades. Or, if a fitter's drill or chisel breaks over his work, is he, instead of going to the smithy or the grindstone, to go to the work's laboratory to discover the physical and chemical properties of the steel of which they are made? Is the "cupola" man to analyse the different sorts of pig iron before he melts them to form a particular casting according to the foreman founder's orders, a matter the former can do much better by the eye, which no other method can teach him, the puddler to learn from the professor the time to ball up his iron, the smith to learn when his iron is hot enough to weld, the furnace keeper to learn when his cinder is running right for his furnace to deliver grey, mottled, or white iron; or, lastly, is the collier to be made into a small geologist? I can understand that certain workmen in towns, as cabinet makers, locksmiths, coach makers, painters, &c. &c., could be taught useful subjects which would improve their taste and so on at schools properly organised, but for this work art schools already exist; or handy, intelligent men in collieries could be instructed in certain subjects, which would enable them to become better overlookers; but this could be done by local night schools, wherein the mine engineers gave instruction in subjects they are acquainted with, assisted, perhaps, by the district mine inspector, and supported pecuniarily by local funds; but for this no Act of Parliament is required, and would be far more practically carried out without hard-and-fast rules.

It has long been a cry in England, "if we only had such technical schools or teaching as there is to be found on the Continent!" Now I should like to know what this celebrated teaching has really accomplished for mankind. If any one can tell me that, I should be able to believe there was something in it. The fact, however, is, I cannot call one thing to mind which has emanated from these schools. They give a sound technical, theoretical education, one man knows exactly as much as another, but in practice they never get beyond mediocracy; and whether it is the teaching or the genius of the people I do not know, but you never either find originality or ingenuity in any of the *élèves* in Germany, though there is a little in Belgians and a little more again in Frenchmen. It may be that chemistry should be excluded from what I have said, because in this branch foreigners have been strong, although England has had great chemists too—as great, indeed, as any on the Continent. Did anybody ever hear of continental technically educated people being engaged to go and establish new works all over the world? Yet this has been the case with Englishmen, wherever they managed to get their technical education and fitness for the work. All the branches in the iron trade, puddling, rolling, coke, blast furnaces, Bessemer, and what not, all the textile industries, marine engine building, lead and copper smelting on the newest principles, and a host of others, in five of which I have been myself engaged, have all been superintended and set to work by Englishmen. If the continental technical education was so pre-eminently good and useful, how comes it that the poor unfortunate Englishman, supposed to be technically neglected, has been able, so to speak, to take the bread out of the mouths of these continently-educated people? To this day this is going on, but not so much so as formerly, of course, because now almost every industry has been established on the Continent, and as before said, mostly by English engineers and English workmen. Again, one would suppose such superiorly educated technicals would not require to copy everything in the shape of machinery and metallurgical processes from Englishmen, yet such is universally the case. Originality there is none to be discovered, but copying without end, and we invent for all the world, except America; and it is well we are able to do so, for so long as we can do this, we skim off the cream of the manufacture, and have the pull of our rivals.

There is another side to the picture too. Do those good folks who preach about the advantages of a system of technical education, such as master and man get on the Continent, ever reflect what Englishmen have done without such? If they did, I think a part of this craze would vanish. Do they forget that England has invented every great thing which has benefitted mankind for the last 150 years? The pumping engine, the steam engine, gas for our streets, puddling and rolling of iron. coke for furnaces, hot blast, railways, the locomotive, iron ships, the propeller, marine engines, Bessemer steel, crystallising lead for silver, and dozens of minor things, all for the enrichment of the world. Now what has the Continent to bring forward against this list, with its boasted technical education?

How is it, I ask again, that when quality is set against quality, no matter whether it is a machine or a pocket knife, we are always able to produce the better and cheaper, or as cheap an article, when cheap wages, long hours, cheaper freight, and the ever boasted better educated workman, are said to be against us? It shows, I think, that some one must be engaged as managers or principals who are not destitute of the proper technical knowledge, and that our workmen cannot be such dullards as some folks would like to make out, and they must have had some means of acquiring this knowledge which enables them to compete with the foreigner as far as manufacturing goes. For my own part, I think too much is made about cheap wages and long hours—at least, in the heavy industries. There is not the difference some people think. The elder Brassey told Siemens that he had found all over the world in his practice that the cost of labour was about the same everywhere, and my own experience bears this out, and as the Englishman does more work in the same time, less plant is required with him than with the foreigner. An Englishman having more ingenuity, more resource, he goes about a job better and quicker, and gets it out of hand more speedily and at the same time better—a better job, in fact. I have always found that unless a job is what we used to call in the shops "scamped," the foreigner cannot make a machine, or anything else, I believe, as cheap as we can in England, despite copying even to the minutest detail—at least, in this country. His competition very frequently is only possible because of the scamped work he puts in.

All this brings me to the conclusion that we cannot, after all, be so badly off for technical instruction as is supposed by inexperienced persons. I believe that our technical schools are sufficient for their purpose, or works could not be carried on as well as they are by the *élèves* of those schools. They may be in time improved, perhaps, as I read, for they are institutions since my time, of which I can give no opinion; and as for our workpeople, give me one in preference to a foreigner, where you want to carry out a job quickly and well. I consider him physically very superior to his continental rival. He is more naturally intelligent, but less intellectual than his rival. He has many superior qualities, but I should like to see him more thoroughly educated generally, but this at the elementary and continuation night school, and if I might say, in order shortly to express what I mean, made more of a gentleman, with broader—at least less narrow—views, as in these respects he is behind his colleague on the Continent. Technically I think we may well leave him alone, when once he is well grounded in general elementary subjects; and I must repeat that, with the exception of a few trades, I cannot see what this Technical Education Bill is going to accomplish in order to make us better able to compete with the foreigner. We are on the wrong track altogether, and therefore I venture to say the public has not yet made the proper diagnosis of our disease. It is not as manufacturers, but in the commercial part of our business, in which we are weak; and if the money to be spent by the Education Bill were employed to strengthen us in this branch, it would do far more to keep foreign competition from our doors than a dozen Technical Education Bills.

This letter has got to an unreasonable length, but the subject is one which interests me much, as it ought to do every lover of his country, and this you will please take as my apology; but as the other or commercial part of it is, to my judgment, by far the more important of the two, with your kind permission I should like to return to it in a second letter, though the subject is a difficult one, and the problem not easily solved in our present social condition.

Rheinland, September 9th. U.

THE RIBBLE DOCKS AND ESTUARY.

SIR,—I am glad to have seen the article in your issue of this week respecting the Preston Dock and Ribble Estuary. If an open channel can be made and maintained from the Irish Sea to the Preston Docks, why, as you ask, was this work not undertaken in earnest and completed before the docks were commenced? The sandbanks are not only left nearly, but absolutely dry at low water—neaps or springs. The Ribble has been a wandering river in the estuary. The deep channel was formerly on the Southport side; then no doubt it changed to the deep called Pleasure-boat Hollow, situate in about the middle of the estuary. It now passes Lytham, but not as a deep, but very shallow channel in many places. I think there is no trustworthy evidence to prove that there was ever a deep channel on the Lytham side in former times; the geological character of the bottom of the present channel seems conclusive in this respect.

Training walls corresponding in height with the sandbanks and dredging of the channel might effect something, but the cost would be enormous and the work of many years, and the doubt would remain as to whether the channel could be kept permanently open for vessels. I do not think it could. The enormous quantity of moving detritus brought down with the tide as it returns, assisted in its progress with the water in the river, relieved from tidal pressure, is against such a conclusion.

Southport may some day reap an advantage, and have a continuous deep channel again, for it is not improbable that the river, after all that can be done, may make an independent channel for itself, not necessarily navigable for large vessels, but of width and depth sufficient to discharge the water.

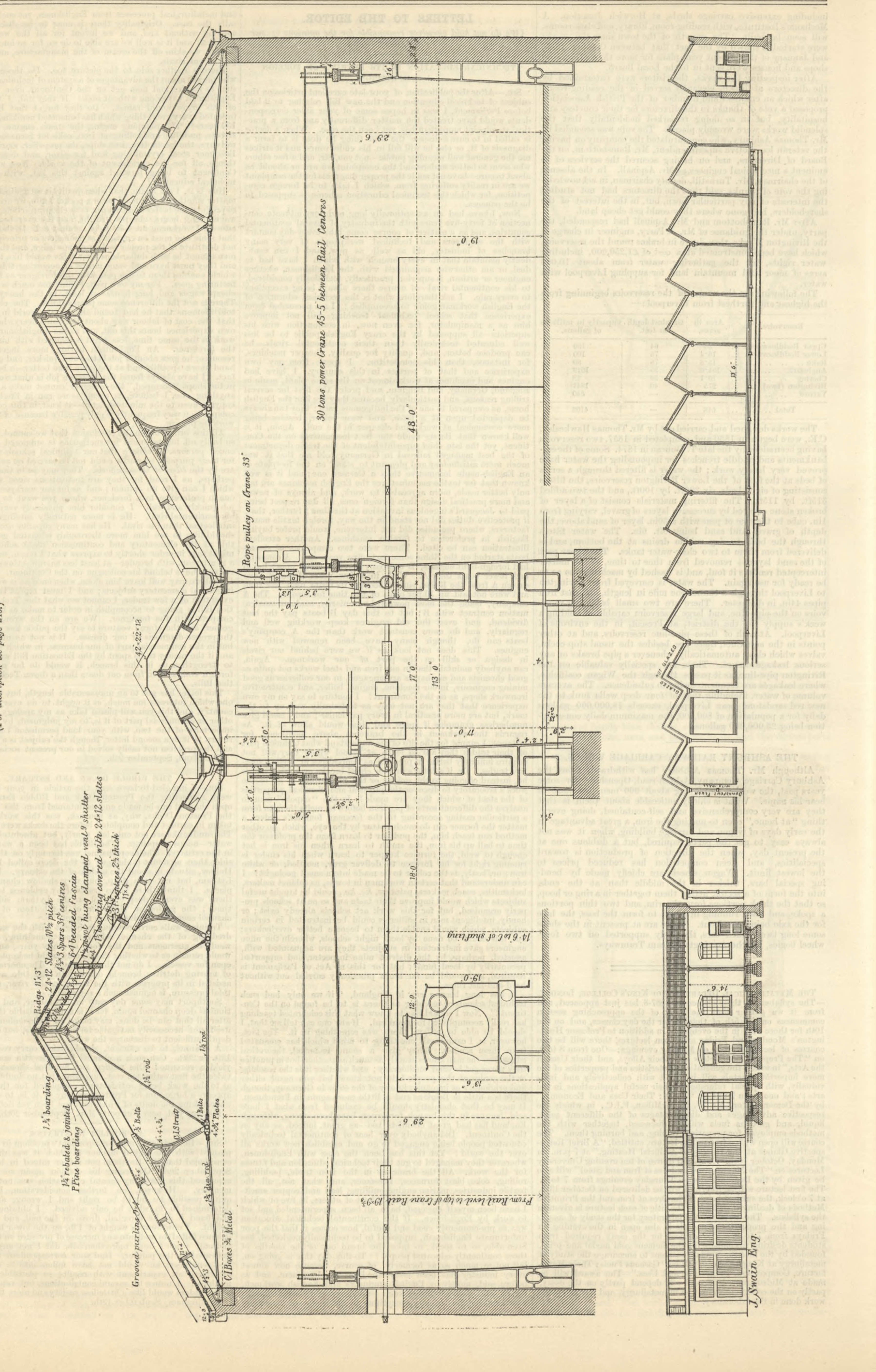
A channel, to be efficient, should safely carry vessels drawing 18ft. or 20ft. Can such a channel be made at a cost that would yield a revenue? One million two hundred thousand pounds—twice the first estimated cost, supposing that no doubt should exist as to the work being satisfactorily completed for that amount—appears a large sum for Preston, wealthy as it is, to expend on an undertaking the limits of which have not been yet defined.

Pontnewydd, near Newport, Mon., September 20th. J. B.

A PROBLEM IN STRAINS.

SIR,—Referring to your correspondent's problem in strains, I was pleased with the logical manner in which it was discussed, but considered that Mr. Hartland got rather mixed in his answer of September 2nd. On seeing his opinion again so dogmatically expressed this week, my mental ejaculation was not very parliamentary. However, on further consideration, I thought it quite possible he might be right and I wrong, and therefore determined to do what he only advised. I obtained a balance and fixed it as he directed, drove in the nail, and removed the weight. I now hung a weight of 1 lb. on the lower hook, but the balance failed to indicate any increase of pressure on the top hook, and only when I hung more than 5 lb. did I get any increase as indicated by the pointer. Had your correspondent been a practical engineer, he would not have fallen into a mistake and described an experiment with results so plausible, but really mythical. I notice his several contributions, but venture to think your readers would like a little less variety and more thoroughness.

Birmingham, September 19th. ZIT.

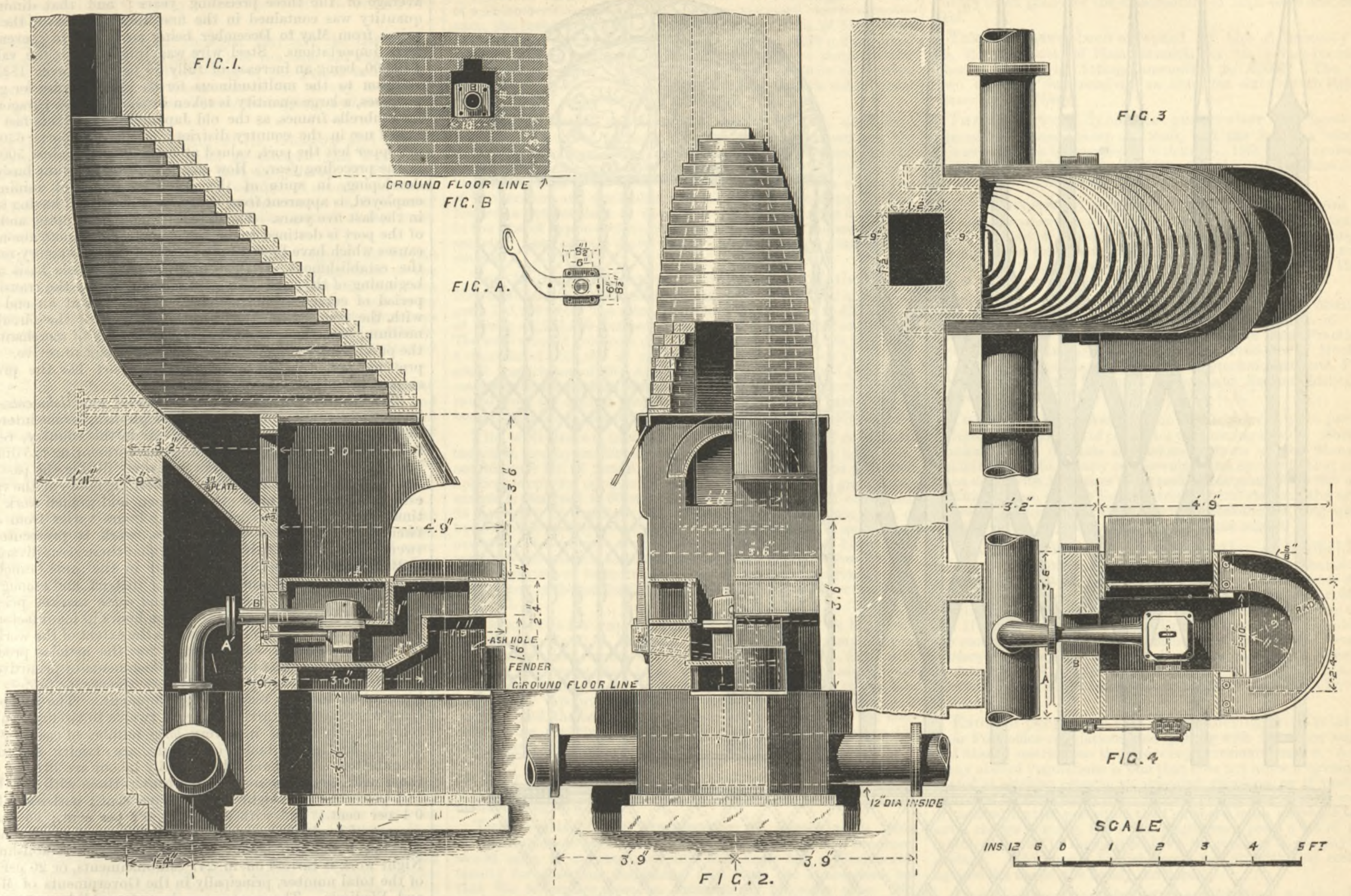


LANCASHIRE AND YORKSHIRE RAILWAY SHOPS AT HORWICH.

(For description see page 246.)

SMITH'S FORGE, HORWICH WORKS.

(*For description see page 246.*)



A NEW GLAND PACKING.

To provide a gland packing which will not adhere to the rod packed, even when considerable periods elapse between the occasional movement of the rod, Messrs. Skelton and Grimshaw have brought out an inadhesive packing for general application. It is so formed that it makes a tight yet easy working-joint by the pressure of steam on the back of it. The material employed is that known as "Woodite," moulded into form by pressure in moulds. Woodite is impervious to the action of oils and acids, and has advantages over the ordinary substances employed for similar purposes. As shown in the annexed engraving, the packing-ring in each case is made in one piece with a projecting flange to butt against the inner surface of the stuffing-box. The inner plate of the stuffing-box is passed over the spindle or rod, and bears against the flange of the packing. The cover when tightened up by bolts and nuts causes the inner surface of the flange to bear against the outer surface of the stuffing-box, and thus to insure a fit between the packing and spindle. The outer surface of the packing ring tapers down to a thin edge at its lower end, as will be seen in the accompanying illustration, Fig. 1. The tapering form given to the outer surface of the packing enables it to embrace the rod under steam

Fig. 1

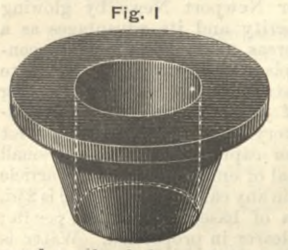
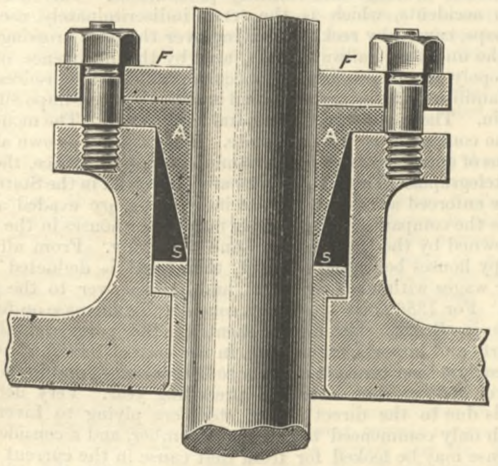


Fig. 2



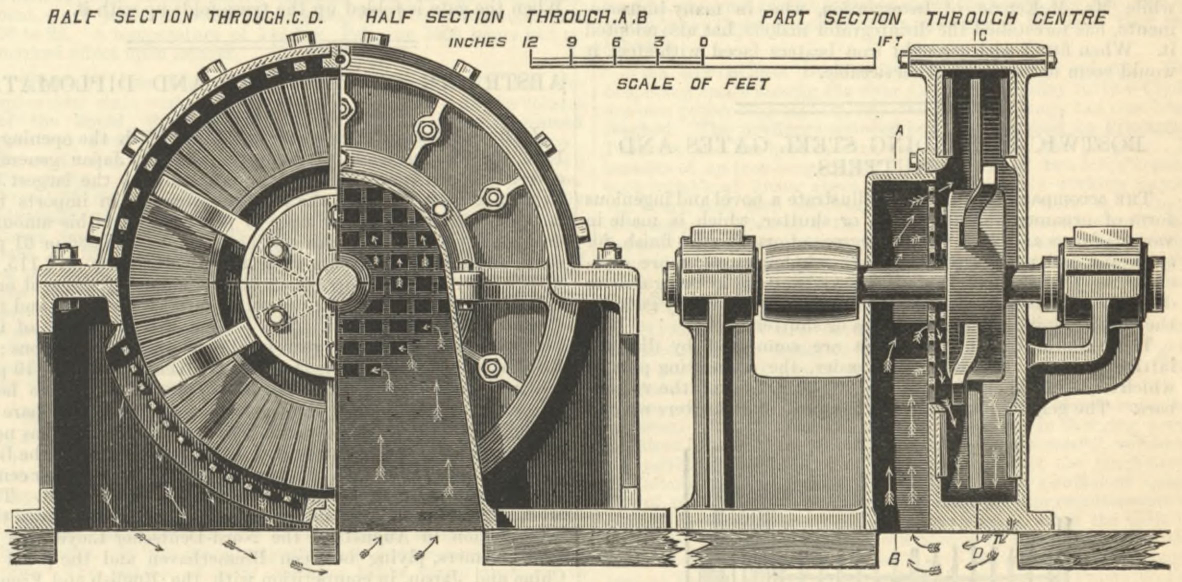
pressure. In Fig. 2, A is the packing ring in position, S the steam space, and H the flange. The inadhesive material makes a steam-tight joint by compression under the pressure at its back, and this without any material interference with the free action of the spindle. The packing is simple in application, and has been tested with success for a considerable time. It is generally applicable, and is represented as specially useful for stop valve, sluice valve, throttle valve, and similar purposes.

THERE is no truth in the statement that the London, Chatham, and Dover Railway Company is converting some of its second and third-class carriages into cattle trucks by simply painting out the words on the doors.

THE PATENT ECLECTIC DISINTEGRATOR.

ALTHOUGH disintegrators are among the most rapid reducing machines, they have not been so extensively adopted as their apparent utility would seem to warrant. Various causes have operated to limit their adoption, and the "Eclectic" which we illustrate seems to have been designed to mitigate the defects of these high-speed machines, and remove the objections so widespread against some ordinary forms of pulveriser. From the illustrations below it will be seen that it is formed of two casings, the greater part of the outer one being cast steel, while the inner, or working parts, are of serrated chilled iron. The chilled iron interior, being fitted into the recesses cast in the outer case, they are easily and cheaply renewed. The outer casing of cast steel makes it impossible that the main walls of the machine can ever wear out, while the interior chilled iron ratchet faces, being fitted to the whole interior, present a large grinding surface, which gives the "Eclectic" a large reducing capacity. The side ratchets are not, however, a novel feature, as they were adopted many years ago by Mr. McKenzie, of Invergordon, and it is doing none of the makers of disintegrators any injustice to state that many of the best features of the disintegrator are the inventions of a few of the manure manufacturers in the north of Scotland.

A most novel feature in the "Eclectic" is the return air chamber, by means of which the air current generated by the fan-like action of the beaters is sucked into the machine again, which mitigates the dust nuisance common to the ordinary form of disintegrator, and at the same time it removes the back-pressure. Many expedients have been tried to overcome these defects. One method was the leading of an air spout from the grinding receptacle back to the feed-hopper of the machine, and another plan was a spout communicating into the side of the disintegrator under the disc spindle; but those methods did not make any perceptible improvement. In designing the "Eclectic" it occurred to Mr. Gilbert Little that the failure of these experiments was due to the fact that the methods were not in accordance with the most simple fact concerning fans, viz., that air is thrown off at the periphery and is sucked in at the centre. A circulating current could only be obtained by leading the return air spout into the axis all round the disc; but a more compact and novel method was devised by Mr. J. J. Stevenson, the engineer of the Grinding Machinery Company, London, who designed the return chamber which forms part of the outer casing of the machine, and the air, as thrown off at the periphery by the beater points, escapes through the openings in the sifting screens fitted in the lower half of the periphery, and is drawn up again through the attached chamber, as shown by the arrows, and enters at the axis through the perforated side. This circulating current entirely removes the back pressure, and



THE ECLECTIC DISINTEGRATOR.

greatly lessens the blow out of dust. The part of the air chambers above the disc spindle is removable at will, which enables the operator to change the beaters or clean out the machine without unfixing any other part, which effects a great saving of time over the old method of unshifting the periphery or upper half. The grinding faces in the upper half of the periphery are formed by square steel bars, each of which drop into recesses cast on the circle of the top side ratchets. These square ratchet bars reduce the cost of wear and tear to a minimum, as the whole of the four edges can, in turn, be reversed, thus giving four wearing sides. In the old-fashioned machines the entire inner and outer casings had to be renewed. These square ratchets are encircled by cast steel removable doors secured as shown by our illustrations. The disc, which is of cast steel, is of a new pattern. On the lower end of the beater a toe is turned which fits into a corresponding recess cast in the steel disc. The beaters are further secured by a 2in. diameter steel screw with a finely-pitched thread, the points being hardened to prevent wear. The point of the screws is reduced to ½in. diameter, and goes through the beater and disc, which

BOSTWICK'S STEEL FOLDING GATES AND SHUTTERS.

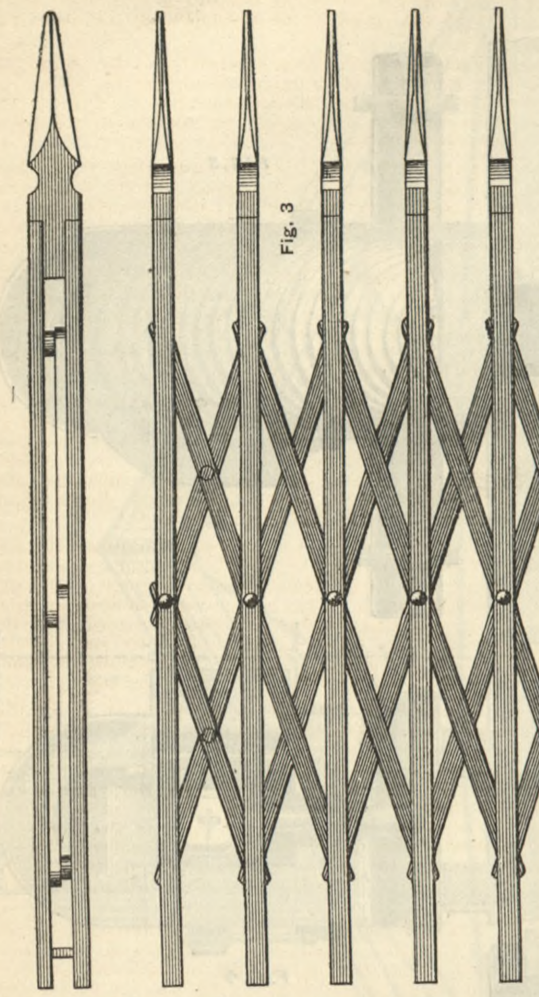


Fig. 3

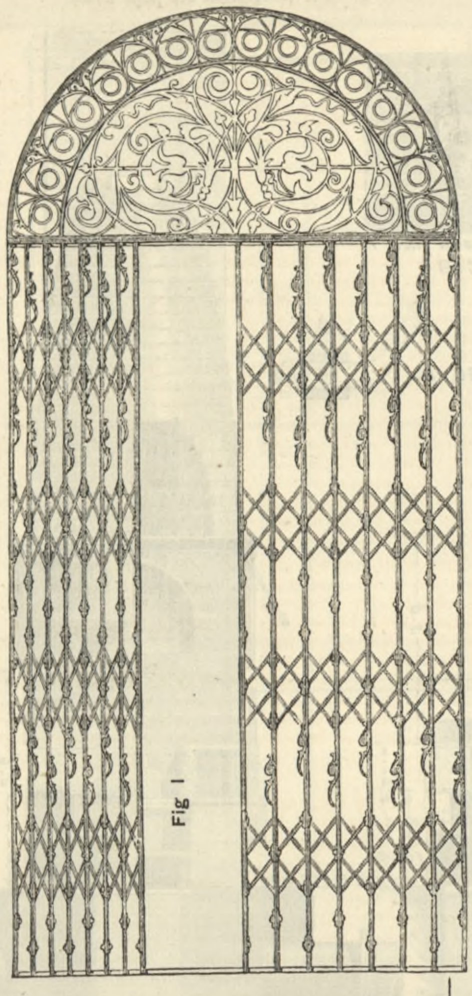


Fig 1

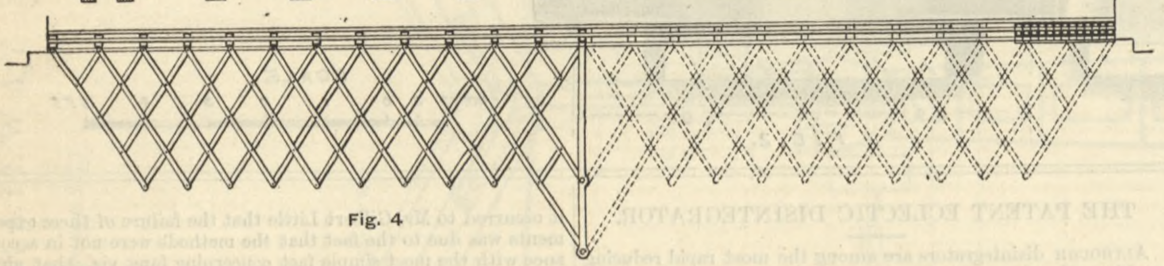


Fig. 4

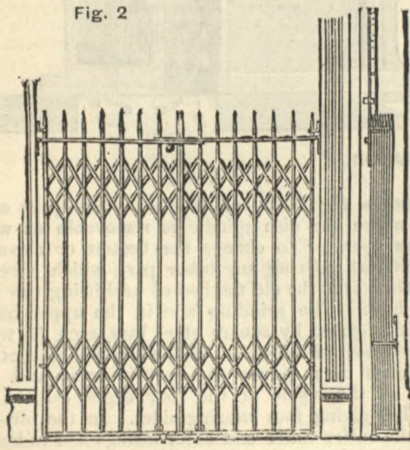
makes it impossible that the beater can get loose. On the larger sizes it is found preferable to make the disc in two parts, the larger part having dovetailed slots cast in, into which the similar-shaped ends of the beaters are fitted, and the other part of the disc fits on to a projecting boss on its counterpart, and the whole is bolted together and the beaters securely held. This disc is also the invention of a Scotch manure manufacturer. During a recent visit to the North we had opportunities of inspecting over a dozen kinds of disintegrator discs designed by several Scotch firms, but the dovetailed slots are preferred for heavy work. At Montrose we saw a very good form of disc, with lugs cast on to hold the beaters, but Mr. Mitchell, the designer, admitted that the dovetailed slot pattern was superior, while Mr. McKenzie, of Invergordon, who, in many improvements, has forestalled the disintegrator makers, has also adopted it. When fitted with wrought iron beaters faced with steel, it would seem to be the most serviceable.

BOSTWICK'S FOLDING STEEL GATES AND SHUTTERS.

THE accompanying engravings illustrate a novel and ingenious form of ornamental folding gate, or shutter, which is made in various forms and with various degrees of ornamental finish, for gateways, and as shutters to cover windows, and more especially for places where there is some advantage in being able to dispense with the swinging room required for ordinary gates or the room required for sliding gates or shutters.

The vertical bars of the gates are connected by diagonal lattice work of the lazy-tongs order, the connecting-pins of which slide in the channel groove of the insides of the vertical bars. The general appearance of the gates and shutters may be

Fig. 2



gathered from Figs. 1 and 2, and Fig. 3 gives a view to a large scale of an edge view of a piece of a heavy strong gate. From this it will be seen that a pair of channel bars are fastened together to make each vertical, and within the double channel and space between them, the lattice-work is placed, and moves as the gate is opened out to fill the space or closed up, so as to go out of sight into the small space occupied by it or by each half of it. In all cases one or two or more of the verticals are fitted with small rollers, which run in a grooved plate or bar on the floor or cill, and in some cases the floor bar folds up and goes into the small space with the rest of the gate. With this system gates can be used where no other kind could be housed, and when great strength is required the top ends of the verticals are held by horizontal bars, which fall over the tops and are locked there when the gate is locked. Fig. 4 of our engravings is a plan view of one of the arrangements adopted with long gates, which require lateral stiffening. A light form of lattice truss is hinged to the back of the gate, and when the latter fills a wide opening, such as at railway stations, this truss is dropped to the position shown, and gives the necessary stiffness. When the gate is folded up the truss folds up with it.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Japan—Trade of Kanagawa in 1886.—With the opening of 1886 the foreign trade of Kanagawa and of Japan generally entered upon a new and brighter era, and was the largest by close on £1,000,000 since the port's existence. In imports the increase was £237,009, or over 6 per cent. Of this amount, engines, fittings, and machinery increased by £28,536 or 61 per cent., and metals, including their manufactures, by £73,115, or 21 per cent. Of the imports, Great Britain and India sent one-half, Germany, the next European country, 6 per cent., and the United States 9 per cent. The foreign carrying trade of the port was distributed last year in the following proportions:—British, 56 per cent.; American, 24 per cent.; German, 10 per cent.; French, 7 per cent. British shipping continues to hold its own notwithstanding the vigorous competition, its share of the aggregate being the same in both years. German has now shot ahead of French shipping, for the third place on the list, having, as compared with 1885, increased in tonnage 90 per cent., while the increase of British tonnage was 19 per cent. The most interesting of the shipping events of the year was the inauguration in August of the Nord-Deutscher Lloyd line of mail steamers, plying between Bremerhaven and the ports of China and Japan, in competition with the English and French mail lines. The Transpacific carrying trade of 1886 was divided between British and United States shipping in about exactly equal shares. The steamers of the Canadian Pacific Line taking cargo and passengers from the ports of China and Japan to Vancouver, not only for Canada but also for Europe and the United States *viâ* the Canadian Pacific Railway, and other connecting lines and steamers, will before long attract not only the bulk of the tea that has hitherto been taken *viâ* the Suez Canal, but also a fair share of the general export trade hitherto passing through San Francisco. As regards the metal market, the heavy imports direct from Middlesbrough have continued during last year, but during the current year have stopped, leaving the trade to run more on the old lines of moderate shipments by general cargo steamers. Bar, plate, and sheet iron show a large increase over 1885, though prices ruled generally low. The chief article among metal manufactures is rails, of which nearly 13,000 tons, value £86,000, were imported, as against 10,000 tons, valued at £54,000, in the previous year. Railway construction goes on apace, and an increasing demand for rails implies an increase in other metal manufactures as well, seeing that railway works require iron of all kinds for numerous incidental and subsidiary purposes. Nails show a considerable business. They are almost all wire nails of Belgian or German make, and not only have they driven the costlier cut nails out of the market, but have paralysed the import of nail rod iron, of which only 453 tons were imported in 1886, one-fourth the average of the three preceding years; and that diminished quantity was contained in the first four months of the year, prices from May to December being so low as to prevent any fresh importations. Steel wire was imported to the value of £43,000, being an increase of fully 50 per cent. over 1885. In addition to the multitudinous forms of steel wire for general purposes, a large quantity is taken in the form of paragon wire for umbrella frames, as the old Japanese umbrella is fast going out of use in the country districts. Among exports 6300 tons of copper left the port, valued at £235,000, as against 5000 tons in the preceding year. How steadily this important busine s is developing, in spite of the primitive mode of mining still employed, is apparent from the quantity exported having trebled in the last five years. The expansion in the shipping and trade of the port is destined to be permanent. Foremost among the causes which have brought about this most satisfactory result is the establishment of the currency on a specie basis at the beginning of the year. The suffering caused by the transitional period of currency contraction is now nearly at an end; and with the restored confidence in the stability of the circulating medium, both the speculative ability, activity of merchants, and the purchasing power of the people have begun to revive. At no previous period in the history of the port has the prospect seemed brighter.

Russia—Hours of labour in industrial establishments.—The inspecting committee of factories have published some interesting details concerning the hours of labour in this country, relating to 1214 manufacturing establishments, representing 125 different branches of industry, that were inspected during the past year. An immense difference exists in the working hours at the various establishments. In most of them men and women work equal time. The number of daily working hours varies from six to twenty, and in a few special cases, work is prosecuted for twenty-four hours. It is remarkable that these great divergences in the number of working hours occur in the same branches of industry, within the same inspector's district, and among establishments whose produce realises the same market price. A difference occurs of from one to eleven hours in manufactories of the same kind. The probable cause is the extent of the works and the greater or lesser local demand for the articles produced. The longer hours exist in those establishments of primitive construction, and belonging to proprietors who are, or profess to be, ignorant of modern technical development. The exceptional cases where work is carried on from twelve to twenty hours are comparatively few, as in a very large number of cases—970, or 80 per cent.—the hours of labour are twelve and under. Manufactories with twelve hours' daily labour are 36·8 per cent.; those with eleven hours, 20·8 per cent.; those with ten hours, 18·1 per cent.; with eight hours, 1·6 per cent.; with seven hours, 0·4 per cent.; and with six hours, 0·2 per cent.; so that an average of twelve hours daily may be assumed as the normal working hours throughout Russian industrial establishments. Night work is carried on in 247 establishments, or 20 per cent. of the total number, principally in the Governments of Moscow and Vladimir. The greater number of establishments—representing 906, or 74·6 per cent.—open at 5 a.m. and close not later than 9 p.m., so that the law of 1st June, 1882, for the protection of children, and fixing their maximum number of hours of day labour at from 5 a.m. to 9 p.m., and of night labour from 9 p.m. to 9 a.m., does not affect them any more than the law of 3rd June, 1885, by which female night labour is prohibited in certain industries. A large proportion of establishments commence work at 6 a.m., or even later, and in some cases as late as 10 a.m., and the hours of closing vary from 4 p.m. to 9 p.m.

United States—Newport News caution to emigrants.—Emigrants are induced to ship for Newport News by glowing accounts of the place, its prosperity and its advantages as a field for capital and labour; whereas, under the prevailing condition of affairs, I know few places less desirable. Private enterprise is overshadowed or strangled by an all pervading monopoly, the administration of justice as well as other conditions of the place are unsatisfactory, there is no field for honest independent labour, much less for capital, especially such small capital as is usually at the disposal of emigrants. Every article of food is 25 per cent. dearer than in any eastern port, bread is 2½d. per lb.; milk, 8d. per quart; tea of basest quality, 3s. per lb.; potatoes, 1d.; and lodging even dearer in proportion. Water is bad and very little of it. Under these conditions the small capital of an emigrant soon melts away while he is looking for work. During the past year there has been a great deal of sickness—the usual malarial fever, and in addition cases of scarlet fever, or scarlatina, to the extent of from 6·6 to 8·3 per cent. of the population. The cause of sickness arises from the unhealthiness of the climate, its sudden changes and extremes of temperature, the prevalence of marshy grounds and swamps, and the total absence of drainage and sanitary precautions. The mortality from accidents, which is the term indiscriminately used for mishaps, caused by reckless driving over the level crossings and on the unfenced railway tracks, and by the negligence of the monopoly companies, has been considerable, while redress for the families of the injured or killed is difficult, if not impossible, to obtain. There is not even a hospital in the town. The monopoly of the companies is most complete. They control or own all the means of entrance and exit, the administration of justice, the law, and telegraphs. The Sunday laws are very strict in the State, and while enforced as regards private individuals, are evaded as regards the companies. The greater number of houses in the town are owned by the Old Domain Land Company. From all who occupy houses belonging to them, their rent is deducted from their wages without their assent, and handed over to the landlord. For 1886 there has been a considerable increase on former years in British shipping frequenting the port, and also in exports and imports, amounting, in the case of British shipping, to nearly 34 per cent., in exports to 380 per cent., and in imports to over 400 per cent. over the preceding year. Very little of this is due to the direct line of steamers plying to Liverpool, which only commenced to run in December, and a considerable increase may be looked for from that cause in the current year. If it is seriously intended to establish a passenger trade, different vessels must be employed. The passage takes about eighteen days, and the service is supposed to be fortnightly, but this rate is not attained. Although but a few emigrants have been landed here, complaints have been made to the British Legation at Washington by men who have been induced by false pretences or promises to make use of this line, and who have been put to considerable expense in reaching their destination. The Huntingdon line, as it is called, is principally managed by the Newport News and Mississippi Valley Railway Company, which has absorbed the Chesapeake and Ohio Railway and several others. The officials of that company have had no experience of shipping, and this among other things militated against the financial success of the line.

RAILWAY MATTERS.

THE East River tunnel project has been revived by the reorganisation of the company and the filing at Albany of the certificate of incorporation under the title of the New York and Long Island Railroad Company. The entire length of the proposed road will be about five miles.

RECENT advices from Delagoa Bay are to the effect that the new railway is laid and engines run over the rails a distance of about 17 miles. The health of the people in Lourenco Marques was good, and the Europeans on the railway seemed to keep their health very well considering the exposure and the quality of work they were doing.

AT the half-yearly meeting of the Glasgow and South-Western Railway Company, held at Glasgow this week, Mr. Thompson, the chairman, stated that the number of first-class passengers had decreased, while the number of second and third-class passengers—especially second—had increased. A dividend of 4 per cent., the same as at the corresponding period of last year, was declared.

THE Italian and Swiss delegates have signed at Berne the convention relative to the junction of the Italian lines to the Simplon tunnel. The financial part of the enterprise has been regulated in the following manner. Switzerland contributes 15,000,000f., the Italian Government 5,000,000f., and the provinces and towns of Upper Italy 10,000,000f. Paris financial establishments have subscribed for 60,000,000f. ordinary and preference shares.

ON July 12th two men named Labranche and Tremblay were run over by a Grand Trunk Railway train and killed, and the coroner's jury brought in a verdict of gross negligence, and held the railway company criminally responsible for the death of the two men. Since that time the Crown prosecutor has been investigating the matter, and has decided to lay an indictment before the grand jury against General Manager Hickson on the charge of manslaughter.

THE total mileage of railways in Great Britain at the end of 1886 was 19,332, an increase for the year of 163 miles. This gives about one mile of road to every 6¼ miles of area. America has 1 mile to 22 square miles of country, not including Alaska. The paid up capital amounted to £828,344,254, an increase of £12,480,000 for the year, bringing the capital account to nearly £41,820 per mile. The total liabilities in America amount to £12,214 per mile, capital stocks, bonds, and floating debt.

THE railway from Belgrade to Constantinople, of a length of 1196 kilos., is complete with the exception of the Bulgarian line from Ichtiman to Pirot, which is 113 kilos. long. As the present Prince of Bulgaria is very anxious to render Europe a service by the construction of this railroad, it is expected, if his reign lasts for another six months, that the works will be finished in that time, when the Oriental railroads will, in accordance with the Berlin Treaty, form at last part of the European railway net.

THE negotiations between the Cape Colony, the Orange Free State, and the Transvaal on the question of railway extension are meeting with difficulties, the Republics refusing to admit the colony to the conference which is to be held in October. It is said that the Transvaal is looking towards Delagoa Bay for its ultimate connection with the coast. The opinion in Cape Town is that a line connecting the Transvaal with Delagoa Bay would conduce to the benefit of the whole of South Africa if Delagoa Bay were in British hands.

THE Bengal Nagpur Railway is asking for about forty engines and tenders. A large portion of the wheels, axles, tires, and springs, noted a fortnight ago on Indian account, have been taken by Sheffield firms. Other railway work is being accepted, and the works engaged in this class of articles are very fully employed. Several of the home railway companies, evidently believing that values are not likely to be lower, are placing contracts for stores. The Midland Company, amongst others, has ordered a large quantity of axles, wheels, &c., and several Scotch companies are also requiring material. The rail orders are being taken at the coast, where the facilities for output are being considerably increased by several firms.

IT is said the Peninsular and Oriental Steam Navigation Company has just concluded a contract with the Assam Railway and Trading Company for a monthly supply of from 800 to 1000 tons of coal for the use of their steamers. This, the *Colonies and India* says, is a highly practical way of assisting to develope the resources of the country, and at the same time a testimony to the high quality and fitness for steaming purposes of Assam coal. It is to be hoped that other lines will follow so good an example, and thus not only lessen their working expenses, but hasten the growth of an important local industry, which only needs due encouragement to render them to a great degree independent of the costly English steam fuel, which now runs away with so large a proportion of their profits. Perhaps Newcastle, N.S.W., could lay down coal at Calcutta cheaper than Cardiff.

THE Grant Locomotive Works, of Paterson, N.J., were partly consumed by fire on September 7th. Several locomotives in process of construction were damaged. The works will be re-built at once. The 600 men employed by the company will nearly all be deprived of work for several weeks. The business of the Grant Works originated in a machine shop started in 1819. Swinburne, Smith, and Co. began building locomotives there in 1849 for the Erie Railroad. In 1852 it became the New Jersey Locomotive and Machine Company, and subsequently it was changed to the Grant Locomotive Works. On the side wall of the burned building was a medallion of Napoleon III., and fac-simile of the prize given the locomotive America at the Paris Exposition in 1867, that superb engine, says the *Railroad Gazette*, having been constructed at these works.

A RAILWAY jubilee has just been celebrated at Antwerp. Fifty years ago, when the first railways were being constructed in Belgium, the Belgian Government obtained from England ten mechanicians who had already acquired experience in the working of railways. One of them, the *Times* Brussels correspondent says, Mr. Woods, who is now seventy-two years of age, has accomplished fifty years' active service in Belgium, and occupies still the position of foreman in the railway building yard at Antwerp, is the only survivor of these ten pioneers of railway work in Belgium, and it is this jubilee which has been celebrated with much solemnity at Antwerp. In Antwerp, societies and numerous delegations from the various Belgian railways formed a *cortége* which went, escorted by bands of music, to the Hôtel de Ville, where they were received by the Burgomaster and aldermen. After a speech by the Burgomaster, warmly congratulating Mr. Woods, the wine of honour was served, and Mr. Woods's health was drunk. The street where Mr. Woods lives was also richly decorated. A great reception was given next in the hall of the Harmonie, which was crowded to the utmost. When Mr. Woods entered with the members of his family the band struck up "God save the Queen." Speeches celebrating the honourable career of the hero of the *fête* were delivered, and a great number of presents, among them a small locomotive in solid silver, were presented to him. As he is already a Knight of the Order of Leopold, he was still further distinguished by the Government with the Civic Cross of the First Class, which Mr. Blancquaert, as representative of the Government, handed to him. In the evening a banquet was given in honour of Mr. Woods. Many of the principal Belgian railway officials were present. A more democratic *fête*, consisting of a ball at the hall of El Bardo, also took place in the evening.

NOTES AND MEMORANDA.

ZINKENITE, a very rare mineral, has been discovered with antimony ores at the Stewart Mine, Sevier Co., Arkansas.

RODS of antimony, when placed in the magnetic field of a Ruhmkorff electro-magnet, show an increased electrical resistance, the resistance being greater across the lines of force than along them. Plates of cobalt when so placed show a diminished resistance, when their planes and the current were perpendicular to the lines of force. When placed parallel to them an increase was observed. Mr. G. Faè is experimenting on this subject, and further results are promised.

WHEN aqueous solutions of zinc, copper, and lead acetates are allowed to remain at the ordinary temperature the electric resistance gradually increases, and this indicates a partial dissociation of the salt, since the resistance of free acetic acid is higher than that of its salts. The resistance increases with a rise of temperature and diminishes with a fall of temperature, tending towards a definite limit in each case. The dissociation is greatest in the case of cupric acetate, and somewhat less in the case of zinc acetate. Lead acetate shows similar changes in a very much lower degree.

THE Melbourne Mint, which is a branch of the Tower Hill establishment, received during last year, in bullion and rough gold, 756,284·88 oz. The coinage of the year amounted to £2,920,500, of which £2,901,500 was sovereigns, and £19,000 half-sovereigns. The total value of gold coin and bullion issued was £3,028,219, being a decrease of £323,609 as compared with the previous year. The great importance of the Australasian colonies as gold-producing countries is unsurpassed when we find that the total amount of gold raised from the earliest records to the end of 1885 is said to have been 79,678,137 oz., the actual value of which has been £318,000,000.

THE well-known method of determination of combined carbon in iron by the direct separation of carbon from iron gives, according to Mr. C. Brand, too low results; he proposes a method applicable only for samples of iron rich in carbon. One gram of the sample is dissolved in 30 or 40 c.c. of hydrochloric acid containing 24 per cent. of bromine; the latter is removed in the form of hydrobromic acid by heating with three to four grams of ammonium oxalate. The removal is completed after one to two hours; the carbon is collected on an asbestos filter, and in the combustion, the small quantity of bromine absorbed by the carbon is retained by interposing in the combustion-tube a small spiral of silver kept at a red heat.

APPARATUS for vapour-density determinations has been described by Mr. D. S. Macnair. The apparatus is a simplification of Hofman's, and consists of a syphon barometer tube, filled with mercury, and suspended in an outer tube, in which some liquid of constant boiling point is heated, so as to surround the syphon tube by its vapour. A weighted quantity of the substance is passed round the bend of the syphon, and rises through the mercury to the slightly widened upper end of the tube, where the vapour soon depresses the mercury. Observations of the volume occupied, the temperature, and the barometer, complete the necessary data for calculating the vapour-density. A determination of the density of toluene vapour gave 46·3, the theoretical number being 46·0.

THE results of the examination of snow taken from different places in Munich and its neighbourhood, by Mr. Sendtner, would seem to indicate not only that snow has a considerable faculty for absorbing sulphurous acid from the atmosphere, but that the absorption goes on continuously for some time. Mr. Sendtner ascertained that on one day when snow fell sulphurous and sulphuric acids were present in it in fairly equal portions, but on the second day almost all the sulphurous acid had been ozonised to sulphuric acid. In the vicinity of chimneys and gas works the absorption would, of course, be greater. The *Pharmaceutical Journal* says:—"This great absorptive power toward sulphurous and sulphuric acids is considered of great practical interest, as explaining the destructive influence of snow upon marble statuary."

AT the meeting of the members of the Library Association, at Birmingham, Mr. C. J. Woodward read a paper in which he explained some experiments he had made as to the influence of gas on bindings. The conclusions he drew were that leather exposed to the foul air in which gas had been burning for 1077 hours was seriously deteriorated, for the extent to which it would stretch was reduced from 10 per cent. to 5 per cent., while the strain it would bear was reduced in the ratio of 35 to 17, or about two to one. The leather exposed to a temperature of 195 deg. Fah. for 1000 hours in an atmosphere free from products of gas combustion was also deteriorated, for the extent to which it would stretch before breaking was reduced from 13 per cent. to 9 per cent., while its breaking strain was reduced from 36 to 28. A temperature of 142 deg. Fah. for 1000 hours had no marked effect upon leather.

GOSSART has repeated Luvini's experiments on the spheroidal state with an apparatus so modified that the volume of the liquid, the temperature, and the pressure remained constant, and the two latter can be accurately measured. Below 33 deg. the temperature of the spheroid is higher than the boiling point of the liquid at the particular pressure. From 33 deg. to 50 deg. the two numbers are practically identical, the differences being sometimes positive and sometimes negative. From 50 deg. up to 90 deg. the temperature of the spheroid is always lower than the boiling point of the liquid under the existing pressure. At low temperatures the differences increase somewhat regularly, but at high temperatures the variations are comparatively irregular. Under a pressure of 0·5 mm. a drop of water weighing 2 grams was completely frozen whilst in a spheroidal state, and was kept in this condition for 15 minutes, notwithstanding the fact that the dish on which it was supported was heated by means of a blowpipe.

MR. DERING, secretary of embassy in Russia, reproduces in a recent report—C. 4924-32—some interesting data concerning the hours of labour in industrial establishments in Russia, published by the inspecting committee of factories, and based on an inspection during the past year of 1214 manufacturing establishments, representing 125 different branches of industry. A great difference exists between the working hours at the various establishments. In the large majority men and women work equal time. The number of daily working hours varies from six to twenty in the various branches of production; and in one or two special cases, uninterrupted toil is prosecuted for twenty-four hours. These great divergences occur in the same branch of industry, within the same inspector's district, and among establishments whose produce realises the same market price. A difference occurs of from one to eleven hours in manufactories of the same nature. The probable cause of this is the extent of the works and the greater or less local demand for the article produced. The longer hours are found in those establishments of primitive construction and belonging to proprietors who are either ignorant or profess to be so of modern technical development. The exceptional cases where work is carried on from twelve to twenty hours are few; in 80 per cent. of the factories the hours of labour are twelve and under. Factories with twelve hours daily labour are 36·8 per cent. of the whole; eleven hours', 20·8 per cent.; ten hours', 18·1 per cent.; eight hours', 1·6 per cent.; seven hours', 0·4 per cent.; six hours', 0·2 per cent.; so that an average of twelve hours may be fairly assumed as the normal working day of Russian industry. Night work is pursued in 20 per cent. of the factories. The majority open at 5 a.m., and close not later than 9 p.m. Female night labour is prohibited by a law of 1885 in certain industries, notably the textile industry. A large proportion of establishments commence working at 6 a.m. or even later, and in some cases as late as 10 a.m.; and the hours of closing vary from 4 p.m. to 9 p.m.

MISCELLANEA.

ARRANGEMENTS are in progress for organising a new iron and steel company with works in the neighbourhood of Glasgow. It is expected that if the company is successfully established, it will lay down plant for the manufacture of both basic and Siemens steel.

TENDERS have been accepted by the Admiralty from Mr. Ronald Scott of Hammersmith, for his switch-boards and other electric light fittings amounting to £3000. The Silvertown Company has received an order for sixty search light projectors for the Navy.

THE American dynamite gun cruiser has been commenced by Messrs. Cramp and Sons, and the keel has been laid. It is expected to be completed in January, 1888. The cruiser is to be 230ft. long, 26ft. beam and 7½ft. draught, with engines of 3200-horse power. The contract price is £70,000.

UNTIL recently there has only been a 3-ton steam crane and some hand cranes at Aberdeen Harbour, but a steam travelling crane, capable of lifting 5 tons and stand the strain resulting from stopping this load instantaneously when falling, and to move on rails at four miles per hour, has been now delivered to the Harbour Board by Messrs. Blaikie Bros.

MESSRS. CROSBY LOCKWOOD AND SONS announce, amongst many other technical books, the publication of "Flour Manufacture: a Treatise on Milling Science and Practice, by Friedrich Kick, Imperial Regierungsrath, Professor of Mechanical Technology in the Imperial German Polytechnic Institute, Prague. Translated from the Second Enlarged and Revised Edition, with Supplement, by H. H. P. Powles, A.M.I.C.E."

THE Manchester Association of Engineers have prepared an interesting syllabus of papers for the ensuing session. Short communications on exhibits in various sections of the Manchester Exhibition are to occupy one evening, and amongst other subjects to be dealt with in papers to be read subsequently are the modern carding engine, electric lighting from central stations, the economy of health in workshops, the Anderton hydraulic lift, ring spinning, and the thermo-dynamic analysis of the gas engine.

GLASGOW is inviting the co-operation of Sheffield with reference to the International Exhibition to be held in that city next year. A deputation from the executive council, consisting of Sir William Collins, Ex-Lord Provost, Bailies Dickson and Shearer, Mr. J. L. Mitchell, of the Clyde Trust, Mr. Walter Mackenzie, of Edin Carnet, Mr. Hedley, the manager of the Exhibition, and Mr. Cunningham, the secretary, are to meet the members of the Town Council, the Cutlers' Company, and the Chamber of Commerce, the object being to interest the people of Sheffield in the proposed enterprise. Sheffield has a large industrial connection with the City of St. Mungo.

ENGLISH people are very long-suffering with relation to their Post-office regulations, and put up with far more vexatious and absurd restrictions than does any continental nation. Amongst many absurd regulations is one that does not allow a circular to be posted at circular rates in an unsealed envelope, or if posted not delivered without extra fee. English people may receive circulars or printed matter posted on the Continent in an envelope, and no extra charge is made, but if an Englishman posts a bit of printed matter this way to the nearest town the receiver has to pay double postage. Why should English people put up with this restriction against the use of the handy envelope?

THE Oceana, the third of the additions to the Peninsular and Oriental Company's already large fleet, was launched from Messrs. Harland and Wolff's yard at Belfast on Saturday last. Her dimensions are—length, 482ft.; breadth, 52ft.; and depth, 37ft. She will register nearly 7000 tons, and her triple expansion engines are expected to develope 7000 effective horse-power, which should drive her 17 knots at full speed. In addition to the Oceana the Peninsular and Oriental Company are also building at Belfast the Arcadia, of nearly 7000 tons. These steamers are being constructed for the India, China, and Australian mail services of the company.

WRITING to the *Times* anent the price of wheat and other things, a correspondent says:—"I fear it is difficult for Englishmen to realise to themselves the extent and the rapidity of American development. In only sixteen years the population of the United States has increased 50 per cent., the production of grain 85 per cent., the production of iron 200 per cent., the length of railroads 192 per cent. The new lands brought within five miles of the new railroads built in the last twelve months is much greater in area than England and Wales. Whatever present prices may be, the vast capital invested shows the confidence felt both in the railways themselves and in the products of the land they run through."

THE operations in connection with the scheme for deepening and widening the river Cart from Paisley to the Clyde are now proceeding rapidly, and the dredging stage has now been reached. The dredger employed has been supplied by Priestman Brothers, and has been constructed specially for the purpose. It consists of an iron barge, upon which are fixed two large cranes, each capable of lifting about 800 tons of mud in a working day of ten hours, and each requiring only one man to work it. Where circumstances allow of it the cranes can be made to elevate and deposit the material direct on to the bank, thus saving a large amount of labour. It is calculated that about one-fifth of the whole work of the deepening scheme has now been executed, and this has been accomplished within the requisite time.

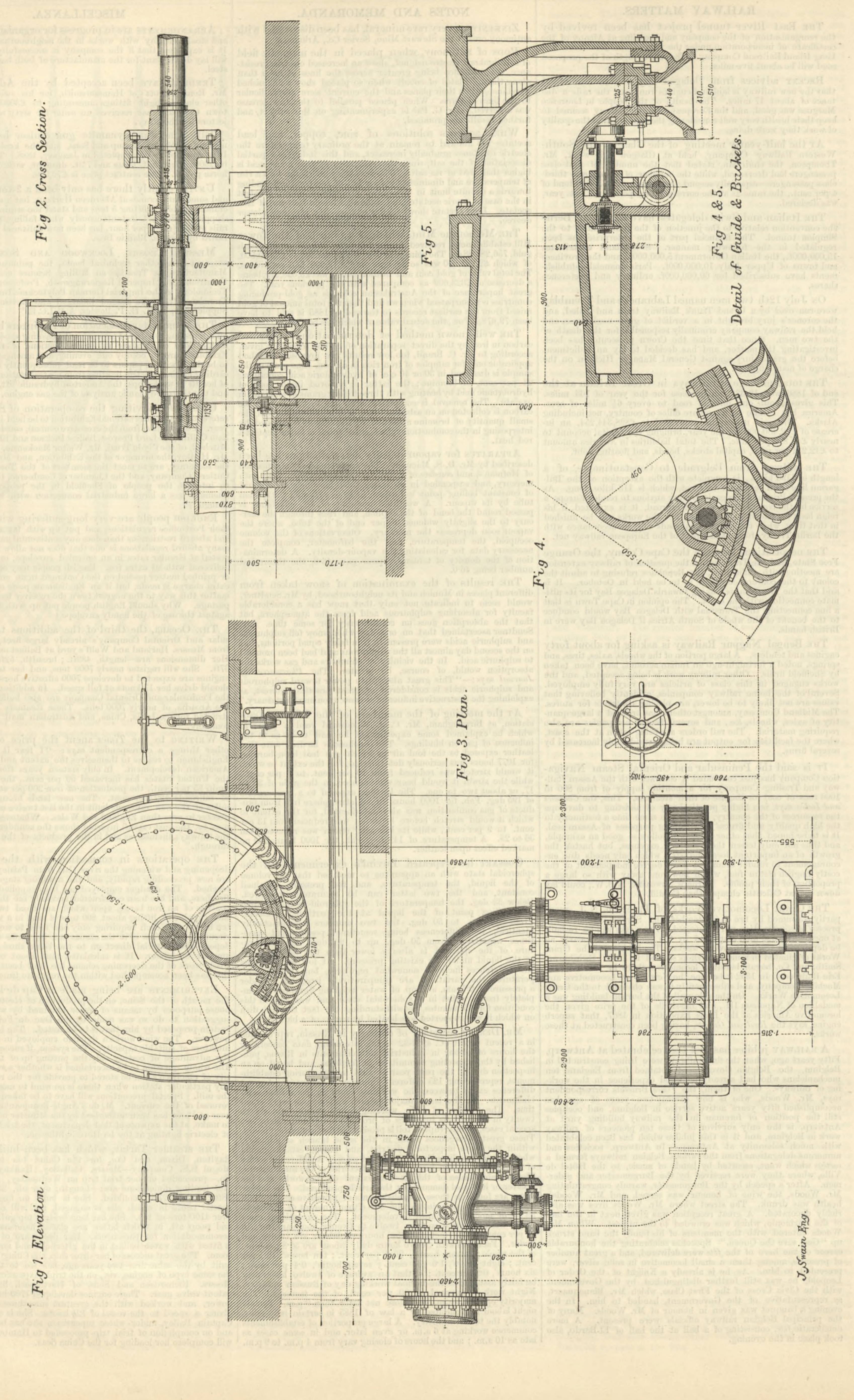
EXPERIMENTS are being made at Cap de la Hève, near the mouth of the Seine, on the production of electricity for lighthouse purposes by means of power obtained by windmills. The suggestion to do so was made by the Duc de Feltre, and it is a system proposed by him that is to be tested. The idea is not new, however. The wind works a dynamo employed in charging accumulators of suitable capacity. The system, if successful, will have the advantage of costing only the putting up of the machinery. The whole question to be ascertained is whether a sufficient quantity of electricity can be stored to provide for the requirements of any particular station when there is no wind to move the sails of the mill. Special precautions will have to be taken to prevent the reversal of the current. M. de l'Angle-Beaumanoir, a civil engineer at Paris, has been authorised by the Minister of Public Works to make, at the expense of that department, the trial of this system of electric lighting at the La Hève lighthouse.

THE steamer Tartar, which has been built by Messrs. Raylton, Dixon, and Co., for the China tea trade, for the Mogul S.S. Company—Messrs. Gellatley, Hankey, Sewell, and Co.—proceeded on her trial trip on Wednesday, the 14th inst. Her leading dimensions are:—Length, over all, 332ft.; breadth, 38ft.; depth, 27ft. moulded. She is built on fine lines for the special trade in which she is engaged, and will carry a cargo of over 4100 tons of tea. She has long bridge, top gallant forecastle, and poop aft, in which latter are placed handsome saloon and accommodation for passengers. Her decks are of teak, and she is fitted with water ballast in the afterhold and under the engine room. The great success of her sister ship, the Ching Wo, which was built by the same firm two years ago, has led to the adoption of the same type of engine, viz., on the triple expansion principle, by Messrs. Richardson and Sons, of Hartlepool, having Wyllie's patent valve gear. These engines developed 1700 indicated horse-power, and worked with the greatest smoothness on the trial, giving a speed to the vessel of 12½ knots. She is commanded by Captain Bailey, under whose supervision she has been fitted out, and on completion of trial trip proceeded to Hamburg, where she will complete her loading for the China Seas.

VERTICAL TURBINES, TERNI STEEL WORKS.

MM. J. J. RIETER AND CO., WINTERTHUR, ENGINEERS.

(For description see page 255.)



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BERLIN.—ASHER and Co., 5, *Unter den Linden.*
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J. R. D.—*The engine may slip either wheel or both.*

INQUIRER.—*Probably from Messrs. Trübner and Co., Ludgate-hill.*

L. J.—*The indicators are both good. There is nothing to choose between them at 150 revolutions. For higher speeds the small diagram is best.*

R. S. (Sandon-street).—*Please give the temperature of the air entering the furnace and leaving the boiler. We have no doubt but that you are quite mistaken as to the evaporative efficiency of your boiler; but we should like to have precise data.*

STRESSES IN A CAMP STOOL.

(To the Editor of The Engineer.)

SIR,—A slight error appears in my letter to you of the 31st August, appearing in your issue of the 9th inst. In the last paragraph but one, C D should read *f g*, and *c e e d* should read *e f e g*. This clerical error arose from treating the stool as inverted, as your readers would at once notice. D.

Stoke Newington, September 21st.

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THE ENGINEER.

SEPTEMBER 23, 1887.

TRADE COMPETITION AND EDUCATION.

THOSE who live by trade are best qualified to express valuable opinions concerning the cause of fluctuations in its amount. It is unfortunately a fact that the trade of Great Britain instead of advancing is either standing still or retrograding. If we seek for an explanation among manufacturers, engineers, or traders, we shall be supplied with numerous reasons, varying with the nature of the business carried on by those questioned. But it is a noteworthy fact that lack of education in the South Kensington sense of the word is rarely, if ever, assigned as a cause of trade depression. The importance of this fact is purposely or negligently overlooked, and yet it is something of much moment. We do not find, for example, that the maker of cotton goods assumes that he cannot sell them at a remunerative price because his power loom hands do not know algebra, are uncertain not only as to the date at which Julius Cæsar invaded Britain, but as to whether he ever came hither at all, and are quite unable as a body to say from what province of China their favourite beverage—tea—principally comes. A considerable number of well-meaning and more or less noisy people in this country are running up and down and shouting that England is going to the dogs for lack of education. It is a good cry, simple and uniform. If, however, we catch hold of one of these gentlemen and ask him how he knows that lack of education is ruining us when we come to compete with the foreigner, we quickly find that he personally knows nothing about the matter. He has heard so. He has been told so. His certainties are all second and third-hand certainties. We do now and then meet a man who has really something to say on the subject worth saying, but we shall discover in five minutes that he is connected in some way or another with what may be called "trade art." He makes wall papers, or furniture, or he prints silk goods, or he is a pottery manufacturer, and his ideas of education extend no further than a school of design. We may leave these gentlemen on one side and deal with the technical educationist pure and simple.

The great difficulty which we have to overcome is pulpiness of the man. His arguments, if such they can be called, take no definite shape. He advances no proposition that can be discussed on its merits. He builds nothing that can be demolished. He offers no resistance that can be overcome. He has literally nothing but a cry, and it is extremely difficult to discuss cries. He puts forward a very striking proposition, "England is being ruined because she lacks technical education," but he never gets beyond this. It is as though Euclid had said the three angles of a triangle are equal to two right angles, and stopped there. No one could argue with him on this basis alone without much trouble. We have, indeed, to find arguments for the education man before we can discuss at all. Under other circumstances, we could afford to pass him by with a smile. But he is not content with a cry; he puts his hands in our pockets and takes our money as well. A cry is one thing; an addition to our rates and taxes quite another. The cry may be amusing, but we never yet met the individual who found anything humorous in a tax-collector; even the income-tax is lacking in the rudiments of the ludicrous. We must argue, not with the education man, but with those who, led away by him, would tax us. The first thing to do is to ask for some proof that we are being beaten out of the markets of the world by some other nation, and that our defeat is due to lack of technical education. It is very difficult to get at a definite statement of this kind, so we must manufacture one. Let us, then, assume that Germany is beating us, and ask in what. So far as can be ascertained, Germany is beating us just now in the iron trade, the cutlery trade, tools, and sugar. What has education or ignorance among her working population to do with all this? In the first place, we take it for granted that the German artisan is much more highly educated than his English compeer; that German chemists know a great deal more than English chemists, and that German iron manufacturers and German cutlers possess a technical training which is unparalleled in Great Britain. If this is not conceded, the whole structure, such as it is, of the education man falls to the ground. Let us begin with sugar. Technical education has had to be largely supplemented with bounties in order to keep the German sugar trade on its legs. The German chemist cannot make sugar pay. Why is this? Secondly, let us take iron. A large part of the success (?) which attends the iron trade is due to the fact that the basic process suits German ore. But the basic process did not originate in Germany. Neither Mr. Thomas nor Mr. Gilchrist claimed German origin. To go back a little further, we may say that Bessemer is to all intents and purposes an Englishman, and we never heard that he was much troubled with technical education in his youth. Suppose we concede Siemens and Krupp to Germany; we still can bring forward a few English names which are at least as important; and even if we carry history down to recent dates, may we not rank Armstrong and Whitworth against anything that can be named in any other country under the sun? Is German progress in the cutlery trade an argument in favour of technical education? Perhaps so. There are barbaric peculiarities which unthinking people have called virtues. The uneducated German would probably never have dreamed of branding his cast iron knives as "best Sheffield steel." It may be urged that we have not selected favourable examples of the results of German education. This, if true, we regret. Will some of our readers enlighten our ignorance, and show us what branch of German trade *is* better for technical education? In one respect we must grant that Germany beats England. This is in the waiter trade, in which Germany does a large and growing business; but this is, perhaps, rather outside our province to consider. Our readers will find in another page a letter from one who is eminently qualified to write on the subject of German technical education and its results. We commend this communication to their attention.

We are told that even if technical education did not foster and aid trade, that it helps the individual; perhaps so. This, however, like most general propositions, is not true all round. The German youth who gets what ought to be and is not, an expensive education as an engineer, comes to this country and earns £50 per annum. Ask engineers in this country who employ German or French assistants, and they will tell you with one voice that they are useful, not because of their technical education, but in spite of it. In this country we have known many Germans to go to the top; but when we come to examine into things a little, we find that they are men who would go to the top anywhere. It certainly was not school training, for example, that made the late Dr. Siemens what he was. Let anyone read the life of the late Herr Krupp, which has recently appeared in our pages, and say how far his success was due to technical education. Let it not for a moment be supposed that we are arguing, or asserting, or maintaining, or urging that there should be no technical education; far from it. We find it necessary to be particular on this point; for the education man is not particular, and will lay all sorts of sins at the door of those who wish him to be explicit. We are now endeavouring to show that technical education has not enabled Germany to beat us out of any market, and we will not permit ourselves to be led to discuss on the same lines the merits of technical education from a totally different standpoint. Technical education may be a very good thing indeed, although it nowise affects trade for good or for evil; but this is not the point. It is being not only said in this country, but shouted, that Germany is beating us in trade, because of her technical schools. We maintain that the proposition is not true, and we will go further, and maintain that the commercial success of this or any other nation is due, not to education as a prime factor, but to the genius or talents of certain individuals; and that genius and talent cannot be made in schools —*poeta nascitur non fit.* Englishmen are, as a rule, full of sense, and we believe that they will, if the education man does much more worrying, take strong measures to compel him either to prove his words, or to desist making a noise and diverting attention from the true causes of commercial depression. On the latter point, we commend our abstracts of consular reports to the attention of our readers.

MANCHESTER MEETING OF THE IRON AND STEEL INSTITUTE.

AT the summer meeting of the Iron and Steel Institute held last week in the Chemical Theatre of the Owen's College at Manchester, under the presidency of Mr. Daniel Adamson, the attendance of members was far in excess of that at any previous meeting of the same kind, nearly five hundred members having signified their intention of attending, and of these a very large proportion were actually present. Following the practice of his predecessor in the chair—Dr. Percy—the president, Mr. Adamson, delivered a short address dealing suggestively with many points of interest that have arisen in the development of iron and steel manufacture during the twelve years that have elapsed since the Institute last met in Manchester. Perhaps the most interesting of these was the suggestion that uniformity of composition in large masses of melted iron could most probably be obtained by more systematic use of its alloys with the allied metals, manganese, chromium, aluminium, &c., whose physical and chemical contents approach more nearly to those of iron, in preference to combination metalloids, whose density, specific heat, and melting points differ very widely from those of metals proper. Another point of more local interest dealt with was the smoke nuisance, which was largely ascribed to wasteful uses of fuel in domestic fireplaces, and the remedy suggested was the substitution, under the possible stimulus of dearer coal, of quick-draught stoves grouped by fifties in connection with a central stack, which might substantially improve the atmosphere of the town without vexatious legislation or municipal regulations. In considering the commercial prospects of the iron trade, the President expressed a doubt as to the wisdom of permitting the unlimited free import of foreign iron manufactures in a manner that must have appeared strangely heterodox to the adherents of the economic doctrines popularly attributed to Manchester, and which, as most of our readers will be aware, has already given rise to a considerable amount of newspaper controversy. In dealing with the success of the great improvements in steel manufacture during the period of the existence of the Institute, a very graceful tribute was paid to the valuable services of Mr. Robert Mushet, whose absence from the meeting was much regretted.

After the presidential address the meeting proceeded to the business of reading and discussing papers; but although a goodly list of these, amounting to eleven in all, and dealing with many novel technical points, was prepared, only four were actually brought under the notice of the members present. The first of these, by Mr. Thomas Ashbury, on the metallurgical and mechanical exhibits in the Royal Jubilee Exhibition, was mainly intended as a guide to the members in their visit to the Exhibition, which took place in the afternoon of the same day, and being of considerable length, only a very brief abstract of its contents was given by the author. In connection with this paper an interesting series of specimens illustrating some of the most characteristic metal manufactures of the district—namely, that of fluted rollers for cotton spinning—was brought before the meeting. The preparation of these rolls involves seventeen different operations, which are described at length in the paper. The material used is best malleable iron made from carefully selected scrap. Steel has recently been tried to some extent, but although it is clean and tough, it is more costly to turn and flute, and in consequence of the more rapid wear of the necks, the life of a steel roller is much shorter than that of an iron one, being only from one to three years, while the latter last from ten to fifteen years. The steel rollers are improved by case hardening, but this involves extra expense for straightening, as they are very crooked when taken from the hardening furnace as well as re-polishing. The second paper, by Sir Lowthian Bell, F.R.S., on "The Reduction of Iron Ore in the Blast Furnace," was an extension of some of the author's remarks made in the discussion on Mr. Potter's paper on "The Chicago Blast Furnaces," read at the last meeting in London, which had been omitted in the published report. This dealt with the chemical reaction and heat requirements for the reduction of iron ores in the blast furnace in a manner similar to that adopted by the same author in his numerous previous publications on the same subject, and arrived at the conclusion that the maximum speed of driving compatible with economic consumption of fuel varies with different localities for different qualities of ores, and that for Cleveland ores no advantage was to be gained by adopting the American practice of using very dense and highly-heated blast. Having regard to the cooling effect of given qualities of coke ore and flux upon a given volume of heated gases, it might be inferred that there was a proper driving speed for smelting any particular quantity of ore, and if this is not attained or exceeded, loss of fuel ensued either by the escaping gases being too hot or by an unnecessary oxidation of coke by carbonic acid in the higher regions of the furnace, or by both causes combined. These conclusions seemed to be tolerably generally accepted in the discussion that followed, and extended into the second day of the meeting, although some speakers considered that the American practice might be in part the outcome of commercial conditions not prevailing elsewhere, at any rate to anything like the same extent. The third paper, which was by far the most important communication brought before the meeting, was by Mr. J. W. Wailes, of Wednesbury, on the basic open-hearth process, and described two new modifications of the Batho furnace adapted for use with a lime lining. These modifications have been made with a view of facilitating the repairs of the hearth and sides, where the corrosion is greatest. In the first or smaller furnace the roof is made removable by suspending it from iron girders placed above and carried on runners in a manner generally similar in principle to that adopted in the German silver refinery, but this has not been found to work well in practice, as the roof can only be removed while hot, and in this condition silica bricks easily warp. The large furnace has the upper part of the side walls about 18in. deep made of silica bricks in sections mounted in frames which are attached to rods movable about, hinged on the floor, so that the sides may be readily opened for the repair of the hearth. These hinged sections are kept from contact with the calcareous lining below by a thin layer of a mixture of gas carbon and lime with a little tar, while the lining of the top with the silica roof is effected with a little siliceous fire-clay. The material produced in this furnace from a Staffordshire cinder pig containing 3·75 per cent. of phosphorus and 0·15 per cent. of sulphur is chiefly extra soft metal of comparatively low tensile strength—about 22 tons per square inch —but extremely tough and susceptible of being nicked and pinched without being injured, in which respects its behaviour is analogous to that of puddled iron.

The general impression produced by this paper was that the process described by the author was one likely to be of great value to localities where small ironworks existed dealing with common pig iron, which could be converted at small cost into steel works, producing a material suited for ordinary smith's work. This seems to have been realised to some extent in Germany, where, according to one of the speakers, the numerous small open-hearth steel works that have been started are to a great extent diminishing the demand for the products of the large establishments of older date. An important consideration pointed out by the President is, that although puddled iron may have a tensile strength of 22 tons in the direction of the rolling, the transverse resistance is much less, being as low as 8 tons, while the soft open-hearth metal is substantially equal in strength in both directions. Evidence of the advantageous working of the Batho furnace was given by several speakers, particularly by Mr. Le Neve Foster, of Jarrow, where four of these furnaces turn out from 600 to 700 tons of ingots weekly.

Mr. Purcell communicated through Mr. Hugh Bell some results of dephosphorising in the open-hearth at Terre Noire, in 1879, which seem to have been entirely satisfactory, the plates made having been used by the French dockyards. After the conclusion of the discussion on Mr. Wailes's paper, which extended into the third day, a paper by Professor Fleming on "Electric Lighting in Works and Factories" was read, which gave rise to but little discussion. The general feeling of the members who spoke on the question appeared to be in favour of the high power—500 to 2000 candle—incandescent lights, such as are used at the Newcastle Exhibition, in preference to arc lights, for ironworks lighting. Some remarks were also made upon the experimental electric lamps for underground use made by Mr. Swan and others, after which the business closed with the usual formal resolutions of thanks to the local committee and the authorities who had taken part in the organisation of the meeting. As may be gathered from the summary given above, the meeting has not been distinguished by any communication of great scientific or technical interest, but it was undoubtedly a very agreeable one, the attendance having been well kept up, and the interest of the papers was sufficient to produce a considerable amount of conversation if not of formal discussion. Visits were made on the second afternoon to Oldham and Bolton, as well as to Messrs. Beyer, Peacock and Co.'s works at Gorton, and to Messrs. Daniel Adamson and Co.'s works at Dukinfield. In the latter the visitors had abundant evidence of the use of soft steel in boiler work, some thirty or forty large Lancashire boilers in various stages of completion and intended for working pressures varying from 80 lb. to 150 lb. per square inch, made of this material, having been open to their inspection. In order to render the visit as useful as possible, the sizes and numerical details were chalked upon the boilers and other objects in the different shops, so that much could be learnt with little asking, which was the more necessary as only a very short time was available. This is a system which might be adopted with advantage whenever works are thrown open for inspection by considerable numbers of visitors.

PERPETUAL MOTION IN DISGUISE.

In bye-gone days, before anything was understood concerning the conservation of energy, many ingenious men devoted their time, we had almost said their lives, to the invention of machines which would run until some of the moving parts were worn out, and these men were said to be in search of "perpetual motion." The discovery of the philosopher's stone, which would transmute all metals into gold, and of the elixir of life, of which men should drink and live for ever, and of perpetual motion, were, indeed, the three principal pursuits of the *savants* of the middle ages. Of the two former, nothing is ever heard now-a-days; but perpetual motion is constantly turning up in some form or another. At one time it is used for purposes of fraud; but at another the inventor honestly and firmly believes that he has discovered *the* principle, and that the only reason why he is not quite successful, is that he cannot produce a satisfactory machine to apply the principle, either because he has not the skill or the money.

Superficial men laugh at what they call the "perpetual motion craze," and assert that the absurdity of the thing renders it unnecessary to criticise it or explain why a self-moving machine cannot be made. This is a mistaken view of the matter. In the first place, there are many highly intelligent and sensible men who have quite failed to see that the thing is impossible, and consequently have not hesitated to invest considerable sums of money in the pursuit of a chimera; we may cite the history of the Keely motor as an instance. In the second place, the idea involved is often so ingenious and plausible that it would deceive the elect; and lastly, the line between the possible and the impossible in science is a very fine line indeed, and it is difficult to prove that what is regarded as impossible to-day must be equally impossible to-morrow. In other words, it is by no means so clear that so-called perpetual motion engines cannot be made, as many persons think. Strange as it may seem, it is nevertheless true that there are many hard-headed, clear-thinking men who do not believe that everything a professor or a man of science says is true; and this want of faith is fostered and strengthened by the circumstance that the professors not only contradict each other now and then, but that they are sometimes clearly proved to have made mistakes. Under these circumstances we think that no harm and some good may be done if we explain that there are certain conditions under which the production of a self-moving engine is impossible, while there are others under which it would be quite possible, only unfortunately one condition is lacking. In other words, the whole chain of reasoning of the inventor may be wrong from beginning to end, or it may be wrong in one link only. As an example of the latter class of inventions we may cite a scheme recently brought out in the United States. A wheel is caused to revolve by the interrupted attraction of a permanent magnet. Now, if magnetism admitted of being insulated like electricity, its congener, there would be no difficulty whatever in producing a so-called perpetual motion engine; in other words, a machine which could run till worn out, without coal or fuel of any kind. In such a case, however, the motion would be due to a natural force extraneous to the machine, just as a water-wheel is worked by an external force, namely, gravity; the water being simply the vehicle or means of applying gravity to the required object. But unfortunately there is no known interceptor or insulator of magnetic force. It passes through slate, glass, wood, &c., just as though they had no existence. The American inventor claims that he has discovered a material which will intercept the lines of force. If this is true, all the rest follows naturally. No one can assert that the discovery of such an insulator is an impossibility. All that we can assert is that the chances that such a discovery will not be made are millions to one that it will be made. In any case, as we have pointed out, this new motor cannot be regarded as on all fours with the machines which shall have their motive-power inherent in them, such as those which pump water to work themselves.

Many inventors who have too much sense or too much knowledge to believe in the possibility of making a perpetual motion machine pure and simple, still think it possible that the power of a steam engine or other motor may be enormously augmented by special devices of the perpetual-motion character. A favourite scheme with these gentlemen is to make the engine pump the exhaust steam, in whole or in part, back into the boiler. Here is an extract from the *New York Commercial Advertiser* of August the 8th :—"It is perhaps strange, and to some people it may look like the dream of a dreamer, to say that a steam engine can ever be built that will drive back the steam into its own boiler to be used again for the next stroke. However, a Cincinnatian has invented a 'non-exhaust steam engine' that does that very thing! The inventor is now in New York, and has had several meetings with W. H. Haworth and other New York mechanical experts, who pronounced it a practicable and revolutionary invention. This non-exhaust steam engine consists of four single-acting cylinders, each connected with a common load. Two pistons of same are constantly at work, while the other two are so completely balanced by its peculiar mechanism after the completion of their stroke that but the friction only—which is supplied by the fly-wheel—has to be overcome to restore to the boiler the force—or steam—that drove them forward. There are no valves, excentrics, steam chests, cut-off devices, or many of the other delicate and intricate working parts required. Everything is simple and cheap in construction, and a saving in fuel over the most economical type of engine of from 75 to 80 per cent., and a saving of boiler room of three-quarters. The counter-balance is so arranged that instantaneously on passing the centre—or at the dead stroke—as to be automatically transferred from one to the other, causing thereby an alternate working of one set, while the other returns—while its returning it is driving the steam back in the boiler—and *vice versâ*."

It will be said, and with truth, that this is very poor rubbish; but poor as it is, we understand from the *New York Sun* that a wealthy yacht owner is going to advance £2000 to the inventor to enable him to complete his invention; and there can be no question but that the United States daily press is taking the matter up, and that ere long very considerable sums of money may be lost unless those who can write with authority interfere. Most engineers will of course say that the thing proposed to be done is impossible. Yet if they were asked to say in a very few words why it cannot be done they would be at fault. Let us try if we can put the explanation of the obstacles to the production of perpetual motion in a nutshell. In the first place, then, let us dismiss at once such words as energy and force, which may mislead, because they convey no clear ideas, and confine our attention entirely to motion, the meaning of which word everyone understands—*pace* some of the professors. Now, it absolutely true that no machine, or combination of parts, can create motion. Motion is as indestructible and uncreatable as matter. So far as men's knowledge goes, there is no more and no less motion in the universe now than there was in the beginning. The first question, then, to put to the perpetual motion man and to be answered by him is simply—From what source do you obtain motion? The answer given may, of course, vary, but we know that the quantity of motion contained in any substance, be it a gas, liquid, or solid, cannot possibly be infinite. On the contrary, it is strictly limited, and this being so, the quantity of motion available for the machine must be limited too. For example, if we derive our motion from gravity, then the quantity of it to be got out of a pound or a ton falling a foot or 100ft. is well known. The next point to be considered is that an effect cannot be greater than its cause. If we suffer 1 lb. to fall 100ft. it will do work equivalent to 100 lb. falling 1ft., and so on. But the weight cannot fall for ever, and when it is down it cannot be raised again to its original position without the expenditure of quite as much motion in lifting it as was expended by it in falling. This truth is so clearly felt by most persons that the perpetual motion man disguises and hides the fact from himself by the use of wheels, levers, springs, and what not. We may clear all these things away, however, and go to the two ends of the process, so to speak; something must be put in at one end if anything is to be taken out at the other. The intermediate stages can in no way affect the matter; the inventor will freely admit that no one part of his apparatus can by itself produce motion. If this be true, it is equally impossible for all the parts assembled to do what none of them separately can effect. In answer to this argument we have heard it urged that although one man by himself cannot lift a given weight, that twenty men can. The objection to this is, of course, that it does not apply; although one man cannot lift the whole weight he can lift a part of it, but no separate portion of the perpetual motion machine can generate or create even ever so little motion of itself. Leaving the more absurd and crude forms taken by the idea, let us consider this notion that steam can be pumped back into a boiler. No doubt the injector is responsible for the origin of the idea. Our younger readers may be surprised to hear that when the invention of the injector was announced in this country many engineers refused to believe in it, regarding it as perpetual motion in disguise. When, however, they had seen it work, they were yet more puzzled, and held that it really was "perpetual motion." By-and-bye, as more came to be known about it, it was seen that it had nothing to do with perpetual motion, but that, on the contrary, it was a fairly economical steam pump and nothing more. In the case of the steam engine we find that its motion is due entirely to the augmentation in bulk that water undergoes when it is converted into steam. A foot of cold water becomes 270 cubic feet of steam with an absolute pressure of 100 lb. on the square inch. Let us suppose that all this steam assumed as it was made the shape of a bar or column 12in. square and 270ft. long. This bar would be thrust out of the boiler with a total effort or push of 144 × 100 = 14,400 lb., and the total work done in pushing it out against that resistance would be 14,400 × 270 = 3,888,000 foot-pounds. Let us suppose that the feed-water assumed the form of a rod or bar 1728ft. long and 1in. square. This water rod must be pushed into the boiler while the steam rod is being pushed out. The resistance or push against the rod is 100 lb., and 1728 × 100 = 172,800 foot-pounds; deducting this from the former figures we have 3,715,200 foot-pounds as the net gain due to the augmentation in volume. The motion of the steam bar has been obtained from the combustion of the fuel. We can see at a glance that to push this steam back into the boiler as steam means the substitution of a steam bar 270ft. long and 1ft. square for a feed-water bar 1728ft. long and 1in. square. The motion against a resistance required to force the steam bar into the boiler will be exactly equal in amount to the motion against a resistance with which the steam bar was forced out of the boiler. We need in no way concern ourselves with pumps or cranks or wheels, or anything else. The steam knows nothing about such things. At the two ends of this process are the boiler, and as much force must be expended in forcing steam into the boiler as is spent in forcing it out. If it is urged that the volume of the steam returned is less than that delivered, then the answer is, by just so much is the economy claimed for the engine diminished. The stage pump device, which is virtually a compound engine working backwards, will in no wise assist the inventor.

In a word, the true way to get at the fallacy of all these perpetual motion in disguise schemes is simply to go straight to the two ends of the cycle or process, and see whether they balance each other or not. The intermediate mechanism has no more to do with the affair than the beam of a scale has to do with the weights in the pan. We may alter the length of the beam at each side of the centre how we may, but it will always be found that the weight in one pan, multiplied by the length of its arm of the balance, will give figures identical with those obtained by making a similar calculation for the other end of the balance. In this direction, at all events, nothing is to be gained. Let us hope that a knowledge of this truth may not be bought at a great expense at the other side of the Atlantic.

THE YORKSHIRE COLLEGE, LEEDS.

THE prospectus of the courses of civil and mechanical engineering of this College has reached us, and contains several points deserving special notice, not the least of which is the evident interest taken in the College by the engineers of the neighbourhood as represented by the engineering committee of the College, which comprises Sir Andrew Fairbairn, M.A., chairman, Principal Bodington, M.A., Joshua Buckton, Henry Davey, Samson Fox, Arthur Greenwood, J. Hartley Wicksteed, Hon. R. C. Parsons, M.A., T. W. Harding, A. T. Lawson, A. Meysey-Thompson, Benjamin Walker, Walter Rowley, David Greig, and Alexander Macpherson. Provision is made for the instruction of students in civil, mechanical, and electrical engineering, and a course is given by Professor Barr on the elements of construction for architectural pupils. The latter course treats of the preparation and properties of the chief constructive materials, the elasticity and strength of materials, the strength and stiffness of structural elements, such as beams and girders, and the strength and stability of structures. The complete courses of instruction for civil, mechanical, and electrical engineers extend over three sessions, but students who enter with some knowledge of mathematics can complete the course in two sessions. In each year students have lectures on engineering science and practice, instruction in geometrical and mechanical drawing, and practice in the engineering laboratory. In the first year the work is of a general kind, dealing with the origin, preparation, and uses of the chief constructive materials, the processes of the workshop, the elements of mechanics in their application to engineering questions, and the elementary principles of the steam engine and other prime movers. The students thus obtain at the outset a general idea of the nature of engineering work, which enables them to understand what they see in the laboratory and in the works which they visit. This is found to answer very well, and the students take much more interest in the work than they do if they are at once taken into more abstruse principles. In the second year the civil and mechanical engineering students have different courses, the former hearing lectures on the strength of materials, surveying, levelling, setting out, and civil engineering construction; while the mechanical engineering students have a course on the strength of materials, elements of machine design, friction, and lubrication, &c. The third year course treats of engineering principles requiring more advanced mathematical methods. In the laboratory the work is of a kind quite distinct from ordinary workshop practice, no attempt being made to put the students through an apprenticeship. The College class-room and laboratory are the places in which an engineer should gain a knowledge of the principles of his craft, but it is in the workshop only that a sound knowledge of the methods of production on a commercial scale can be obtained. It will be remembered that the new building, which has been erected for the department of civil and mechanical engineering, was opened last October by Mr. Jeremiah Head, president of the Institution of Mechanical Engineers, accompanied by the members of the Institution, who held their quarterly meeting in the College by invitation of the council. The building is most completely fitted up in all respects. The laboratories, which contain a 100-ton testing machine, an experimental boiler and engine, and numerous other machines and appliances, are well worthy of a visit. Of the total estimated cost of £10,000, the engineers of Leeds and its neighbourhood have already contributed £8400. No better answer than this could be given to those who say that practical engineers do not take much interest in college work. All depends on the kind of work proposed to be done. So long as the Colleges devote themselves to that part of the engineer's training which they can accomplish they will not lack support. In this connection we may quote a paragraph from the prospectus of the courses of civil and mechanical engineering, session 1887-8. "The work of the classes is not intended in any way to supersede the usual requirements of pupilage or apprenticeship in engineering, but to enable the learner to gain such a knowledge of the principles of his profession or trade as he cannot acquire by simply working in the office, in the field, or in the workshop. The classes may be attended either before or after pupilage or apprenticeship; but those who have their engineering education to begin, and who propose to take the College course, are advised to take it first, as they will then be in a much better position to profit by the experience to be gained in practical work, and more likely to obtain speedy advancement in engineering service." From this it will be seen that Professor Barr only claims to impart to students that which will enable them to make engineers of themselves more rapidly and more certainly than they could without the College courses. By the permission of the proprietors, the Professor is enabled to visit, with his classes, many of the most important and interesting workshops and manufactories in Leeds and its neighbourhood. Students are thus enabled to study, in the works, the manufacture of iron and steel in their different forms, the operations carried on in engineering workshops, and the applications of machinery to manufactures of various kinds. With a view to the encouragement of students in this department in the acquisition of a thorough knowledge of mechanical engineering, the following firms have consented to take into special consideration the admission into their works, as apprentices, of such students as shall have distinguished themselves during their College course by gaining the associateship in engineering, certificates of proficiency, and class prizes:—Joshua Buckton and Co., John Fowler and Co., T. R. Harding and Co., Hathorn, Davey, and Co., Kitson and Co., Leeds Forge Company, Smith, Beacock, and Tannett, and Tannett, Walker, and Co.

FRENCH SHIPBUILDING AND SHIPPING.

IN a Blue Book just issued there is a table of the tonnage of vessels built in France; of those bought abroad and added to French registry, and of the vessels sold to foreigners, which gives some rather remarkable statements. The table shows the tonnage of vessels built and bought abroad together from 1855 to 1871, and separately from the latter year to 1885 inclusive, and the tonnage sold in each of the years. We find, then, that in 1855 there were built in France and bought abroad 103,488 tons of shipping, and 174,018 tons in the later year; but from that time, with frequent fluctuations, the amount decreased, and for 1871 only 58,541 tons were built and bought. In 1872 there were 50,697 tons built, and the tonnage built fell, until in 1880 there were only 12,629 tons built. In 1881 that quantity rose to 20,735 tons; in 1882, to 56,594 tons; but from that date—despite the bounty—it has fallen. It was in 1883 35,223 tons; in 1884, however, there were 57,162 tons built; but in 1885 the tonnage built was extremely small, 15,930 tons having been built—this being the latest date given in the table. The tonnage bought abroad since 1871 has fluctuated greatly; it was 34,885 tons in that year, and only 17,646 tons in the following year. The lowest tonnage bought was in the year 1877, when 12,864 tons were so acquired; but from that time up to 1882 there was an increase, 78,612 tons having been bought in the year named. Every year since the purchases have decreased, and for the last year in the table there was less bought than the previous minimum, 9681 tons being the amount for 1885; and as to the clearances from the French register by sale, though there have been great variations, the tendency has been to increase. In 1855 there was only sold the small amount of 1919 tons; but by 1861 the sales rose for that year to 10,354 tons. For some years afterwards there was a decline but in 1870—when 11,135 tons were sold—an increase set in, continuing year by year up to 1874, when the sales aggregated 27,092 tons. After that there was a fall, and 1879 gave the lowest sales of recent years. An irregular increase again set in, and for 1885 the sales were 20,852 tons, the largest total in any one year in the record. It would thus appear that whilst, taking vessels built and bought and deducting vessels sold, France added thus on the balance of the year 1882 no less than 117,000 tons to its shipping—the losses by wreck not being taken into account—yet the yards grew less productive and the purchases less also, whilst the sales were more; and thus for the year 1885, although the bounty law should have stimulated the builders greatly, yet there were only about 5000 tons more built and bought than were sold to foreigners. This limited tonnage, it is evident, would be far from sufficient to meet the losses by wreck and other casualties, so that the conclusion is established by this official paper that the tonnage of vessels owned by France must have been decreasing, and that probably at a rapid rate. This is a remarkable fact, as we have said; but the source of the figures prohibits doubt, and it would be well worth obtaining some reason, but this is not furnished by the bare official figures which we have thus above summarised.

THE NEW EXPLOSIVE "CARBONIT."

IT is almost superfluous to remark that, since many of the governments of countries, where coal mines are extensively worked, have legislated to prevent as much as possible the use of common blasting powder in those mines abounding in gas and coal dust, it became a matter of the first importance to find an efficient substitute, and as was to be expected, the manufacturers of explosives have turned their attention to the subject, the result being that, now two or three new compounds have been discovered, which after lengthened trials in Westphalian and other mines have proved applicable to the purpose required and are being manufactured in large quantities at the present time in Germany, carbonit being one of the new substances, of which we are about to speak. Carbonit was expressly invented for being used in fiery mines and those abounding in coal dust. It has occupied years of experimental research in the laboratory as well as lengthened trials in the experimental level constructed for the purpose at the manufactory at Schlebusch, near Cologne, and in the Royal Mines on the Saar, to bring the explosive to that state of perfection in all its bearings to fit it for the purposes of the coal miner. Carbonit is distinguishable from dynamite exteriorly by the more sandy and at the same time plastic properties of the mass, but like the latter it is exploded by means of a detonating cap. In its effect it surpasses black powder two and a-half times, and is therefore in this respect equal to dynamite. The manner in which it acts, however, is similar to that of powder; it explodes slowly, and consequently breaks up the coal or rock less, having more of a heaving and splitting effect, which, of course, is a great consideration in a coal mine, as it produces more lump instead of so much small coal. Carbonit leaves very little, if any, after residue, and it is completely converted into vapour, which is in no way hurtful to the human organism—in a word, is innocuous. It is not hydroscopic, *i.e.*, it attracts no moisture from the air, is neither affected by heat nor cold, and can therefore be employed in exit bore holes and with water tamping, and can be kept stored for any length of time. If hammered on a firm anvil with a heavy sledge, it explodes after repeated blows at the point struck, with a crackling noise, without a sharp report, or without the ignition being communicated to the neighbouring portion of the mass which has not been struck. In case the anvil does not rest solidly, *i.e.*, if it rebounds, no explosion will take place. If a cartridge of it be thrown into the fire, it burns with a bluish-violet flame without an explosion.

PRESTON DOCKS.

WE told our readers last week that it was contemplated to raise further sums for the construction of the Preston Docks. At a meeting of the Town Council held on Thursday, the 15th inst., a very stormy discussion took place, when it was decided by twenty-four votes to fourteen to apply to Parliament for power to borrow a further sum of £510,000. The discussion served to reveal, to say the least, a very extraordinary and unsatisfactory state of affairs. Among other things we may say that it was admitted that certain tenders had never been opened; and one member of the Council said that instead of grumbling at the money being spent, he only "wished it was more." It appears to us that the ratepayers of Preston will do well to have a fairly exhaustive inquiry made into the whole matter before they saddle the town with an enormous debt.

THE INSTALLATION OF TURBINES AT THE STEEL WORKS OF TERNI, ITALY.

TURBINES, with vertical or horizontal axes after the Girard system, have for some time been employed in preference to those of other systems wherever the quantities of water to be utilised are variable, where the height of fall to be utilised is constant, and the lower level of water consequently does not rise or vary. A certain number of these turbines has been set up at the steel works at Terni, Italy, by the constructors, MM. J. J. Rieter and Co., of Winterthur, Switzerland, to furnish the motive power required. These motors work the following machines:—

Designation of the machines and apparatus.	Motive power in horse-power.	Quantity of water. Litres per second.	Revolutions per minute.	Diameter of the turbines.
				metres.
General rolling mill	1000	500	180 to 240	2·400
Mill for rails	800	450	200	2·500
Mill for tires	500	280	240	1·800
Train of 500 mm. mill	350	200	200	2·500
Train of 280 mm. mill	150	85	250	1·950
Movable crane	50	28	850	0·565
Great pump..	50	28	850	1·070
Great shears	40	24	450	1·070
Mill for iron plate	40	24	450	0·800
Small pump	30	17	600	1·070
Small shears	20	12	450	—

The total amount of motive force is equal to 3030-horse power, and the quantity of water corresponding with this is 1708 litres per second. The turbines of the steel works of Terni may be divided into two principal groups:—(1) The small motors of 20 to 50 effective horse-power, which are mounted on a cast iron frame, and can be removed and attached to the machines to be set in motion as required; (2) the great motors, each placed separately on masonry and concrete foundations.

We shall describe one of these great motors, represented by Figs. 1 to 5 on page 252. This turbine works a mill for the production of railway rails; its force is equal to 800-horse power. There are guides bolted on to a large pipe, which is fixed to a solid foundation, and from which a water pipe branches on the opposite side to the distributing apparatus. This pipe is 600 mm. in diameter inside, and allows for a discharge of 450 litres per second. The head of water is 180 m., equivalent to about 270 lb. on the square inch. In order to resist this great pressure, the thickness of the water pipes, as well as those of the movable wheel and of the fixed guide wheel, is considerable. The interior diameter of the movable wheel is 2·5 m., and it makes 200 revolutions per minute, so that it has had to be constructed with great care.

To test whether the dimensions of the rims of the wheel are capable of resisting the centrifugal force which is developed, let us represent the speed of rotation by V, the extreme diameter of the wheel by $d = 2·896$ m., the number of turns per minute by n, and we get $V = d \pi n = 30·24$ m. per second. If, further, S represents the tension per unit of surface, which is developed through the action of centrifugal force in a ring turning rapidly, V the angular velocity corresponding to the tension S, and γ the specific of the metal of which the wheel is composed, $g = 9·81$ the force of gravity, we get (1) $8 = \frac{V^2 \gamma}{g}$; (2) $\sqrt{\frac{g \cdot S}{7}}$, supposing that the thickness of the ring in rotation is in proper relation to its diameter. When S is equal to the breaking strain of the metal the ring will break. The following table gives the stresses and the breaking speeds of the three metals which are most employed:—

Metal.	Rupture tension in kilog. per square centimetre.	Rupture speed in metre per second.
Cast iron	1,300	130
Iron..	1,800	230
Soft steel	4,500	235

It will be seen, then, that for a coefficient of safety of 2·5 the circumferential speed is 26 m. for cast iron, 44 m. for iron, and 47 m. for soft steel. The turbine we give in Fig. 2 is of cast iron. The circumference speed corresponding to its average diameter is, when the wheel makes 200 revolutions per minute, equal to 28·30 m., that is to say, a quarter of the speed at which the wheel would break, consequently the wheel presents a coefficient of safety of 14. If the load were suddenly removed, in consequence of the breakage of the transmission straps or from any other cause, the security against rupture by centrifugal force would be equal to $\left(\frac{130}{45}\right)^2 = 7·8$. The cast iron employed by the construtors for the wheel is very hard, so that one is justified in considering S to be over 13 kilogs. per square millimetre; the rim of the wheel is further strengthened by two steel rings welded up and shrunk on. It is united to the boss by a stout disc, so that the whole constitutes a very massive construction. The admission is regulated by a hand wheel placed sufficiently above the ground to permit its being easily worked. The motion of this wheel is transmitted by means of bevel gear to a cog-wheel, which is placed in the interior of the sluice, and the advance or recoil of the latter is thus produced. Figs. 4 and 5 represent the sluice and a part of the wheel on a larger scale than that of the whole turbine. The distribution apparatus is furnished with two admission orifices, by which 0·345 m. of water can be introduced. The radial width of these orifices is 125 mm., that of the bucket wheel is 140 mm. at the smallest part, and 510 mm. at the largest. The horizontal shaft of the turbine is supported on one side by a bent tubular bracket, fixed to the foundations by means of holding-down bolts. On the other side the shaft turns in a massive block, also bolted on to the foundations. The bearings are made of a composition which has succeeded very well so far. Two grooves are hollowed in the shaft to receive the steel rings, which are shrunk on after fixing the wheel on the main shaft, so that the latter is well collared.

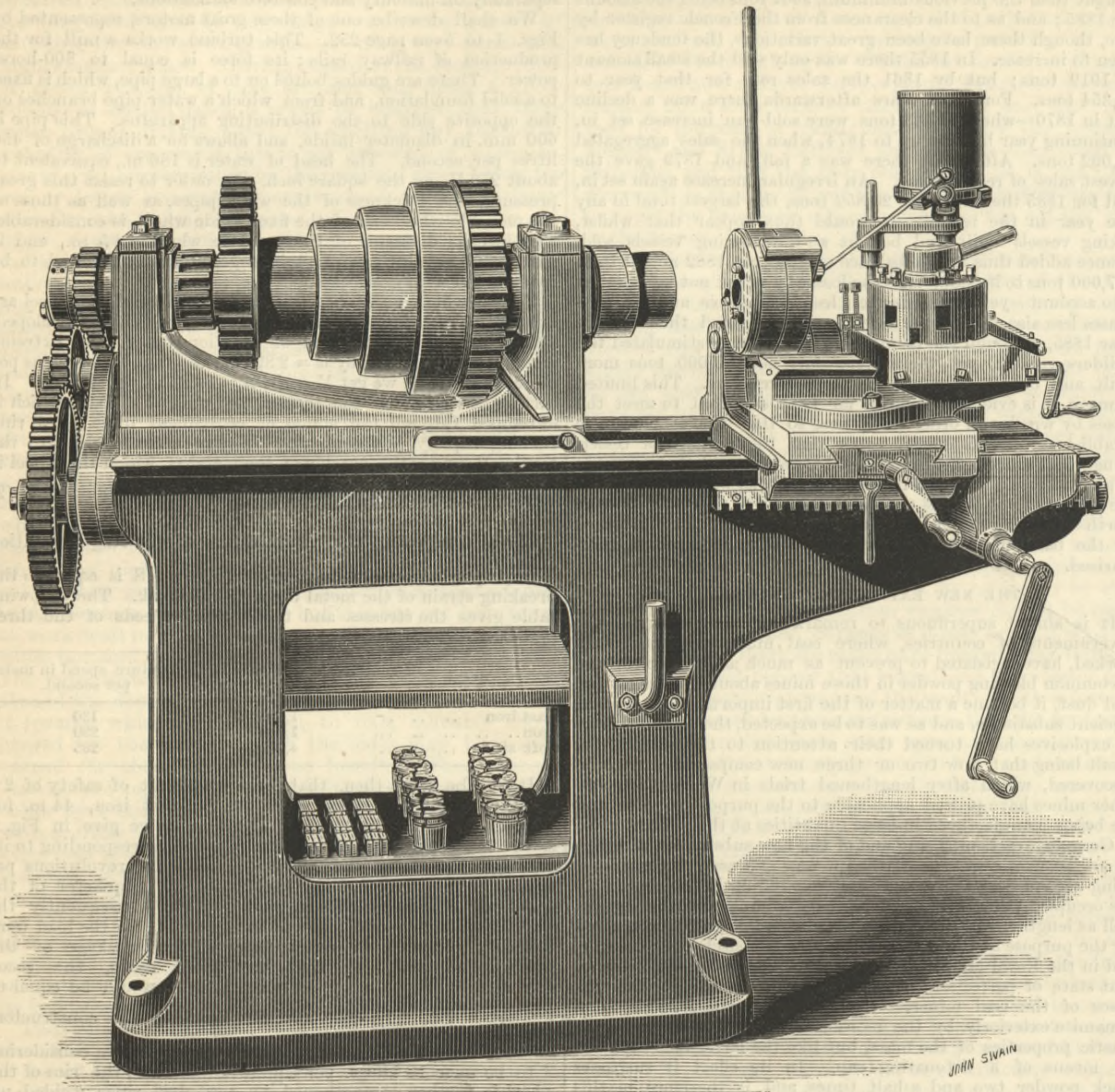
It is important to the efficiency of the mill that the turbine should be easily and quickly stopped and set in motion again. The high pressure brought to bear upon the distributing apparatus would not have permitted this quick arrest and re-start without a very complicated disposition of the sluice. For this reason the admission valve is only employed in exceptional cases, and the sluice is worked by means of the wheel previously described, and which can be managed by a single man. But in order to avoid damaging shocks to the pipes when the admission is abruptly shut off, a pipe has been placed in front of the large valve which contains a smaller one. These two valves are united together by a gearing, so that the opening of the one causes the closing of the other, and *vice versâ*, and there is no fear therefore of a rupture of the water-pipe. The necessary quantity of water to work these turbines is brought by a long canal through two tunnels. The interior diameter of the pipes is 770 mm.

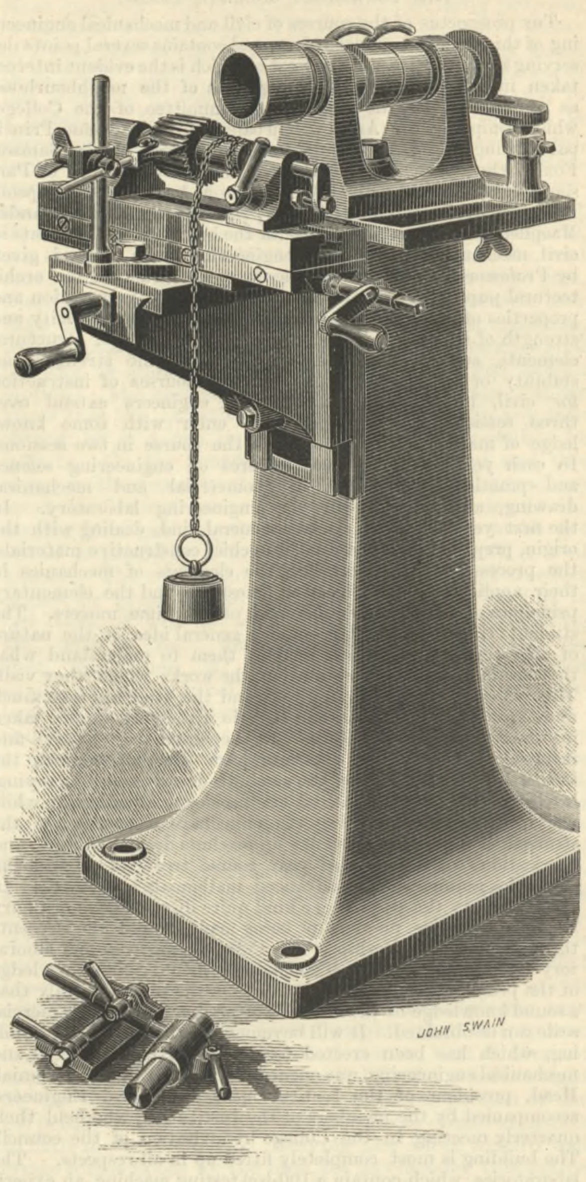
TRIAL OF STONE BREAKERS.—At the Manchester Agricultural Society's Show a competitive trial of stone breakers took place; the judges being Mr. J. T. King and W. Scotson. The only machines entered were a knapping motion 16in. by 8in. breaker by Messrs. Baxter and Co., of Leeds, mounted on wheels, with automatic delivery, and a Blake machine, 16in. by 8in., on wheels with a screen. The first trial was made on boulders. Baxter's machine broke 21 cubic feet to 2½in. ring, and made 7ft. of gravel in 5 min. The Blake machine made 7 cubic feet, 2½in. ring, and a little over 1 cubic foot of gravel in the same time. In a second trial, working on Clee Hill stone, Baxter made 15ft. of stone and gravel in 5 min. while Blake made 5 cubic feet of stone and gravel in the same time. The power expended is not stated. A silver medal was awarded to Messrs. Baxter.

EXTENSION OF THE GAS LIGHTING OF THE CLYDE.—The growing appreciation of the use of constant gas lighting for navigable rivers and estuaries is shown by the increasing numbers of gas-lighted buoys and lightships now anchored in different places where a light is necessary, but where a regular lighthouse is too expensive, although these would become indispensable in some tidal rivers owing to the growth of shipping. The Clyde Navigation Trustees have adopted and have ordered from the Pintsch Patent Lighting Company the necessary high-pressure oil gas apparatus for lights at Cardross and Dumbrich lighthouses, and for the light towers at Donald's Quay, Rashille, and Dalmuir. The gas burns night and day through two to three months at a time, and dispenses with light keepers and attendants. The system thus procures a given result in places where ordinary lights could not be had except at great cost, and in some places where it could not be obtained except at the cost of a large lightship and crew.

MACHINE TOOLS AT THE NEWCASTLE EXHIBITION.

MESSRS. HULSE AND CO., MANCHESTER, ENGINEERS.

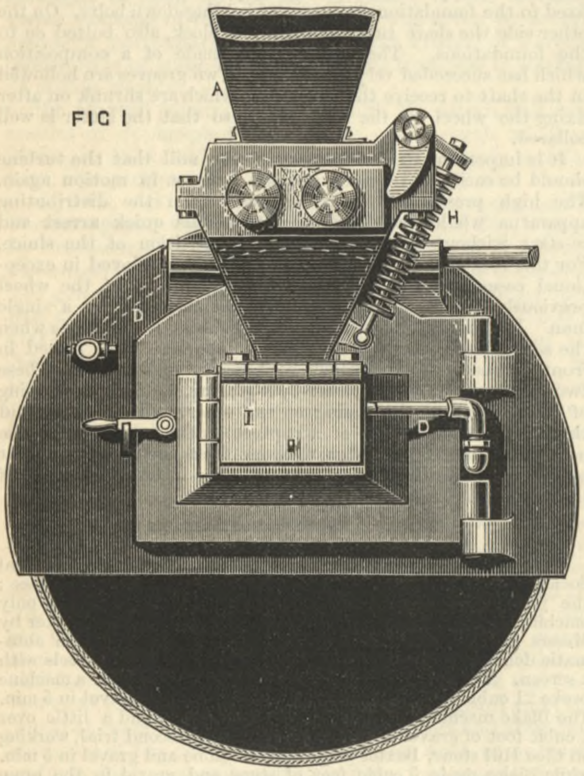




THE NEWCASTLE EXHIBITION.

Messrs. D. Hart and Co., Wenlock-road, N., exhibit an improved steam stoker, which we illustrate by three views below. This apparatus is manufactured under the patents of Messrs. Johnston and Blandford, and has been designed with the view of using the small coal, which accumulates at all collieries, and feeding it on to the fire in its natural state, without grinding or other preparation, by means of a jet of steam. The enlarged

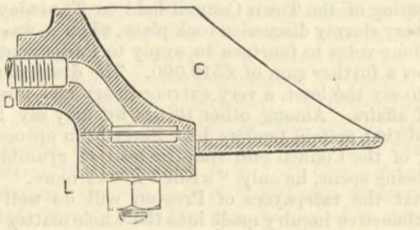
FIG I



JOHNSON AND BLANDFORD'S STOKER.

section shows the arrangement of the nozzle. The jet itself consists of two flat plates, between which a thin sheet of brass, shaped like a horseshoe, is bolted. The cavity thus formed, which is only about a hundredth part of an inch in depth, is in connection with the boiler, the steam supply being led through a bent pipe, marked D in Fig. 2, which passes through the furnace, and so superheats the steam. The small coal is placed in the hopper A. At the bottom of this hopper is a pair of fluted rolls, driven by suitable gearing, which regulate the feed, and crush any lumps of coal to above the size that may be determined on, one of the rolls being made to slide so as to permit a stone or other foreign substance to pass without causing injury. The coal falls on to a fan-shaped plate below the jet, and is blown into the furnace and scattered evenly over the fire. The stoker is fixed on the ordinary furnace door, and the gearing is so arranged that the door can be opened without disconnecting any of the parts, so leaving the fire and flue as accessible as in a boiler fired by hand. In addition to claiming simplicity, the manufacturers state that by the use of this stoker small coal can be burnt with an entire absence of smoke. They also claim a considerable economy in the cost of fuel, seeing that "small" can generally be obtained for about two-thirds the price of hard steam, and about one-half that of Welsh. The following are the results said to have been obtained with a Lancashire boiler 20ft. long and 6ft. diameter, having flues each 2ft. 3in. diameter and six cone tubes:—Hand-firing with Welsh coal, 8·43 lb. of water per lb. of coal from and at 212 deg.; steam stoking with

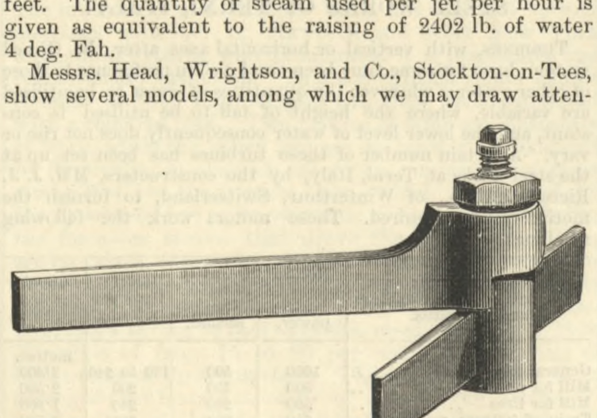
FIG.3



STEAM STOKER NOZZLE.

small Silkstone, 6·78 lb. of water per lb. of coal from and at 212 deg. The grate area in each furnace was 10 square feet. The quantity of steam used per jet per hour is given as equivalent to the raising of 2402 lb. of water 4 deg. Fah.

Messrs. Head, Wrightson, and Co., Stockton-on-Tees, show several models, among which we may draw atten-



GAVIN JONES' TOOL HOLDER.

tion to a type metal model of the Empress Bridge. The bridge itself consists of sixteen spans, all of similar design. Only one span is shown, but the effect of the whole bridge is produced by a system of reflecting mirrors, placed at each end of the model, the light being just about sufficient to show the sixteen spans. The illusion is complete, and has attracted considerable attention. At night the effect is produced by means of a couple of electric lights. This bridge crosses the river Sutlej, and was opened for traffic in 1878 by Sir Andrew Clarke, R.E.

The difficulty of dealing with the fumes produced in smelting lead ores is well known. Lead, though a heavy metal, is a volatile one, and in separating it from the ore there is always a considerable waste, due to volatilised

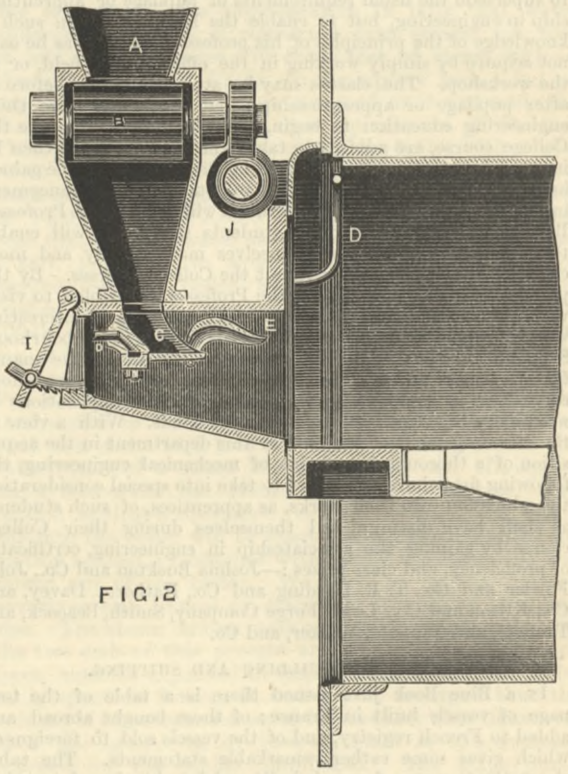


FIG.2

JOHNSON AND BLANDFORD'S STOKER.

lead compounds passing away with the furnace gases. A common method of recovering a portion of these waste products is to pass the gases through long flues, built upon or below the surface of rising ground, and terminating in a chimney. In some cases these flues are several miles in length. The gases in passing through gradually cool and deposit the heavier particles, and these are usually allowed to collect for about a year, when the works are stopped, at considerable loss, and the flues cleaned out. Various other plans have been tried, chiefly involving the use of machinery, without any great degree of success. Mr. John Warwick, Newcastle-on-Tyne, has endeavoured to supply this want by means of an apparatus, which he shows by models in the North Court. The system is based on the fact that gases in cooling increase in density. The gases after leaving the furnace are made to traverse a series of vertical pipes or flues, in such a way that the descending column must always be heavier than the ascending one; and in this way a syphon action is brought about, which causes a forward movement without checking the draught. At the same time, in consequence of the rapid rate of cooling, the metallic particles are speedily deposited. This takes place in proper receptacles provided below the pipes, and arranged so that they can be conveniently cleared out as required. By means of the vertical pipes, which may either be constructed of iron plates suitably lined, or of brick, a great length of cheap flue is obtained on a small area of ground. Besides this the inventor claims economy in working by the adoption of his system.

As is usual on such occasions, Messrs. Hulse and Co., Manchester, show a fine collection of well-finished tools. Some of these are similar to those illustrated and described in THE ENGINEER of May 8th, 1885, in connection with the Inventions Exhibition, while some are new. Of the latter we may mention an improved hollow spindle lathe for turning, screwing, and finishing studs, pins, &c., from $\frac{5}{8}$in. up to $1\frac{1}{8}$in. diameter, out of long bars, which we illustrate on page 256. The bars are passed through the spindle, which is fitted with a concentric chuck for gripping them while being operated on. Immediately each article is completed and cut off the bar is released and fed forward so as to present a fresh portion to the action of the cutting tools. Much time and expense is saved by this system, as compared with the old plan of cutting the bars into lengths and then centreing each length before putting it into the lathe. The lathe has only one headstock, which is double-geared, and is carried upon a bed formed with a trough for catching the lubricant, and with shelves for holding the cutting tools when not in use. A sliding carriage movable along the bed either by guide screw or rack and pinion mechanism at option, holds a capstan rest for six cutters, and a screwing apparatus. The several cutters for sliding, ending, chamfering, &c., and the screwing apparatus, can be rapidly put in or out of position for operating on the work; and adjustable stops are provided for ensuring exact repetition of diameters and lengths. We also illustrate a universal cutter grinding machine, specially constructed for grinding to a keen cutting edge the teeth of face and edge-milling cutters, parallel or taper reamers with straight or spiral flutes, and other similar cutters after they are hardened and tempered. The grinding is effected by a high-speed emery wheel, the work being acted on by one of the sides of the wheel instead of by its edge, as is usually done. This system has several advantages over edge-grinding, as, for example, that the grinding of the work into wavy forms is avoided, and that in grinding cutters having finely-pitched teeth emery wheels of comparatively large diameter may be employed. At the outer end of the spindle of the machine is a second emery wheel for general grinding purposes, an adjustable tee rest being provided for supporting the work. The machine is capable of operating on milling cutters, reamers, &c., up to 6in. diameter and 9in. long. Another useful little appliance is Gavin Jones' patent swivel tool-holder. This is shown on page 256, and it will be seen that the cutter can be taken out for grinding and replaced without disturbing the adjustment of the swivel. The swivel can also be adjusted without disturbing the adjustment of the cutter.

INTERNATIONAL RAILWAY CONGRESS, MILAN.

THE first International Railway Congress was held at Brussels in 1885, when it was decided to hold the second at Milan, two years later. The city on the little river Olona, where Leonardo da Vinci established himself, like Rubens in Antwerp, as engineer as well as architect and artist, was celebrated four centuries ago as the centre of a complete system of inland navigation, for the rectangular figure formed by the Po, the Adda, and the Ticino, with a line parallel to the former passing through the city, is united by diagonal canals. The whirligig of time, however, has now brought about a railway congress in the city which formerly owed its importance to water communication; and, indeed, Milan is now no less well provided with iron-ways than it was formerly with water-ways, being the centre where meet the following important lines, affording direct communication not only with adjacent, but also with still further countries. The handsome and commodious central station unites the Turin line with France by the Paris, Lyons, and Mediterranean, and Mont Cenis Tunnel; the Como-Chiasso line with Belgium; and Switzerland by the St. Gothard; the Piacenza, Bologno; Brindisi with the overland route to India; the Venice line with Austria; Hungary by Vienna; and that of Verona with Germany. Besides these lines of international importance, the system of the Mediterranean, the Adriatic, and the North of Milan Companies, with others of minor importance, also meet in Milan. The number of passengers arriving at, and departing from, that city in the year is no less than four millions, while the annual traffic amounts to 15,000,000 lire or £600,000. There is, therefore abundant reason to have chosen Milan as the seat of the second Railway Congress.

The sittings are held in the Scala, which disputes with two, if not three other theatres, the honour of being the largest in Europe; the dimensions of the stage being the data on which reliance is chiefly placed for asserting the supremacy. When the Exeter calamity has so soon succeeded that of the Paris Opera Comique, and one knows not from day to day what theatre will be the next to immolate an equal number of victims, it may not be out of place to state here that the Scala is built of stone and iron, with the exception of a few wood floors, which are being gradually replaced by those of fireproof material. The numerous doors all open outwards, so that the audience of four thousand persons may be cleared in eight minutes. The theatre is lighted throughout by three thousand incandescent lamps, while 250 candles are provided in case of failure in the electrical or motive plant.

While the sectional meetings are held in various halls in the building, the afternoon general meetings took place in the handsome foyer—the origin of which term is not generally known. In the early days of the drama, when public and performers were not so well housed as at present, a *foyer*, or hearth, was provided where the amusers and amused might meet to warm themselves between the acts. Over the platform is a portrait of the present King of Italy—*il rè Umberto*—surrounded by the Italian tri-colour, green, white, and red.

The subjects submitted to the meeting are:—(1) Metal sleepers and steel bridges; maintenance of permanent way; provisions for dealing with snow; conditions and cost of maintaining lines with exceptionally heavy traffic. (2) The best utilisation of locomotives; improvement of passenger stock; construction of locomotives; lubrication and premiums for economy; continuous brakes; lighting and heating of carriages. (3) The control or checking of passengers; passenger trains; goods traffic; minor lines; shunting; lighting of stations. (4) *Employés*, their recruiting and remuneration; benefit societies; dues and taxes; international relations; technical information; and (5) questions specially relating to secondary lines.

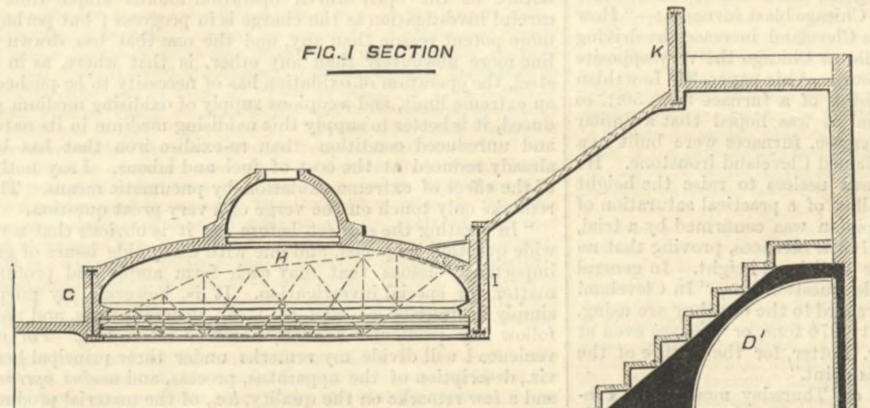
Here is ample matter for hard work and useful discussion, while the *utile* will be agreeably combined with the *dulce* by receptions, excursions to Venice, Genoa, and Lake Como, besides a grand banquet to wind up with.

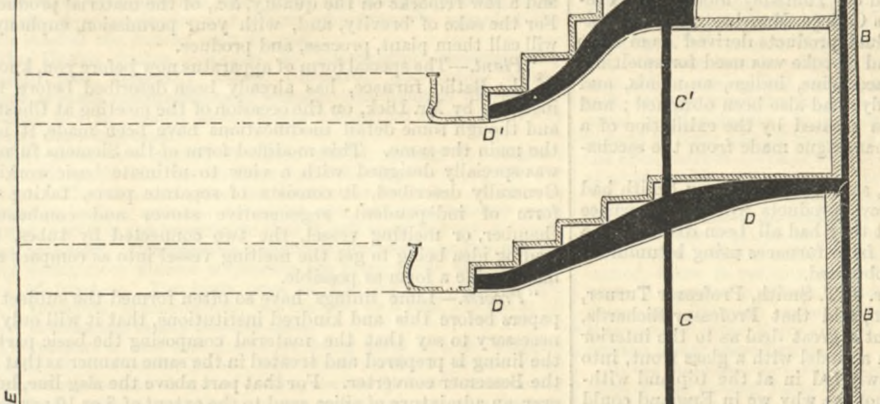
NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—William J. Bevan, engineer, to the Trafalgar; Frank W. Hawkins, engineer, to the Aurora, to date September 19th; and James Shirvell, engineer, to the Ranger, when re-commissioned, and until then additional, to date September 16th.

ON THE CONSTRUCTIVE IRONWORK IN A NEW THEATRE.

By MAX AM ENDE.

THE fireproof construction of the roof and galleries in a theatre now being erected in the Strand, in London, offers some points of interest, not only with regard to this particular building, which is of small dimensions, but with regard to much larger buildings of a similar character if the construction were applied to them. A short description seems therefore desirable. (1) The general construction is characterised, as in most such cases, by galleries projecting far beyond the points of support—the columns—so that these may not obstruct the view of the stage to persons placed in the best seats. Usually the overhanging weight of these galleries is balanced by the weight of the wall at the back of the seats, while in this case it is balanced by the strain in an anchorage bar which is fixed to the bed-plate upon which the columns rest at the bottom. The bed-plate is designed as a plate girder of nearly the same length as the cantilevers. This is shown in Fig. 1. A is the bed-plate, B the anchorage bar, C C are the columns, and D D are the cantilevers. In consequence of this arrangement the weight of the wall at the back of the seats is not taken into account, and the iron structure, provided that it is braced horizontally—which is the case—would stand upon its brick foundations safely without that wall. The centre of pressure upon the foundations lies exactly under the centre of the total load, and its amount is the same as the load. The difference of cost between this and the usual arrangement, if there be one at all, is trifling, while it is an advantage to be able to complete the erection of the ironwork without taking notice of the existence of the surrounding walls or their possible settlement. (2) The construction of the stepped floor for the seats. In plan the steps lie in circles, Fig. 2; the girders forming the steps, therefore, have circular flanges, and if they were made in the ordinary way it would be necessary to support them by cantilevers at intervals so short that the unsupported arc differs little from a straight line. The cantilevers would then be collected upon a cross-girder which would rest upon columns. This arrangement generally leads to complications in the connections, and is otherwise not economical. A better arrangement has been adopted in the present case, and the writer believes for the first time. The circular girders have the same depth as the steps, and their flanges are each formed by one light angle iron. The horizontal flange of the top angle iron of one girder lies thus in the same level as that of the bottom angle iron of the next girder, and the two angle irons can therefore be connected by horizontal bracing. In this way the torsional strains are absorbed by horizontal girders of great depth. The whole floor acts like a corrugated plate under an inclined pressure, and, like such plates, it does not require supports at very short intervals. Indeed, it will be found that with this simple structural element problems may be solved which have hitherto been little thought of in the construction of theatres and similar buildings.





In a succeeding article upon this subject I intend to show the leading details of this construction, and to discuss a few other items peculiar to it.

THE syllabus of the lectures in the engineering department of the City of London College, White-street, Moorfields, for the session 1887—8, has been issued. Mr. Henry Adams, M. Inst. C.E., is the professor in this department, assisted by Mr. R. J. Hatton and Mr. S. F. Howlett, the syllabus including a useful and practically applicable set of subjects. The lectures are given in the evening, and the fees are within the reach of all

THE IRON AND STEEL INSTITUTE AT MANCHESTER.

The proceedings on Wednesday, the 14th inst., of which we have already published a preliminary report, were concluded by the reading of a paper, by Sir Lowthian Bell, entitled "Notes on the Reduction of Iron Ore in the Blast Furnace," and by the opening of a discussion thereon.

Sir Lowthian Bell prepared his paper as a more ample reply to the following question, addressed to him at the last meeting by Mr. Windsor Richards, during the discussion of Mr. Potter's paper on the performance of the Chicago blast furnaces:—"How does it happen that when we in Cleveland increase the driving of a furnace we waste coke, while at Chicago the very opposite result is obtained?" In the course of his paper, Sir Lowthian Bell remarked that, as the raising of a furnace from 50ft. to 80ft. had proved beneficial, and it was hoped that a similar result would follow further increase, furnaces were built to a height of 103ft. for smelting calcined Cleveland ironstone. He considered, however, that it was useless to raise the height beyond the point required to allow of a practical saturation of the gases with oxygen. This opinion was confirmed by a trial, and also by the working of the 103ft. furnaces, proving that no fuel economy resulted from the additional height. In general terms the answer to Mr. Richards' question was, "In Cleveland the furnaces are driven, having regard to the ore they are using, at a maximum speed, whereas at 1370 tons, or perhaps even at 1510 tons per week, those of Mr. Potter, for the nature of the ores used, are working below this point."

This discussion was resumed on Thursday morning by Professor Watson Smith, of Owen's College, Manchester. He exhibited samples of various residual products derived from blast furnace gases, where coal instead of coke was used for smelting. These included paraffin wax, saccharine, indigo, ammonia, and creosote. A beautiful scarlet dye had also been obtained; and a good deal of amusement was created by the exhibition of a bottle of what appeared to be champagne made from the saccharine product.

Mr. A. H. Allen, of Sheffield, said that Professor Smith had been the first to extract the above products from blast furnace gases. It was noteworthy that they had all been distilled at a low temperature. It was only from furnaces using bituminous coal that such things could be obtained.

After a few remarks from Mr. J. T. Smith, Professor Turner, of Mason's College, Birmingham, said that Professor Richards, of the United States, had learnt a great deal as to the interior working of a blast furnace from a model with a glass front, into which similar materials are slowly fed in at the top and withdrawn at the bottom. He did not see why we in England could not assimilate our practice to that of the Americans, and so increase the output to the 2000 tons per week occasionally obtained by them.

Mr. J. E. Stead, of Middlesbrough, believed that heat passed upwards in slow-driven furnaces, to a large extent, by conduction operating on the materials.

Mr. W. Whitwell was glad to observe that Sir Lowthian Bell now seemed fully to admit the advantage of highly heated blast as a source of saving of fuel. He considered that the height and dimensions of a blast furnace were most important factors in relation to economic working.

A member from the United States said that ease of smelting depended greatly on the nature of the ore used. That from Bilbao was very easy to smelt. The 60 per cent. ore from Lake Superior was easier to smelt than that containing 67 per cent.; and some they had containing from 42 to 45 per cent. was still easier. Their furnaces worked best when one ton of slag was obtained for one ton of iron. Their pressure of blast was often from 9 lb. to 10 lb. per square inch, and heated sufficiently to make the tuyere pipes red hot. The higher the pressure of blast, the more quickly the furnace worked, and the less in proportion was the fuel used.

Mr. Henry Kirk, of Workington, considered that the members of the Institute were too much divided into the purely scientific and the purely practical. The latter could seldom be prevailed upon to give their experience. In his six and a-half years' practical experience as a blast furnace manager, he had been able to reduce the silicon from 2½ per cent. down to under 1 per cent. by constant analysing.

The President said that in the Frodingham district some of the furnaces were 80ft. high. More gain had ensued in raising from 65ft. to 70ft. than from 75ft. to 80ft. With indifferent coke they did better with a furnace 70ft. than with one 80ft. high.

Sir Lowthian Bell, replying on the whole discussion, referred to the question originally put to him by Mr. E. W. Richards. He said that much depended on the quality of ore used. If the latter was such as to admit of speedy reduction, the longer it was kept in the furnace the less would be the economy. Enlarging the Cleveland furnaces had tended to make the descent of the materials slower. He had tested this question by slow driving before he decided on enlarging. He found that the slower he drove the hotter were the escaping gases. There was a proper speed for every furnace, and for each quality of ore used. The pressure of blast must be adapted to the minerals employed, according as they were easy or difficult to pass through. A very high pressure was necessary in America, where anthracite was the fuel used. There was an absolute loss in using blast of a higher pressure than was necessary. Using coal in the furnace amounted to employing the latter partly in doing work which could be better done in a coke oven. In order to work efficiently and economically, for every pound of carbon in the form of carbonic acid in the products of combustion, there should be present 2 lb. of carbon as carbonic oxide. One pound of carbon burnt to carbonic acid produced 4266 calories. When they got 500 calories or 600 calories per pound of air in the blast they could not usefully go beyond, nor could they supplement the heat beneficially if they thereby altered the above relation of carbonic acid to carbonic oxide in the products of combustion. He did not think it possible to go much below 20 cwt. of coke per ton of Cleveland pig iron. Where charcoal was used, as in Styria, and only white iron was made, with scarcely any slag, the fuel could be brought down to 14 cwt. or 15 cwt. per ton of pig iron. He had proved, when in America, that a pound of carbon in charcoal was of precisely the same value as a pound of carbon in coke. He did not think it mattered much what the shape of the interior of a blast furnace was. Every furnace would soon make its lining into the best form for itself. The various shapes which were advocated worked about equally well. The endurance of blast furnace linings, reaching, as it did, thirteen years and even more, was astonishing, considering that a piece of fireclay would dissolve in slag almost like sugar in hot water. He thought it was due to the deposit of carbon on the interior surfaces, forming a protecting covering. It was exceedingly difficult to run a blast furnace for any length of time on white iron. The carbon being deficient in that quality, the furnace lining was rapidly cut away. This confirmed the view he had just stated. With regard to Mr. Kirk's remarks—which Sir Lowthian Bell seemed to take to himself—he said he had twenty-five years' practice before he even ventured to theorise at all.

A paper was next read by Mr. J. Wailes on the "Basic Open Hearth Process," of which we give an abstract.

"In the production of that class of material known as 'mild steel,' the open-hearth process has undoubtedly taken the most prominent position. The reasons for this are matters of common knowledge with most makers and users of steel. The protracted nature of the open-hearth operation affords ample time for careful investigation as the charge is in progress; but perhaps a more potent reason than any, and the one that has drawn the line more absolutely than any other, is that where, as in soft steel, the operation of oxidation has of necessity to be pushed to an extreme limit, and a copious supply of oxidising medium produced, it is better to supply this oxidising medium in its natural and unreduced condition than re-oxidise iron that has been already reduced at the cost of fuel and labour. I say nothing of the effect of extreme oxidation by pneumatic means. These remarks only touch on the verge of a very great question.

"In treating the subject before us, it is obvious that a very wide question is opened, and one with many side issues of great importance—issues that may each form ample and profitable matter for special investigation. It is, however, my purpose simply to describe, as well as I can, general points, and not to follow any particular branch, however interesting. For convenience I will divide my remarks under three principal heads, viz., description of the apparatus, process, and *modus operandi*, and a few remarks on the quality, &c., of the material produced. For the sake of brevity, and, with your permission, euphony, I will call them plant, process, and produce.

"*Plant.*—The special form of apparatus now before you, known as the Batho furnace, has already been described before this Institute by Mr. Dick, on the occasion of the meeting at Chester; and though some detail modifications have been made, it is in the main the same. This modified form of the Siemens furnace was specially designed with a view to ultimate basic working. Generally described, it consists of separate parts, taking the form of independent regenerative stoves and combustion chamber, or melting vessel, the two connected by tubes, the leading idea being to get the melting vessel into as compact and manageable a form as possible.

"*Process.*—Lime linings have so often formed the subject of papers before this and kindred institutions, that it will only be necessary to say that the material composing the basic part of the lining is prepared and treated in the same manner as that for the Bessemer converter. For that part above the slag line, however, an admixture of silica sand to the extent of 8 or 10 per cent. may be used with marked advantage. In the smaller vessels shown, where the side walls are carried to the top, I use fine wire cuttings, mixed with the basic composition, to prevent the material cracking and falling away, much as hair is used in plaster. In the large furnace this device is not necessary, the walls being lower and possessing a natural slope. The silica part of the furnace lining having been built in and dried, the basic portion may be quickly introduced. The most convenient and economical way of doing this is in the form of bricks. I have found 11in. by 4½in. by 3in. a very good size to deal with. These bricks were produced by hydraulic pressure, equal to about 150 tons applied on 11in. by 4½in. of face. Great expenditure of power, moreover, is not necessary—a ton pressure being sufficient to pack the material in the mould, and the final squeeze is easily given by a few strokes of a pump working directly on the ram. The bricks are conveyed at once from the press and placed in the furnace, a very simple operation, requiring only careful ordinary labour. As soon as the lining is complete, gas may be turned on, and full heat obtained as quickly as possible. It is here where the great advantage of this particular form of furnace is apparent. The necessary process of slow annealing in ordinary furnaces is of no consequence in this arrangement. The hearth may be charged on as soon as the full heat is obtained, and in this particular the basic-lined furnace has a great advantage over the acid, where the greater part of a week is required to fuse in a new hearth. A basic-lined hearth having been obtained, a basic slag must always be kept in working. The composition of the iron to be treated will, of course, determine the amount of oxidising base necessary. I have always adopted the plan of charging a large part of the ore and lime in the bottom of the furnace, and the charge on that. Every manager will doubtless establish his own particular mode of treatment. One general point must be observed, however, and that is that the purifying agent should be created as early as possible in the working of the charge. The reasons for this are too obvious to need further enlargement. Perhaps a practical point of the greatest importance is that of preserving the bottom and keeping it in working order. In the case of an acid furnace, dry silica sand is used to repair local damage at the slag line or below the charge; it is placed on the sides of the hearth, and allowed to run down into the bottom, forming a neat slope. Exactly the same thing is done with a basic hearth, the only difference being that the material used is dolomite, either shrunk or in its raw condition. If slight repairs only should be requisite, raw stone will answer well. If of a more extensive nature, it may be necessary to have the stone, in its 'shrunk lime' form, crushed moderately fine; but in either case a percentage of silica sand must be used as a flux—8 to 12 per cent. And just as in the acid furnace a flux is mixed with too refractory silica sand and gradually diminished in quantity as the working pace is reached, so in the same way may the flux be diminished in the dolomite. Rapid working means the rapid production of heat. A furnace may melt slowly and then gradually attain a very full heat, but this does not necessarily mean quick working or economy of fuel; it proves that the furnace is capable of reaching a very high heat, but that slowly. What appears necessary to produce rapid action is a large supply of gas and air, and a tolerably strong chimney draught, so that abundant volumes of flame may be brought to bear on the charge in its earliest stage, and it may be gradually reduced when the charge is melted, when also the gas and air may be reversed at more frequent intervals. Any desired size of gas and air port may be used in the combustion chamber under discussion, and any degree or nature of combustion is simply a question of mechanical detail.

"*Produce.*—The author held that if it is a fact that the basic converter possesses advantages over the acid converter for the production of mild steel, he would say that the basic open-hearth possesses the same advantage over the acid open-hearth, and—save for the presence of eminent open-hearth steel makers—in a more marked degree. A cinder pig iron, containing 15 per cent. of sulphur and 3·75 per cent. of phosphorus, worked with 20 per cent. of ordinary steel or iron scrap, can be converted into good mild steel, so that the effect of an oxidising base applied to metal under high heat may be imagined. Some samples of steel before the audience possess the following mechanical properties:—

Date.	Description.	Dimensions of test piece.				Breaking strain.		Extension.			Fractured area.			Elastic limit.	
		Dia.	Width.	Thickness.	Area.	On piece.	Sq. in.	Limit.	In.	Per cent.	Dimensions.	Area.	Per cent.	On piece.	Sq. in.
1887.						tons.	tons.	in.						tons.	tons.
Sept. 3	¾in. round "steel," 1	·68	—	—	·363	8·45	23·27	8	2·3	28·75	·36 dia.	·1017	71·98	5·7	15·7
Do.	Do. 2	·685	—	—	·368	8·65	23·5	8	2·37	29·63	·4 dia.	·1256	65·86	5·7	15·48
Do.	Do. 3	·685	—	—	·368	8·6	23·36	8	2·42	30·25	·37 dia.	·1075	70·78	5·8	15·76
Do.	Do. 4	·685	—	—	·368	8·55	23·23	8	2·35	29·37	·375 dia.	·1104	70·0	5·6	15·21

The author is indebted to Mr. James Riley for the trouble his assistants have taken in checking and verifying these analyses. It is not always expedient to carry the process of purification to the limit represented by 22 tons tensile strain. Such efforts are sometimes misunderstood by engineers; but the President of this Institute was very near the mark when he named the low tensile strain as the measure of purity."

Mr. Percy C. Gilchrist commenced the discussion on Mr. Wailes' paper by expressing strong approval of the open-hearth furnace he had described, which embodied the patents of Thomas and Gilchrist, Batho, Riley, Dick, and Wailes. He considered it the best furnace of the kind yet produced. The facilities for repairing had been greatly increased. For reasons given in a previous paper, by Mr. Harbord, the elimination of the phosphorus was complete as soon as ever the charge was melted, but usually the latter was not hot enough for pouring until it had remained some time longer in the furnace. Steel produced by the open hearth process was perfectly suitable for being cast into small ingots. He had seen the latter made successfully only 6in. square. There was no question in his mind but that steel made in a basic was softer than that made in an acid-lined furnace, and was also more easily welded. He considered that 2in. or 3in. of chrome ore might usefully be interposed between the acid and basic portions of the lining.

After a question from Mr. E. P. Martin, of Dowlais, Mr. E. Riley, London, said that the steel made from a basic-lined Siemens furnace was decidedly purer than anything which could be made in any other way. There was no difficulty in reducing the phosphorus to ·007 and the sulphur to from ·01 to ·02.

Mr. Alexander Thielen, of Ruhrort, Germany, said that one half of the steel produced at his works was sold in the market as high-class iron. It was exceedingly mild and easily welded, and the consumers did not care to inquire further. Basic-lined Siemens furnaces were largely on the increase in Germany. Of the materials charged 60 to 70 per cent. was usually scrap. The pig iron contained from 2 to 2½ per cent. of phosphorus. It was economical to use as much scrap as possible, because pig iron required more purification than scrap, which meant expenditure of time. He was not in favour of making the top of the furnace movable. Repairs to a basic furnace could be effected more easily than to an acid one. At the same time he had some of the latter, and retained them for the present rather than incur the expense of a change. He regarded the present position of steel furnaces as one of transition. There was no difficulty in Germany in getting shipbuilders to accept basic steel-plates as was the case in England. The real desideratum in finished steel was, he thought, a high elastic limit and a tensile strength equal to that of the best Yorkshire iron.

Mr. G. J. Snelus, Workington, approved generally of the furnace described by Mr. Wailes, but not of the plan of making the roof movable. He said that hitherto the costliness of the repairs had been the great difficulty in the way of the adoption of basic-lined Siemens furnaces. After three months' wear and tear great expense had been necessary in this way, but this difficulty might now be considered to have been obviated. He said that the plan of using lime mixed with carbon as a material for separating the acid and basic portions of the lining had been used by him years ago. A neutral zone was absolutely necessary, and to effect this he preferred the material described to chrome ore. At Seraing, in Belgium, five charges of six tons each were easily obtained in twenty-four hours by the use of a large percentage of scrap with the hematite pig iron. Such results could not be obtained by the ore process nor with acid-lined furnaces.

Mr. Riley had, he said, obtained a larger production from basic than from acid-lined furnaces of the same size. A silicious cinder had the effect of predisposing iron to oxidation, whereas a calcareous one had the opposite effect. The former was really a silicate of iron, whereas the latter was a ferrate of lime. With a basic-lined opened-hearth furnace purer iron or steel was obtainable than by any other means. He could not understand how it was that Sheffield tool-steel makers continued to import from abroad iron containing ·02 of phosphorus, when they could get much purer material and more cheaply from the basic Siemens furnace. Phosphorus was indeed most poisonous to tool steel, and there was no longer any need for its existence therin.

Mr. Jeremiah Head, Middlesbrough, who was called on by the President to give his views, said he would prefer not to enter into the discussion until certain steel-making plant for which he was responsible had been completed and tested.

Mr. Foster, Jarrow, said that at Messrs. Palmer and Co.'s works the open-hearth furnaces were stopped at 10 p.m. every Saturday, and the next charge was poured into ingots at four o'clock on Monday morning.

A communication was read from Mr. Arthur Cooper, Middlesbrough, in which he said that at the North-Eastern Steel Company's Works steel was being made by the Bessemer basic process, quite as soft as that described by Mr. Wailes.

Mr. J. C. Janson, Darlington, wished to be informed whether there was any clear and definite advantage in a basic, as compared with an acid-lined Siemens furnace, when the materials used were hematite pig iron and scrap.

Mr. Harbord, Bilston, said that the materials charged at the Staffordshire Steel and Ingot Company's works contained on an average 2 per cent. of phosphorus. He would be able to run out the charge in four and a-half to five hours, if he had at his disposal better gas, enabling him to command a higher heat. As it was, he was compelled to keep it in three hours after completion of the melting—that is, eight hours in all. There was a decided advantage in the basic lining under all circumstances. With phosphoric pig it was absolutely essential. Hematite pig usually contained from ·03 to ·04 of phosphorus, which in acid-lined furnaces would increase to ·05 in the steel. To get it down to ·02, which was so desirable, the lining must be basic. There was a great advantage in the use of ferrous oxide, as it existed in best tap cinder, as against ferric oxide. The fettling could be put on the bottom of a basic-lined furnace before charging, but not so in the case of an acid-lined one. This effected a considerable saving in the time of working a charge.

Mr. T. Walker, Leeds, said that certain Italian customers of his put down, under his advice, two basic-lined furnaces of the kind under discussion. The workmen employed in the erection were totally new to the business. Nevertheless, the very first charge resulted in excellent and marketable steel. Representatives of the Bochum Works were consulted, and at first strongly opposed, but afterwards approved and advocated the system. Mr. Walker considered that the basic lined furnace would prove a substitute for the puddling furnace, and would save many ironmaking districts from ruin.

Mr. James Riley said there were many ores containing a percentage of phosphorous in excess of what could be deal with by acid-lined furnaces. Mr. Wailes had worked most persistently at the development of his furnace. At the same time his paper was to be regarded as being rather a suggestion than as a final and complete one.

Mr. Barnett wished to know what degree of impurity in pig iron could be dealt with.

Mr. Hutchinson, Bilston, said that materials, however impure, could be dealt with in a basic Siemens furnace, whether in the form of pig iron or scrap. With material containing originally an average of 2 per cent. of phosphorus, and 1·5 per cent. of silicon; a tensile strain of 25 to 30 tons; and the usual elongation or contraction could be finally obtained. He advocated the use of chrome ore to divide the two kinds of lining.

Mr. Edward Riley said that almost all the ores obtainable in the Southern States of America were such as to produce pig iron containing 0·5 per cent. of phosphorus. There were enormous deposits of them, and the pig iron derived from them could only be utilised for steel by treating it in the way under discussion.

Mr. J. C. Janson wished to know if steel suitable for Lloyd's and Board of Trade tests could be made in a basic-lined furnace.

The President said that Lloyd's Committee and the Board of Trade were both now considering the advisability of modifying their tests. After the Tay Bridge accident, he had himself made some tests on ordinary bar iron. He found that whereas lengthwise of the grain he could easily get 22 tons per square inch, he could not get more than 8 tons across. At Woolwich they had found that they could not rely on more than 12 tons per square inch across the grain in the iron they used for gun coils. Steel gave the same tensile strengths both ways of the grain. He had long kept a record of the quality of steel supplied to him by various makers. The best was produced by a Scotch house, but an English house came close up to it. For good welding steel there should not be so much sulphur as had been spoken of in the paper.

Mr. T. Hugh Bell read the translation of a communication from M. Pourcel, the object of which was to give an account of the performance of a furnace worked by him at Terre Noir in November, 1879, but as the communication will be printed in the journal it is not necessary to notice it further here.

Mr. John Gjers, Middlesbrough, inquired why Mr. Wailes used such wretchedly impure pig iron.

Sir Lowthian Bell said that any Siemens furnace might be lined with acid or basic material. It was not difficult to remove the first, but only the final portions of phosphorus from the charge. He could not understand why ferrous oxide should be better than ferric oxide in a fettling. It was the oxygen in these substances that did the work, and the latter contained more of that element than the former.

Mr. Gilchrist explained that the fettling in use at the Staffordshire Steel and Ingot Company's Works was best mill tap cinder from a re-heating furnace with a cinder bottom; 20 per cent. of this material was ferrous and the remainder ferric oxide.

Mr. Wailes in reply said that as manager for a company he could not be expected to give full details of his working practice. He was making ingots as small as 6in. or 7in. square for rolling into bars. The product was more ductile than anything from an acid-lined furnace. There was no occasion for excessively large ingots. He purposely gave the results obtained from the worst pigs he used, to show the capabilities of the furnace. He considered that ·08 of sulphur was too large a proportion in finished steel. He could easily get rid of it, to a much greater extent than that, by the use of oxide of manganese, but sulphur in soft steel was not so detrimental to welding as it was in hard steel. He considered the use of chrome ore quite unnecessary, as the carbon compound described was as good and cheaper. There was no difficulty in making joints from the outside of the furnace. Naturally pig iron used would be the best obtainable, but the very commonest could be utilised. The phosphorus was easier of elimination than the carbon. A basic lining could certainly be adapted to an ordinary Siemens furnace, but in that case if very poor pig iron was used, there would be trouble to effect the necessary repairs, as they could only be done from the inside. The furnace would be a "Godsend" to ironmakers, who would be able again to compete with the big steel makers. Given an equal sized acid and basic-lined furnace, with the same materials, the best yield would be obtained from the latter. The furnace was simple, cheap, and easy to get at from the outside. To the pure steel produced by it any element might be afterwards added, so as to produce Lloyd's tests or any others.

The President moved a vote of thanks to Mr. Wailes, which was carried by acclamation. He considered the furnace described would be a death blow to the puddling system, and would once again bring the old ironworks of the country to the front in opposition to the more modern and larger steel works.

The next paper read was that by Professor J. A. Fleming, of London, on "Electric Lighting in Works and Factories." There was only a slight discussion on this, in which Mr. E. H. Carbutt, Mr. Matthieson, Mr. Aspinall, and Mr. H. Bauerman took part.

Mr. Wheelock, of the United States, in a humourous speech, said he hoped that the Institute would see their way to visit America at an early date, and assured them of a hearty welcome there.

The proceedings were concluded with various votes of thanks, including one to the President.

A ship canal from the Thames, near Woolwich and the Albert Docks, to Newhaven, is proposed by Mr. H. W. Grylls, and the proposal is said to be received with favour. The country to be passed through is supposed to be easy and not costly, but no surveys have been made.

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

(*From our own Correspondent.*)

'Change in Wolverhampton yesterday and in Birmingham to-day—Thursday—was marked by a continued accession of finished iron orders. The home demand has slightly relaxed for the moment in some branches by the approaching end of the quarter, when consumers generally deem it inexpedient to enter into large purchases. There is, however, no diminution in the number of shipping orders coming to hand, and this is the source from which certain of the mills and forges are now receiving work in the largest bulk.

Execution is especially urgent on account of Canada and Russia and other Northern markets. Business with the latter country will close about the end of October, but with Canada makers have a further extension of time in which to complete their orders of several weeks. Being so near to the end of the season, the works are being put to their full capacity. Several additional Canadian orders have within the past few days been received.

The October quarterly meetings to be held three weeks hence are expected to reflect trade in a more favourable light than they have done for some time past. The October meeting is the time when any advance in marked bars is usually declared, and that class of finished iron is at the moment unusually brisk. Sheets stand in an excellent position, and it is expected that the quarterly meetings will lead to important results in this branch. At present some of the leading makers who are booked heavily forward decline to entertain business except at an advance upon current rates.

A good demand at the quarterly meetings is also confidently predicted for steel. The material is gaining increased favour for constructive work, and the steel works are already receiving large inquiries from engineers and others who formerly regarded the basic steel of the district with distrust.

The United States continues an encouraging consumer for finished iron, especially sheets, tin-plates, and baling hoops. There is some speculation as to whether this demand will be permanent, but as regards baling hoops the period of shipment will shortly draw to a close.

Black sheets are quoted at £6 to £6 5s. strong, for singles; £6 7s. 6d. to £6 10s. for doubles; and £7 7s. 6d. to £7 10s. for lattens. The advanced price for doubles and trebles, which was quoted by leading makers a fortnight ago, has now become more normal, and it is not improbable that it will soon become a recognised standard. Considerable activity is observable at the galvanising works, from whence shipments are being made with a good deal of freedom. The basis price of £10 per ton for 26 gauge, f.o.b. Liverpool, is maintained, but makers, as a rule, are not at all strict in adhering to any definite basis.

The makers of best thin sheets are doing quite a brisk business on account of Canada, Russia, and other northern ports. Some makers declare that they are getting better prices than recently by fully 5s. per ton, and that on some occasional contracts they are securing a 10s. advance upon the quotation of three months back. Consumers are, however, reluctant to give any advance in the general way of business, and these advances must be regarded as rather exceptional.

The quotation for marked bars is strong on the basis of £7. Second-class branded qualities are £6; merchant bars, £5 10s.; and common about £5. Rather higher prices are occasionally received for common bars, especially by makers who do shipping business. These announce that they are freely obtaining from £5 12s. 6d. to £5 15s. per ton f.o.b. London. These prices, however, have to compete with the Welsh prices of bars, which are much lower.

A good call for hoops is being received from South America, India, and the Colonies. Good qualities are quoted at £5 7s. 6d. at works, or £6 per ton f.o.b. London; but inferior sorts are selling at £5 15s. f.o.b. Thames. Strips are in good request, gas tube qualities being £4 17s. 6d.

The bar and hoop makers are in receipt of decidedly more numerous enquiries, this being the season when much urgency is given to orders for European markets. Vendors of pigs experience a better enquiry for some descriptions, especially for imported Midland brands. Heavy deliveries have, however, yet to be made under contracts negotiated a few months ago. Prices are this week quoted up by some sellers, with the object of feeling the market, 1s. per ton. Northamptons are now quoted 36s. to 36s. 6d., to stations in this district; Derbyshires 37s.; and Lincolnshires 40s. to 41s. Native pigs have not yet participated in this strengthening tendency. The blowing-in of one or two furnaces is said to be in contemplation. All-mine pigs are 50s. to 52s. 6d.; part mines, 40s. to 42s. 6d.; and common, 30s. to 31s. 6d. Ulverstone hematites have advanced on the quarter 1s. 3d. per ton, No. 4 forge now being 54s., delivered here. At the January quarterly meetings the price was 57s. 6d. Other hematites are in proportion.

The attempt which was made in Birmingham last week to sell by public auction the extensive Bromford Ironworks, until lately carried on by Messrs. John Daws and Sons, was unsuccessful. There was a fair attendance of South Staffordshire ironmasters and others. Bidding began at £5000, and advanced slowly to £11,000, when, the upset price being £15,000, the property was withdrawn. An attempt will be made to sell it privately. The loose stock fetched unusually good prices.

In the Birmingham hardware trades shipping orders—which are still fairly abundant from South America, parts of Australia, the United States, and the Cape—run largely upon railway material, constructive ironwork, fencing wire, and roofing iron. Wrought iron, hollow ware, and iron tubes are also rather in brisk request for the South American markets and Australia, and machinery is going in considerable quantities to all our leading export markets, including Germany, Holland, France, and the United States. With India the most important part of our trade is in railway material and bridge work.

The paralysis of the hand-wrought nail industry, consequent on the strike of some 15,000 operatives for a return to the higher wages of 1879, is imparting a stimulus to the demand for the better kinds of machine-made or cut nails, and especially steel nails. Productive power in this branch, however, is not yet fully employed, and underselling is consequently rife. In wire nails there is a fair business doing in the Midlands, but the export trade is mainly in the hands of the Belgian and German manufacturers.

During a recent visit to Wolverhampton, following on his visit to Birmingham, Sir Salar Jung was conducted over several works, including those of the Corrugated Iron Company and of Messrs. T. and C. Clark and Co. At the works of Messrs. Elwell and Parker, electricians, Sir Salar Jung was shown the manufacture of dynamos, one of which, when completed, will be capable of driving twenty-five tramcars, to be constructed for service in a town in the north of Ireland.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business in the iron trade of this district remains in a dull, depressed condition, with a continued absence in the outlook for the future of any encouraging feature indicative of probable early improvement. The iron-using branches of industry show no present development of activity, nor is there the prospect of work coming forward likely to lead to an enlarged consumption of the raw material. Shipments have been tolerably large, and in this direction producers have found a means of disposing of a large quantity of their output; but in these there will necessarily soon be a considerable falling off, and discouraging prospects are presented for the ensuing winter. In the steel trade, however, general activity is still maintained, and in the introduction of steel for an almost endless variety of purposes for which iron was previously used, there is a steadily increasing displacement of iron, which no doubt largely accounts for the present depression in this branch of industry. But even the rapidly expanding requirements of the steel trade are being more than anticipated by the increased development in the output of hematite, and in this branch of trade over-production is already becoming almost as serious a question as in the common pig iron trade. In fact, the readily available means of production in all branches of the iron trade are so much in excess, not only of present but of prospective requirements, that there seems a more or less general disposition to regard the future with despondency, and to look upon a long period of unremunerative trade as inevitable unless a remedy can be provided in a permanent contraction of the output to something like the level of the legitimate wants of trade.

The iron market at Manchester, on Tuesday, was much of a repetition of the dull, inanimate markets which have been held for some time time past. There was a fairly good attendance, but business all through was extremely slow with, if anything, a weaker tone in prices. In pig iron the business doing continues of a hand-to-mouth character, buyers in most cases preferring to wait, in the expectation that as there is no indication of any upward movement in values, any change that does occur in the market is more likely to be in their favour than against them, and the transactions which are put through are, as a rule, of the most limited possible dimensions. Prices are not quotably any lower, but the tone is easier, sellers having in most cases to meet buyers with some concession before they can secure orders. Lancashire makers still quote 38s. 6d. to 39s. 6d., less 2½, for forge and foundry qualities delivered equal to Manchester, but these figures are simply nominal so far as the open market is concerned, and the business doing in local brands continues extremely small. For district brands, quotations remain at about 36s. 6d. and 37s. for forge, and 37s. to 37s. 6d. for foundry Lincolnshire, and about 40s. for foundry Derbyshire, less 2½, delivered equal to Manchester, with a small business doing in foundry numbers, chiefly Lincolnshire; but it is exceptional where more than the minimum quoted price is being got. Outside brands offering here, such as Middlesbrough, have been rather weaker, but makers generally still hold to 42s. 10d., net cash, as their minimum for good named foundry qualities delivered equal to Manchester; in Scotch iron, although makers profess to hold to their quoted rates, the actual selling prices reported in the open market continue very irregular, and there is iron offering at considerably under some of the makers' nominal quotations.

In some quarters a rather stronger tone is reported in hematites, but for this I have not been able to gather any satisfactory explanation, unless it is due to the recent advance in freights and the price of ore. So far as the actual condition of the market is concerned, there is nothing to indicate any actual improvement in trade; supplies continue plentiful, with only a small business doing, and although makers hold to 53s. and 53s. 6d., less 2½, as their quoted rates, there are still sellers prepared to take 6d. to 1s. per ton under these figures.

In the manufactured iron trade shipping orders are still keeping most of the makers fairly employed, but for inland requirements the demand continues very poor, and the prospects of trade after the close of the usual shipping season are anything but encouraging. Quoted prices remain at £4 17s. 6d. per ton for bars, £5 5s. for hoops, and £6 7s. 6d. to £6 10s. for sheets, delivered into the Manchester district; and makers are generally firm at these figures, but it is questionable how they will be maintained when they have to rely more entirely upon the home trade than is the case just at present.

The engineering branches of industry, in which some improvement appeared recently to be showing itself, seemed to have again got into a stagnant condition. At any rate, the improvement does not make any progress; there are fair inquiries stirring in some departments, but the actual work resulting is very small, and trade generally is showing no increasing activity. A few concerns engaged on special work are busy, but taking engineers and machinists generally, they are only moderately employed, and very few of them have work of any weight ahead of them. In the matter of prices there is no improvement, as any work there is going continues to be competed for quite as keenly as ever.

The proposals which the employers in the Bolton engineering trades have put forward for submitting the wages question to arbitration as a means of bringing to an end the strike, which has now lasted nearly five months, have, like all previous efforts in the same direction, been altogether futile. As I have pointed out in previous "Notes," the men have been so well backed up by funds to carry on the struggle, that they have assumed the position of dictating to the employers their own conditions as the only terms on which they will consent to arbitration, and these have been so unreasonable, including a stipulation that the imported men, in defiance of all agreements made with them by the employers, should be removed from the works, that it is only too evident the men have no real wish for arbitration at all. The only inference therefore to be drawn is that the men are aware they have taken up a position which they could not maintain before a fair and impartial arbitrator, and their rejection of this means of settling the dispute, which, so far as the question of wages is concerned, has been openly and unreservedly offered to them by the employers, ought to place on the right shoulders the responsibility of the present disastrous strike, which besides crippling both the employers and the men, is ruining the industrial interests of the town for many years to come. The employers have now made their final offer, and as the men who have gone out on strike decline to accept it, they will have to procure the requisite labour elsewhere, and they have a right to demand that the authorities of the town shall afford ample and effective means for protecting the men they engage from the gross intimidation which has been so largely resorted to all through the strike.

The autumn meeting of the Iron and Steel Institute, held in Manchester last week, has been the most successful and the most numerously attended meeting ever held. The papers and the discussion have been important and interesting, whilst the members have had the opportunity of inspecting some of the finest engineering and machine works to be found in the country, and the whole proceedings were brought to a very pleasant close on Saturday by a most enjoyable excursion to Chatsworth, where, after an inspection of the chief features, and the extensive palmhouse and gardens, they were entertained at luncheon, the Marquis of Hartington, in the absence of the Duke of Devonshire, making a special journey over to give them a hearty welcome. The varied and excellent arrangements made by the local committee have given the greatest satisfaction to the members of the Institute, and the visit to Manchester cannot fail to be remembered as one of the most pleasurable in the history of the Society.

In the coal trade there is an improvement in the demand for the better classes of round coal for house-fire consumption, which is now making itself appreciably felt, and here and there collieries have got on to about full time. In other descriptions of fuel, except that perhaps steam and forge coals are moving away more steadily, there is no material change, and beyond a little hardening where sellers have been cutting very low, prices remain without quotable alteration. At the pit mouth best coal averages 8s. 6d. per ton; seconds, 6s. 6d. to 7s.; common coal, 5s. to 5s. 6d.; burgy, 4s. 6d. to 5s.; best slack, 3s. 6d. to 4s.; and common sorts, 2s. 6d. to 3s. per ton.

The shipping trade is extremely quiet, with very low prices ruling at the ports on the Mersey, good ordinary steam coal being obtainable at 6s. 6d. to 6s. 9d. per ton, delivered at the high level, Liverpool, or the Garston Docks.

Barrow.—Much satisfaction is felt in the Furness and Cumberland district at the prospect there is of a very much better business in hematite iron ore than that which is experienced at present. It is generally understood that the mines in Spain, which of late years have been the great competitors of this district in hematite iron ore, cannot possibly continue to yield the large bulk of ore which at present is shipped to this country for more than about a couple of years. The best ores at Bilbao are near the port, and can be wrought and shipped as cargo in a comparatively short time and at a small cost. The freights on ore are low, and Spanish hematite can at present be shipped to British ports so as to enable its being sold at practically the same price as the native ores, which are now quoted at from 8s. 6d. to 11s. 6d. per ton, according to quality. Hematite ores in the North-West of England generally contain a higher percentage of ore than Spanish descriptions; but nevertheless, the Spanish trade has very seriously affected local raisers of ore, and in many cases mines were closed, owing to the absence of profit in working them. It is now noticed that at several mines where nothing has been done for some time preparations are being made to re-start them, in anticipation of higher prices being obtained for ore. There seems every reason to believe this will be the case, and that at no distant date there will be a very considerable demand for hematite. This is all the more assured because of the fact that, with the exception of the mines in Spain, there are no other deposits of hematite ore of any value, or which would pay for their working. The demand for pig iron remains quiet, and sales show a falling off as compared with the trade done a month ago. The demand is more for forward deliveries than for prompt deliveries, but in the meantime makers are well sold forward. Prices are a shade lower, parcels of Bessemer iron in mixed numbers being quoted at 45s. per ton net f.o.b. There is a good demand for steel rails, and prices are quoted firmly at £4 6s. per ton net f.o.b. for ordinary heavy sections. There is not a large trade doing in other sorts of steel. Shipbuilders and engineers have booked no new orders, but the inquiry is very good. Finished ironworkers are not above half employed. Coal and coke are in steady demand at full prices. There is every prospect of an improved request and better prices during the winter months.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

A few indications of improvement in the iron trade present themselves, though quotations keep very low and business is dull. The Sheepbridge Coal and Iron Company has lit an additional blast during the year, and the directors hope to be able to sanction the blowing-in of another at an early date. This company, in presenting its annual report, states that the figures, when compared with the corresponding items of the preceding year, all show an improvement, and those setting forth the increase of gross profits, and consequent large diminution of net loss, are regarded as particularly encouraging. It is stated that these better results are due, to some extent, to the economies referred to in last year's report, and also to the slight improvement in the demand for pig iron and its selling price, which occurred at the beginning of the present year, establishing conclusively the statements which were made to the shareholders at the last annual meeting, viz., that a small permanent improvement in the prices of coal and iron would at once place the company in a very satisfactory condition.

The Council of the Yorkshire Miners' Association have held an important meeting at Barnsley. Delegates attended from the principal collieries in South and West Yorkshire. The question of international arbitration was considered, and a resolution adopted in its favour, the Council also authorising Mr. Benjamin Pickard, M.P., to proceed with a deputation to America, to present an address to the President and Congress of the United States, urging the Congress to take the necessary steps for concluding such a treaty with the Government of Great Britain. The Council unanimously resolved to send Messrs. J. Frith and W. Parrott to a conference to be held at Edinburgh, for the purpose of considering the question of shorter hours for miners working underground, and the desirability of restricting the output of coal. The subjects set down for discussion at the conference are—(1) the best means to be adopted to limit the output of coal; (2) the advisability of all men being idle a certain portion of their time each fortnight; (3) the question of a national federation; (4) the desirability of seeking an Act of Parliament to make eight hours per day the working hours of miners underground; (5) consideration of the Lords' amendments to the Mines Bill. It is expected that the Edinburgh conference will be representative of the colliery industry of the United Kingdom.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The Cleveland iron market held at Middlesbrough on Tuesday last, was fairly well attended, but the tone was very far from satisfactory. There was scarcely any inquiry for pig iron of any quality or any brand, and, indeed, general stagnation prevailed. The tendency towards lower prices, itself the effect of depression, became the cause of a further aggravation thereof. Buyers held off, and sellers increased in number and in eagerness to realise. Notwithstanding this, the deliveries against old contracts continue heavy, no less than 50,502 tons having been shipped from the Tees between the 1st and the 19th of September inclusive. This return exceeds that of last month by 8700 tons, and, indeed, it has not been equalled any month since May. If exports continue at the same rate it is tolerably certain that stocks will not be found to have increased at the end of the present month, as they did in August and July. The price current for No. 3, g.m.b., is now 34s. for prompt delivery. For forward no buyers are prepared to operate at all. Towards the end of the market the price had fallen by 1½d. per ton.

Stevenson, Jaques, and Co.'s current quotations are:—"Acklam hematite," (mixed nos.), 45s. per ton; "Acklam Yorkshire," (Cleveland) No. 3, 35s. per ton; "Acklam basic," 36s. per ton; refined iron, 48s. to 63s. per ton, net cash at furnaces.

Warrants have given way considerably, in sympathy with makers' iron, and 33s. 6d. is the utmost now obtainable. For forge iron the demand is anything but brisk, depending as it does upon the finished iron trade. Its present value may be taken at 32s. per ton at makers' works. Founders complain loudly of slackness, their outputs tending to diminish week by week, with no present prospect of a turn of the tide. Finished iron makers have great difficulty in securing sufficient orders to keep their works in operation, and indeed some of them are working short time. Ship plates are quoted at £4 10s. per ton, bars the same, and angles at £4 5s., in trucks at makers' works, less 2½ per cent. discount. Steel works are well employed, with plenty of orders in hand, and numerous inquiries in the market. For rails of heavy section, and in considerable quantity, £4 2s. 6d. at works is the present minimum price. Coal and coke are in somewhat better request, owing to the approach of winter, and of the end of the shipping season.

The recent lamentable accident on board the s.s. Elbe at Stokes Bay has created a profound impression in the North, where several of those concerned are well known. The accident appears to have been of the same character as that by which the late Mr. Thomas Whitwell lost his life some years since at Stockton. It is not generally realised what a perfect death-trap a marine engine room is, if any considerable outburst of steam takes place. The air is soon all expelled, and the poor fellows have nothing left to breathe but scalding hot steam. The channels of exit are always so small and difficult as to be impracticable without plenty of time; and in the struggle for life of a number of men, scalded with heat, blinded with vapour, and suffocated for want of air, they become absolutely unavailable.

The directors of Sir W. G. Armstrong and Co., of the Elswick Works, Newcastle-on-Tyne, have just decided to recommend to their shareholders the payment of the magnificent dividend of 10½ per cent. At a time when the peaceful industries of the country are in few instances in a very thriving condition, it is worth a passing thought to consider how it is that one which depends so largely on bellicose products should be apparently in the heyday of prosperity.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

Last week's improvement in the Glasgow warrant market was not maintained. By the close of the week the prices had fallen away several pence a ton. This week the market has been sluggish. Comparatively little speculative business has been done. Early in the week there was a slight rally in prices in consequence of reports that several fair orders had been received from Canada and the United States, but the prices of warrants again gave way. The past week's pig-iron shipments were rather disappointing, the total being 7136 tons, as compared with 9396 in the same week of 1886. No pigs were despatched to Italy, but of the exports 1673 tons went to the United States, 1070 to Canada, 600 to Belgium, 315 to India, and smaller quantities elsewhere. The coastwise shipments amounted to only 1170 tons. The total Scotch shipments for the year to date are now 280,947 tons, as compared with 286,746 in the same period of last year. Since last report one furnace has been put out of blast at Coltness, and there are now 83 in operation against 78 twelve months ago. The quantity of pigs being sent into the warrant stores is at present very small.

Messrs. William Baird and Co., announced a reduction of 1s. per ton in No. 1 Gartsherrie early in the week. Free on board at Glasgow, Gartsherrie, No. 1, is now quoted at 47s. 3d. per ton; No. 3, 43s. 9d.; Coltness, 53s. 3d. and 44s.; Langloan, 49s. and 45s. 6d.; Summerlee, 51s. and 42s. 9d.; Calder, 48s. and 42s.; Carnbroe, 44s. and 40s.; Clyde, 46s. and 41s.; Monkland, 43s. and 39s.; Govan at Broomielaw, 43s. and 39s.; Shotts at Leith, 48s. 6d. and 45s. 6d.; Glengarnock at Ardrossan, 48s. 6d. and 41s.; Eglinton, 43s. and 39s.; Dalmellington, 43s. 6d. and 39s. 6d.

There is at present a very active inquiry for iron sheets. The rolling mills that produce these in the Lanarkshire district are as busy as they possibly can be, and it was found impossible this week to place some of the orders that came into the market, except on condition that they awaited their turn to be implemented. It is from Italy that the bulk of these orders are coming at present, and they are all wanted in time for shipment, so as to reach Italian ports before the beginning of next year, when the import tariff rates are to be increased.

For common bars there is a good, but not so pressing, an inquiry. The pig iron that is being employed is chiefly Cleveland, and the quantity of Scotch consumed by the malleable makers gets gradually smaller, on account of the price at which it is maintained by the speculative market.

The coal trade is active, and the past week's coal shipments embraced—from Glasgow, 33,572 tons; Greenock, 2318; Ayr, 9574; Irvine, 2661; Troon, 3446; Burntisland, 12,739; Leith, 3495; Grangemouth, 11,341; Bo'ness, 8401; Granton, 1433; Port Glasgow, 300; and Dundee, 559; total, 89,839 tons, as compared with 90,763 in the same week of 1886. There is now a better inquiry for home consumption, both for furnace and household coals. Coalmasters are unwilling to contract for more than a month forward, fearing trouble on the part of the colliers. There is no quotable change in prices.

There was some expectation that the shale miners' strike, which has now continued about two months, would have ended early this week. The miners, however, drew up terms that their employers could not possibly agree with, and so the chance of a settlement was again lost. The condition of the Scotch mineral oil trade is so bad that a rigid economy is absolutely essential, and the companies are at one in the present effort to enforce a reduction of wages.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

So far as prospects go, the total of the foreign coal exports from Wales will not be very different to that of the past year. The third quarter is now coming to an end, and if a little improvement is perceptible—20,000 tons in excess this week of the previous week being recorded—there is a good deal of lost ground to be made up to bring about an average.

It will interest readers to note what was done last year by three of the principal coalowners. The output of the Powells Duffryn was 1,198,312 tons. Messrs. Davis and Sons, of the Ferndale Collieries, came next with 1,031,138 tons, and the Dowlais Iron to close upon one million tons. I only instance these three, but doubtless the Ocean Company could compare with the best, and in the matter of shipping the Messrs. Cory would take a high rank. During last week Newport coasting trade showed a distinct improvement. Swansea was not so good, having a deficiency of fully 10,000 in tonnage to hand, but its exports of coal to some foreign destinations showed well, France taking over 9000 tons. Some large tonnages have to be recorded from Newport this week, one steamer of exceptionally large size being in process of despatch.

There were bad symptoms at Cardiff exchange this week. In no quarter was there any degree of firmness in quotation. Prices were low and the business done was by the acceptance of figures which a few weeks ago would not have been looked at. The quotations this week for best steam are 9s. 3d., 9s. most frequently accepted, but trade has been done for 8s. 9d. and even at 8s. 8d., while coals regarded as of good value have been selling for 8s. and 8s. 3d. per ton. Small steam, as I predicted, is going rapidly down. It dropped from 5s. to 4s. 6d., then to 4s. Still another drop and it was quoted at 3s. 9d., and now sales are carried out for as low as 3s. 6d. In all probability if coalowners continue to accept low prices for large steam, and thus keep up their output, we shall have small at 3s. It is rumoured that quantities have already been disposed of for 3s. 3d.

Rhondda No. 3, though known to be getting rapidly less in its area, is being sold at 8s. That it will remain at this low figure is problematical. For this coal, and the best house coal of the Monmouthshire valleys, a better price may be expected shortly.

A larger bulk of Mynyddyslwyn will be turned out this next quarter if inquiries mean anything, and new fields of operation are worked well.

The steel works are now tolerably busy again, and the tone of trade is better. Demand has something to do with this, but there is another important factor coming into play. The price of foreign ore is rising. Prices have risen 6d. during the last week. The principal ironmasters would seem to have an impression that existing prices will not remain long at the present state, and large cargoes are coming into port. The South Wales Import Company, Ebbw Vale, Tredegar, and Dowlais, figure largely. Prices quoted for Rubio ore are sufficiently tempting even now for brisk business. Prices are, at Newport, 12s. 6d.; Cardiff, 12s. 3d. per ton.

In imports of pig and bar Swansea trade showed that the good tone current in tin-plate yet remains unchanged. Nearly a thousand tons of pig came to hand and over 300 tons steel bar last week. Tin-plate quotations are the same as I have quoted of late. There is no abatement in the eagerness to secure wasters, which are sold at only a shade less than the cheap brands of perfect make. There is little in the market under 13s. Best cokes and Bessemer range between this and 14s., and the best of Siemens command as much as 18s. 6d. The shipments of tin-plate last week from Swansea amounted to 20,678 boxes, and as double that quantity was received from the works, it follows that stocks are increasing. 107,205 boxes now remain in stock, compared with 81,199 the previous Saturday; but as compared with this time last year, stocks are less by 23,000 boxes. The tin-plate trade with America during August showed, in contrast with the trade of August, 1886, an increase of 23 per cent., and prospects, despite failures, &c., are encouraging.

Newport sent away a good mixed cargo this week by the Worcester of 1000 tons of blooms, 900 tons spiegel iron, and 165 tons tin plates. The tin-plate trade of Monmouthshire is improving, and exports going foreign, Buenos Ayres, &c. Large consignments of steel rails, one 2000 tons, left Swansea this week, and judging from the make now going on, the books of the Welsh ironmasters look well.

One good sign of reviving speculation in steamship building and industries connected therewith is to be recorded in connection with Cardiff. A few years ago there were some unfortunate collapses, and the whole thing was overdone. Then the usual result followed, no one could be induced to touch a share in any "boat," no matter who floated it. I see now a new company started, the Kate B. Jones Steamship Company, with some good names connected. The company has been registered with a capital of £23,000 in £100 shares.

I have no good news to record in connection with the Landore strike of steel smelters. Men and masters appear obdurate.

The burning of a petroleum ship in Cardiff lately, suggests the abandonment of all wooden vessels for the carrying oil trade. This was said to be literally soaked with petroleum.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The position of the iron market continues to be favourable. There is a brisk demand for almost every article, and prices tend upwards, and for many an enhancement of price is in immediate prospect. The pig iron market in Silesia is a slight exception, as the demand for it has been somewhat checked, whilst production has increased, but the rolling mills, on the other hand, are extremely well off for orders, and are working away regularly and vigorously. The plate convention has become an accomplished fact, and the sales bureau has resolved to raise the ground price of bars by M. 5 p.t., so that they are now noted M. 132·50 to 135; best quality, 140 to 145; and boiler-plates, 150 to 155; whilst forge pig remains at 47; and foundry, 51 to 54 p.t. The mills are occupied on blooms, billets, bars, sectional iron, girders, and corrugated sheets principally, whilst the bolt and nut factories are all well engaged, as well as foundries and other workshops.

The Rhenish-Westphalian crude iron market increases in firmness, and the activity of last week continues at the furnaces, especially in puddling sorts, which are everywhere in good demand, whether in Westphalia, the Siegerland, or Luxemburg. The production, though larger by far than at this time last year, can scarcely keep pace with the consumption at the rolling mills, and therefore the stocks lying over from last year are gradually melting away, which is fortunate, as the large stock accumulated, especially in the Siegerland, often worked disadvantageously on prices, as may be gathered from the fact that they have risen now M. 8 to 9 p.t. above what they stood at a few months ago.

Under these circumstances the ore trade is naturally active, and prices are slowly rising in company with those of pig iron, so that Luxemburg minette, now going in large lots to Westphalia and Belgium, cost M. 1·88 to 3·30, according to the sort, and the Siegerland brands 9 to 12·90 p.t., on trucks at mines. Spiegel iron is still going abroad in heavy quantities, and keeps firm in price in consequence, and contracts for nearly all the make of forge pig have been made for long terms, even up to the end of the year, so it is difficult at present to purchase, except at an enhanced figure. Foundry pig has not been able to follow, although the foundries and machine shops are much busier than short time back, so the prices have remained stationary, but these are now more willingly paid. Bessemer and basic pig are in full demand just now. Spiegel, with 12 to 13 p.c. Mn. is noted M. 50 to 51, and higher in proportion to its contents of Mn.; best forge sorts, 46·50 to 47; and common, 43 to 44; foundry, 49 to 55; Bessemer, 49 to 51—paid—Luxemburg forge, 34 to 34·50 p.t., free on trucks at works. All the forges and rolling mills, without exception, are now in full activity. The sales bureau prices are readily realised, and it is quite content with the business it has done in the first month of its existence; it does not, however, for the moment intend to raise the prices, as dealers and merchants still hold stocks, but in the end a rise will take place, if no untoward circumstance intervenes. Contracts into 1888 are known to have been closed. Last week at Berlin the preliminary arrangement for a German wrought iron convention, including all the Saar and Mosselle, Silesian, Rhenish-Wesphalian and middle German groups of works, thirty-six of the largest in all, but still not the whole, was concluded, and it is expected that all the formalities will have been soon enough regulated to allow of operations beginning in the first half of October. Girders and heavy plates are in brisk demand at firm prices, and at last it seems probable that those of the latter can be raised. Sheets are also quick of sale, but makers are requiring four to six weeks to execute the orders, as they are so fully booked—a circumstance which has not happened for a long time—so probably prices will be able to be raised, as at present they do not pay. Of wire rods there is little new to report; the demand is satisfactory but not increased. As regards railroad materials there is little change to note. The works are moderately employed on all steel articles. On the 13th inst. the 5100 tons mentioned last week as to be tendered for at Berlin were offered at M. 110, 110·40, and 110·50 p.t. by three Westphalian works, and at 110 and 115·50 by the Ougré and Cockerill Company, respectively, free at Herbesthal, which, of course, was too high against the same prices at the works in Westphalia. These offers were M. 1½ higher than those lately accepted at Bromberg. In Baden the tenders for rails for points were M. 139·50, and for fish-plates, 130·70 p.t. The wagon trade is very flat, only one order for seventy-five covered trucks having been given out this week. The machine tool works are better off for work than for some time past, and prices are more remunerative. Foundries are also better employed, but the prices will not rise in proportion to the raw materials. The State Railway Direction at Berlin gave out on the 9th orders for twelve six-wheeled locomotives. Six firms tendered; the lowest price for each was M. 15,250, and the highest M. 17,500.

The list prices of iron and steel per ton are:—Bars, M. 115; hoops, 125 to 127·50; best boiler plates, 150; sheets, 135 to 140; iron wire rods, 110 to 112; steel ditto, 108 to 110; drawn ditto in iron or steel, 127 to 130; light steel rails, 110.

The average prices of coal in Silesia for the first six months of this year have been M. 3·25, against 3·88 p.t. last year. Westphalian coal costs at present M. 7 to 8 for good furnace; smalls, 2·60 to 3; and furnace coke, 7·60 to 8·40 p.t. As conventions, restriction of output, and the proposition for a common sales bureau have all failed to improve the depressed condition of the coal trade, or to enable the mines to compete in the north and east against English imports, an important industrial of the Ruhr basin, backed by financial supporters of eminence, is purchasing as fast as he can all the bituminous coal mines of the district, so as to form them into one consolidated administration. This has already received the name of the "monopoly company." Time will reveal whether the scheme will answer better. It is a sore subject not being able to compete with England in their own country and in Italy.

The French iron market is as lifeless as ever, and the remark is current at Paris that iron is being given away and not sold. Nominally bars are noted 130f. and girders 120f. p.t., but large concessions on these prices are made, and sales of the latter at 115 and even 110 have been made. In the Haute-Marne and Nord districts things are little better, very few transactions are passing: here and there a work is well employed, whilst the rest complain of want of orders. The Comité des Forges du Nord is to meet at the end of the month to devise means for improving the condition of the trade, but little is expected to result from the meeting. The coal production for the first six months has been 10,278,987 t., the output of the Nord and Pas de Calais having been 2,065,153 t.

The Belgian iron trade remains excellent. The Conference held at Brussels on the 16th inst., by the iron and steel masters, resulted in declaring that in principle a rise in prices must take place, but the extent to which this should be done was postponed to a second meeting. A rise in girders is also to be included in the programme, but rails are to remain as they are.

NEW COMPANIES.

The following companies have just been registered:—

Maentwrog Slate and Slab Quarry Company, Limited.

This company proposes to acquire and work the slab and slate quarries known as the Braichddu Slate and Slab Quarries, but intended to be called the Maentwrog Slate and Slab Quarries, held on lease from the Crown; situate about 200 yards from the Bala and Ffestiniog Railway, in the parishes of Trawnsfynydd and Maentwrog, county of Merioneth, comprising about 227 acres of land, with all the machinery, plant, and buildings thereon. It was registered on the 13th inst., with a capital of £50,000, in £1 shares, with the following as the first subscribers:—

	Shares.
J. Bland, Gresham House, merchant	1
W. Fuller, Cromarty-road, Hornsey Rise	1
*S. White, 47, Lime-street, solicitor	1
*S. W. Davids, Twthill, Carnarvon, quarry proprietor	1
C. S. Johns, 58, Oakfield-road, Clapton, engineer	1
F. A. Ramsey, Ranelagh-road, Ealing, wine and spirit merchant	1
F. A. Williams, 35, Hereford-road, W., librarian	1

The number of directors is not to be less than three, nor more than five; qualification, £250 in shares or stock; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration, but £500 per annum is to be the maximum.

Mansfield Mexican Silver Mine, Limited.

This company was registered on the 14th inst., with a capital of £100,000, in £1 shares, to acquire, work, and develope certain silver and lead mining properties, situate in the Sonora, Mexico, and for such purposes to adopt an agreement of the 28th July, entered into by William Mansfield, of the Douglas County, Kansas, U.S.A., on behalf of the Lawrence and Sonora Milling and Mining Company, and Percy B. Schreibel, of 6, Marlborough-crescent, Bedford Park, W., for this company. The subscribers are:—

	Shares.
A. C. Dockerill, 160, Albion-road, Newington-green, secretary to a company	1
F. J. Lee Smith, Newlands Park, Sydenham	1
R. H. Gould, 11, Great Coram-street, clerk	1
F. Burr, 43, Porson-street, Lewisham, clerk	1
J. A. Ollard, 38, Gracechurch-street, solicitor	1
A. J. Dunn, 23, Applegarth-road, Brook-green, merchant	1
M. Cunningham, 597, Putnam-avenue, Brooklyn, merchant	1

The number of directors is not to be less than three, nor more than nine; the subscribers are to appoint the first and act *ad interim;* remuneration, £150 per annum each, with an additional £100 per annum for the chairman, and a further sum equal to one-tenth of the net profits above the first £20 per cent. made by the company applicable for dividend, but such additional amount is not to exceed a total of £1500 per annum.

Roberts' Capsule Stopper Company, Limited.

Upon terms of an agreement entered into with Edward Arthur Roberts and Frederick Charles Roberts, this company proposes to acquire the following British letters patent for improvements in means or apparatus for corking bottles, and for facilitating the uncorking of the same, viz.:—No. 2089, dated 14th February, 1885; No. 4737, dated 17th April, 1885; and No. 15,015, dated 7th December, 1885. The company was registered on the 9th inst., with a capital of £20,000, in £5 shares, with the following as the first subscribers:—

	Shares.
*E. A. Roberts, 22, Harp-lane, cork merchant	1
*F. C. Roberts, 22, Harp-lane, cork merchant	1
W. H. Tomkins, 59, Mark-lane, clerk	1
J. Richardson, 5, Wroxton-road, Peckham, clerk	1
C. M. Edenborough, 6, Upper Station-road, Church End, Finchley, cork merchant	1
A. M. Simon, Old Trinity House, Water-lane, wine agent	1

The number of directors is not to be less than two, nor more than five; qualification, 20 shares. The company in general meeting will determine remuneration. The first two subscribers are appointed directors.

Sudworth and Company, Limited.

This is the conversion to a company of the business of electricians, mechanical engineers, and manufacturers carried on by Sudworth and Falkenstein, at Falcon Works, Bentham-road, South Hackney. It was registered on the 14th inst., with a capital of £5000, in £1 shares, with the following as first subscribers:—

	Shares.
C. K. Falkenstein, 73, Bentham-road, E., electrical engineer	1
S. Sudworth, 2, Queen Anne-road, South Hackney, electrical engineer	1
H. Rosenheim, 2, Lime-street-square, merchant	1
D. H. Pope, Whetstone, Herts, clerk	1
S. Smiles, 56, Malpas-road, Brockley, clerk	1
W. Brooks, jun., 33, Camden Park-road, N.W., clerk	1
L. H. Rosenheim, 2, Lime-street-square, merchant	1

The vendors are to nominate the first directors, and during their respective lives they are to retain the right to nominate one director. The number of directors is not to be less than two, nor more than five. The company in general meeting will determine remuneration.

Having regard to the frequency of fires in the crowded streets of Hangchow, and the danger to which the goods stored in the imperial manufactures are in consequence exposed, the Superintendent Ch'i-k'o-sên-pu reports that he has purchased out of his own pocket a fire engine of foreign type, and has engaged fifty coolies to work it. The engine will be at the disposal of the city in all cases of fire, and by way of providing for the renewal of the machinery, and the maintenance of the fire brigade, a sum of Tls. 20 per month will be taken from public funds.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

13th September, 1887.

12,358. Dyeing of Yarn, T. Sampson and F. H. Jealous, London.
12,359. Raising and Lowering Window Sashes, B. A. Blackburn, Leytonstone.
12,360. Point Leads, J. Jardine, Nottingham.
12,361. Merry-go-rounds, J. Welburn, Haxby.
12,362. Counter-balancing of Window Sashes, P. Barrett, Keighley.
12,363. Letter-press Printing Machine, S. Brotherhood, Heaton Chapel.
12,364. Rear-driving Safety Bicycles, C. Grant, Bedford.
12,365. Combining Fur, J. Nasmith, Manchester
12,366. Flushing Cisterns, J. Crighton and S. Robertson, Dundee.
12,367. Self-acting Mules, W. Dobson, Manchester.
12,368. Automatic Alarm Valves, J. H. Lynde, S. Walker, and G. Mills, Manchester.
12,369. Multiple Turnover Machines, T. P. Wood, Bristol.
12,370. Garment, G. M. and H. Mawson, Bradford.
12,371. Screw Propellers, G. A. Calvert, Glasgow.
12,372. Automatic Brake for Basinettes, &c., M. Hynes and W. Cavanagh, Manchester.
12,373. Checking the Taking of Money, J. Whittaker, Birmingham.
12,374. Elbow Plates of Rag Engines, J. Brailsford, Sheffield.
12,375. Waist-belting, R. Rees, London.
12,376. Draw-out Slide for Stoves, &c., H. W. Bean, Wellingborough.
12,377. Preventing the Spreading of Fires in Theatres, T. B. Sharp, Smethwick.
12,378. Pneumatic Steel Process, B. H. Thwaite, Liverpool.
12,379. Water-closets, J. and A. Duckett, Burnley.
12,380. Washer for Washing Purposes, W. J. Jones and W. N. Venner, London.
12,381. Mirror or Looking-glass Fixtures, H. Harrison, Leeds.
12,382. Tap for Bottling Purposes, J. O'Sullivan, Burton-on-Trent.
12,383. Protecting Gas Piping in Case of Fire, B. F. Cocker, Sheffield.
12,384. Switch and Signal Mechanism, F. H. Treacy, London.
12,385. Calculating Machines, J. D. Burton, Birmingham.
12,386. Automatic Fire-extinguishing Sprinklers, A. A. Tattersall, London.
12,387. Splash Screens, R. W. Brumby and S. Clarke, Sheffield.
12,388. Packing Paste-blacking, E. C. Atkinson, London.
12,389. Ventilating Hats and Helmets, C. Potter, London.
12,390. Governing Dynamo-electric Machines, W. T. Goolden and H. W. Ravenshaw, London.
12,391. Delivery of Prepaid Tramway Tickets, C. H. Bingham, London.
12,392. Disinfection, Gillis van O. de Meyers, London.
12,393. Rolls of Lamp Wick, &c., T. Daniel, London.
12,394. Steam Vessels, S. A. Johnson, London.
12,395. Granulating, &c., Substances, G. Brewer.—(*J. Joly and J. Bochon, Belgium.*)
12,396. Making Leather from Rabbit Skins, J. Pujos, London.
12,397. Warming Rooms, &c., by Hot-water, J. C. Mewburn.—(*T. Sterné, France.*)
12,398. Inhaler, T. F. Edgeworth, London.
12,399. Electrical Hot-air and Vapour Baths, M. Maitland, London.
12,400. Taps for Kegs, &c., J. A. Schofield and J. Brierley, London.
12,401. Drying Machines, J. W. Lord, London.
12,402. Vessels for containing Aerated Liquors in Bulk, R. W. Starkey, London.
12,403. Pencil Holder, C. de Meyer, London.
12,404. Moving or Propelling Toy Horses, &c., J. Watterworth, London.
12,405. Button-hole Sewing Machines, W. Norris, London.
12,406. Electrical Type-writers, A. J. Boult.—(*J. F. McLaughlin, United States.*)
12,407. Mincing or Finely Cut Meat, J. C. Plimpton. (*O. D. Woodruff, United States.*)
12,408. Digging Potatoes, J. Holt, Liverpool.
12,409. Cutting or Stamping Presses, W. Bridgewater, London.
12,410. Flap Valve Pumps, J. O. Lundberg, Liverpool.
12,411. Tobacco Pipes, &c., A. J. Boult.—(*C. L. Clarke and C. J. Crowley, Canada.*)
12,412. Soap Tablets, W. L. Byers, London.
12,413. Velocipedes, F. Wilkins, London.
12,414. Electric Arc Lamps, F. C. Phillips and H. E. Harrison, London.
12,415. Electric Switches, F. C. Phillips and H. E. Harrison, London.
12,416. Impregnating Pulverulent Substances with Volatile Essences, L. Teltscher, London.
12,417. Stuff-chests for Paper-making Machines, R. Smith, Canada.
12,418. Conveying Electric Energy, S. Z. de Ferranti, London.
12,419. Electric Railways, S. Z. de Ferranti, London.
12,420. Corrugated Sheet Metal Roofs, G. Paxton, jun., Glasgow.
12,421. Spark Arresters, J. M. C. Tyner, London.
12,422. Dies for Swaging Spoon and Fork Blanks, C. A. Hamilton, London.
12,423. Spooling or Winding Machines, A. W. Mathewson, London
12,424. Explosive Compounds, E. D. Müller, London.
12,425. Freeing Air from Dust, &c., H. Seck, London.
12,426. Spiral Supporter for Plants, T. L. Towler, London.
12,427. Weighing Machines, I. F. Clasen, London.
12,428. Covered Buttons, A. Brand, London.
12,429. Lamps, E. S. Baldwin.—(*I. de Zouch, New Zealand.*)
12,430. Induration of Articles made of Wood Pulp, &c., H. H. Lake.—(*Governor P. C. Cheney, United States.*)
12,431. Treatment of Cocoa, H. Stollwerck and L. Stollwerck, London.
12,432. Motor Engines, W. D. Priestman and S. Priestman, London.
12,433. Blower or Smoke Exhauster, F. C. Alford, London.
12,434. Ventilator, F. C. Alford, London.
12,435. Impact Tool for Dental Purposes, W. W. Horn.—(*J. F. Clement, United States*) [Received 13th September, 1887. Antedated 14th February, A.D. 1887. Under International Convention.]

14th September, 1887.

12,436. Combing Grates for Beaters, W. Brierley.—(*H. Franck and C. S. Colat, Belgium.*)
12,437. Electric Lighting, R. E. B. Crompton and J. Swinburne, Chelmsford.
12,438. Buckles and Fastenings for Braces, &c., C. N. Eyland, Birmingham.
12,439. Safety Exit Apparatus for Theatres, &c., J. Adams, Dawlish.
12,440. Fire Escapes, B. W. H. Brameld, Manchester.
12,441. Napping, &c., Felt Hat Bodies, G. Atherton, Manchester.
12,442. Driving Mechanism for Carding Engines, B. Ormerod and G. Haworth, Manchester.
12,443. Rotary Washing Machine, S. Woodall, Dudley.
12,444. Producing Fancy Figured Wooden Plates, R. Himmel, Germany.
12,445. Stamping, &c., Parts of Sheet Metal Trunks, T. Blackburn, G. Hinchliffe, G. Arrundale, and J. Crawshaw, Bradford.
12,446. Mercurial Electric Commutator for Railway Semaphore Signal Repeaters, A. Morrison, Aberdeen.
12,447. Making, &c., Flocks, R. Ellis and A. Longfellow, Halifax.
12,448. Rotary Engine worked by Steam, Air, or Water Pressure, A. J. Bateman, Charlton.
12,449. Pocket Telescope and Case, E. J. Trevitt, Birmingham.
12,450. Ships' Globe Lanterns or Lamps, G. Moss, Birmingham.
12,451. Treating Anthracite Coal, J. T. Williams, London.
12 452. Solitaire, &c., Fastenings, F. R. Baker, Birmingham.
12,453. Unstoppering of Internally-stoppered Bottles, F. A. Walton, Birmingham.
12,454. Governor, C. L. Hett, Brigg.
12,455. Press, H. W. Lewis, London.
12,456. Electrical Measuring Instruments, W. Hibbert, London.
12,457. Knife-cleaning Apparatus, J. Wilson, Glasgow.
12,458. Treating Residual Spent Iron Liquors, H. Bird, Liverpool.
12,459. Fournisseurs for Hosiery Loom, W. P. Thompson.—(*W. Heidelmann, Germany.*)
12,460. Stop Motions for Looms, W. P. Thompson.—(*W. Heidelmann, Germany.*)
12,461. Discharging Projectiles by Air Pressure, T. Whitaker, Manchester.
12,462. Attaching Pencil to any Fixture, P. Ellis, Wallington.
12,463. Chenille Rugs, J. Lyle, jun., Glasgow.
12,464. Boxes, J. Paton, Glasgow.
12,465. Valve Gear for Engines, J. Spence, Glasgow.
12,466. Locks, R. Hunter, Glasgow.
12,467. Brick-making Machines, A. Winrow and H. R. Tandy, London.
12,468. Saving Life from Fire, W. Boyle, London.
12,469. Balls for Castors, C. Copus and H. D. Booth, London.
12,470. Fuel-feeding Apparatus for Gas Engines, &c., W. S. Windham, London.
12,471. Promoting Circulation of Blood, E. Bluck, London.
12,472. Fire Extincteurs, J. and J. Hall, London.
12,473. Groovings of Wood Blocks for Floors, A. E. H. Harrison, London.
12,474. Novel Non-conducting Fabric, G. H. Herdman, London.
12,475. Apparatus for Writing, J. Hickisson, London.
12,476. Velocipedes, H. S. Cooper, London.
12,477. Printing Presses for Colour, T. D. Worrall, London.
12,478. Evaporator for Freezing Apparatus, A. Feldmann, London.
12,479. Armoured Ships, Sir E. J. Reed, K.C.B., London.
12,480. Tobacco Pouches, J. G. Ingram, London.
12,481. Artificial Fuel for Heating, &c., W. H. Nevill, London.
12,482. Vapour Engines and Generators, K. Bellew, London.
12,483. Disinfectant, J. Bennett, Goole.
12,484. Combined Gas Motor Engine and Raising, &c., Apparatus, F. W. Crossley, London.
12,485. Plastic Compounds, &c., H. Gerike, London.
12,486. Producing Sodium and Potassium, O. M. Thowless, London.
12,487. Velocipedes, W. Fisher and E. Redman, London.
12,488. Ventilating, &c., J. McConnell, London.

15th September, 1887.

12,489. Supports for Cooking Utensils, J. Wilson, Glasgow.
12,490. Adjuster for Wrist Cuffs, F. R. Baker, Birmingham.
12,491. Quadruple Action Lift and Force Pumps, J. Leckie, Gourock.
12,492. Umbrella Holder, S. S. Robertson and W. R. Lester, Glasgow.
12,493. Stay Fasteners, J. Record, Birmingham.
12,494. Venetian Blind Fittings, W. Head, Bournemouth West.
12,495. Kitchen Tables, H. Greaves, Leeds.
12,496. Ovens for Cooking Ranges, H. Greaves, Leeds.
12,497. Opal Glass Plaques, S. G. Mason, Birmingham.
12,498. Bracelets and Bangles, J. Adie and A. Lovekin, Birmingham.
12,499. Silk Wadding, W. Jowett and W. Jubb, Manchester.
12,500. Treating Clay, E., F., and J. Winser, Manchester.
12,501. Furnaces, J. Bancroft and W. Wild, Manchester.
12,502. Printing Textile Fabrics, J. Birtwistle, Manchester.
12,503. Surgical Truss, P. Kirwan, Dublin.
12,504. Files, T. N. Muller, Saltburn-by-the-Sea.
12,505. Milling Cutters, C. Noble, London.
12,506. Destroying Vegetable Matter, J., J. jun., and E. Fitton, Bradford.
12,507. Washing Machines, H. Colburn and J. Ogden, Keighley.
12,508. Lamp Stoves, E. Bowen, Birmingham.
12,509. Water Tube Steam Boilers, C. C. S. Knap, Birmingham.
12,510. Boots, W. H. Stevens, Leicester.
12,511. Magneto Machines, T. F. Walker and J. G. W. Fairbairn, London.
12,512. Dressing the Surface of Biscuits, A. Harvey, Glasgow.
12,513. Excavating Rock under Water, G. Lawson, Glasgow.
12,514. Telegraph Apparatus, F. R. Francis, London.
12,515. Coin Receptacle and Ink Reservoir, S. Maloy-Valdivielso, London.
12,516. Interrupter for Electric Circuits, I. E. Lecoultre, London.
12,517. Draw-bar Apparatus, G. and J. Gaskell, Liverpool.
12,518. Displaying Advertisements, E. J. Barnes, London.
12,519. Producing, &c., Heat, J. Orchard and H. Lane, London.
12,520. Preservation of Food, I. M. Mitchell, Chicago.
12,521. Photographic Films, J. Brown, Kingston-on-Thames.
12,522. Dyeing Wool, &c., T. Skene and L. Devallée, London.
12,523. Protecting Horses' Feet, C. J. Carr, London.
12,524. Cements, G. J. Snelus, W. Whamond, and T. Gibb, London.
12,525. Cements, G. J. Snelus, W. Whamond, and T. Gibb, London.
12,526. Cements, G. J. Snelus, W. Whamond, and T. Gibb, London.
12,527. Metallic Bedsteads, E. Peyton and T. Bourne, London.
12,528. Secondary Batteries, I. A. Timmis, London.
12,529. Toilet Furniture, B. J. B. Mills.—(*J. Peillon and L. G. Brossette, France.*)
12,530. Bottle-washing Machines, A. M. McQuat, London.
12,531. Locking Apparatus for Railway Point and Signal Levers, J. Saxby and J. S. Farmer, London.
12,532. Bolting Machines for Flour, &c., H. Coubrough.—(*G. Summerton, United States.*)
12,533. Supplying Aerated Liquors, R. W. Starkey, London.
12,534. Portable Buildings, W. M. Ducker, London.
12,535. Stretchers for Rowing Boats, C. T. Dennis and A. R. King, London.
12,536. Keyboard, S. E. Hunt, London.
12,537. Protector for Water Gauges of Steam Boilers, G. F. Redfern.—(*F. Schnitzlein, Luxembourg.*)
12,538. Tile-making Machines, G. F. Redfern.—(*M. Dugraro and A. R. Houot, France.*)
12,539. Excluding Draught, &c., from the Bottoms of Doors, G. F. Redfern.—(*C. Watiez, France.*)
12,540. Sodium and Potassium, A. B. Cunningham London.
12,541. Looms for Weaving, E. Casper, London.
12,542. Electrical Storage Batteries, T. C. Lewis London.
12,543. Ends of Braces, J. Morton, Manchester.
12,544. Multiple Expansion Engines, W. Allan, London.
12,545. Slide Valves of Engines, W. Allan, London.
12,546. Glass Annealing Kilns, A. D. Brogan, J French, and J. Craig, London.
12,547. Roundabout Waltzing Machine, A. A. Lippett London.
12,548. Wheels of Velocipedes, &c., T. W. Feeley, London.
12,549. Colouring Matters, H. H. Lake.—(*Wirth and Co., Germany.*)

16th September, 1887.

12,550. Automatic Signalling Apparatus, G. Bell, Sutton Coldfield.
12,551. Buckles, T. Evans, Birmingham.
12,552. Collecting Fares in Vehicles, H. R. Foley and S. F. Pitt, Birmingham.
12,553. Spinning Fibres, E. Tilston and W. H. Nixon, Manchester.
12,554. Lighting Regenerative Gas Lamps, H. Fourness, Manchester.
12,555. Cinder Sifters, T. McGrah, Sheffield.
12,556. Heating, &c., Steam Engines, A. MacLaine, Belfast.
12,557. Gas Pressure Regulator, W. Hargreaves, Bradford.
12,558. Brake Beams for Railway Trucks, W. P. Thompson.—(*W. A. Pungs and F. G. Susemihl, United States.*)
12,559. Tricycles, &c., H. Edwards, Liverpool.
12,560. Incandescent Gas Fires, A. Hill, Birmingham.
12,561. Automatic Brakes, C. H. McEuen.—(*N. Selfe, New South Wales.*)
12,562. Fastenings for Packing Cases, S. W. Suffield, Birmingham.
12,563. Fastening Boots, &c., W. B. Maxfield and G. F. Sturgess, Leicester.
12,564. Velocipedes, M. Woodhead and P. Angois, Nottingham.
12,565. Warp Dressing Machines, A. B. Rowley and J. Fielding, Manchester.
12,566. Pottery Kilns, C. G. Warne, Weston-super-Mare.
12,567. Looms for Weaving, I. Gaunt and M. Stansfield, Bramley.
12,568. Gears for Weaving, I. Gaunt and M. Stansfield, Bramley.
12,569. Operating Pattern Mechanism of Looms, M. Leach, Halifax.
12,570. Connecting Pipes to Water-closets, W. H. Foster, Halifax.
12,571. Machines for Collecting and Separating Dust, F. H. Gottlieb and E. A. Whitehead, Charlton.
12,572. Air-tight Valve, C. Pegg, T. Hunt, and J. Butlin, Chilvers Coton.
12,573. Feed-boxes of Portable Engines, R. Maynard, London.
12,574. Manumotive Force for the Propulsion of Vehicles, G. Quick, London.
12,575. Production of Aluminium, &c., A. Feldmann, London.
12,576. Tool for Spiral Turning, E. Cutlan, London.
12 577. Silver Metal Pointed Unbreakable Eyed Elastic Gum Catheter, C. A. Chapman, London.
12,578. Lids for Culinary Utensils, R. Clayton, London.
12,579. Convertible Cape and Hood, I. Simons, London.
12,580. Chamber Closets, M. E. E. B. von Neergaard, London.
12,581. Drawing on Stone, J. L. Mills, London.
12,582. Velocipedes, D. G. Weston, London.
12,583. Slicing Cucumbers, &c., W. Marsh, London.
12,584. Regulating the Tension on Sewing Machines, W. Stott, London.
12,585. Manufacture of Metallic Pipes, &c., A. Wylie, London.
12,586. Lamps for Velocipedes, R. E. Phillips.—(*A. H. Overman, United States*)
12,587. Match-box Holder, R. Holbrook, London.
12,588. Velocipedes, H. Wilson, London.
12,589. Punching Machines, C. Litchfield, London.
12,590. Shaping, &c., Metals, H. Lane, London.
12,591. Storing, &c., Motive Power, H. Lane, London.
12,592. Vaporisation of Volatile Liquid Hydrocarbons, C. E. Hearson, London.
12,593. Stoppering Bottles, R. Winder, London.
12,594. Regulating Supply of Gas, &c., J. H. Hayes, London.
12,595. Preparing Coffee, W. H. Beck.—(*E. A. Dexmier, France.*)
12,596. Making White, &c., Sugar, C. H. J. Franzen, London.
12,597. Treating Raw, &c., Sugar, C. H. J. Franzen, London.

17th September, 1887.

12,598. Moving the Valves of Ports of Cylinders of Steam Engines, H. W. Pendred, Kilkenny.
12,599. Legging, J. B. Wilkins, London.
12,600. Lamport Hive, J. E. L. Gilbert, Northampton.
12,601. Apparatus for Measuring Anodes, T. Leportier, Liverpool.
12,602. Dyeing Wool, &c., C. T. and H. A. Clegg, and F. Lee, Manchester.
12,603. Fastenings for the Doors of Theatres, &c., W. Baird, Glasgow.
12,604. Combination of Cee Springs in Carriages, C. S. Windover and Co., Huntington.
12,605. Discovery and Remedy of Faults in Pneumatic Tubes, F. B. Welch, Manchester.
12,606. Automatically Shutting Off the Vacuum and Delivering the Carriers from Pneumatic Tubes, F. B. Welch, Manchester.
12,607. Self-winding Clocks, H. N. G. Cobbe, Birmingham.
12,608. Photo Etching, M. M. Scott and T. Scott, jun., Edinburgh.
12,609. Walking Sticks, &c., for Measuring the Height of Horses, &c., H. Bennett, Redcar.
12,610. Ventilation of Hats, T. W. Gorton, Tamworth.
12,611. India-rubber Cover for Bottles, &c., G. A. Cubley and J. Preston, Sheffield.
12,612. Revolving Flats for Carding Engines, T. Forknall, Manchester.
12,613. Applying the Brakes of Trains in Motion, E. Hartmann, London.
12,614. Casement Windows and Doors, J. Hird and J. A. Ford, Glasgow.
12,615. Extinction of Fires, D. B. Adams, Edinburgh.
12,616. Ingot Moulds, J. Thomas, Middlesbrough-on-Tees.
12,617. Rivetting Machine, W. H. Beck.—(*E. Varlet, France.*)
12,618. Combined Door Springs and Pneumatic Checks, P. E. Ayton, Birmingham.
12,619. Radiators for Heating by Steam and Hot Water, J. Jeffreys, London.
12,620. Simultaneously Locking Railway Carriage Doors, S. J. Rofe, Birmingham.
12,621. Combs and Bearers for Lace Machines, J. Jardine and J. Chamberlain, Nottingham.
12,622. Power Looms for Weaving, R. B. Thomson, Glasgow.
12,623. Gas Apparatus for Grilling, &c., D. Cowan, Glasgow.

12,624. ENGRAVING GLASS, &c., L. A. Groth.—(*C. Monchablon, France.*)
12,625. ARTIFICIAL FEET, L. A. Groth.—(*J. Rosenfelder, Germany.*)
12,626. DECOMPOSIBLE BOXES of PASTEBOARD, L. Fink and L. Casper, Germany.
12,627. INTEGRATING the FLOW of LIQUIDS, G. F. Deacon, Liverpool.
12,628. SPINDLES and CAPS for SPINNING and TWISTING FIBRES, S. Littlewood, London.
12,629. CHIMNEYS for TRAMWAY ENGINES, &c., J. Aldworth, London.
12,630. DATE INDICATOR and PAPER WEIGHT, J. Johnson, London.
12,631. REFRIGERATING APPARATUS, O. Imray.—(*La Compagnie Industrielle des Procédés Raoul Pictet, France.*)
12,632. PAINT, J. C. Lyman.—(*J. H. Lyman, United States.*)
12,633. AIR GUNS, L. Poilvache, London.
12,634. FACILITATING READING of MAPS, H. H. Lake.—(*P. R. Morton and C. Durand, France.*)
12,635. ELECTRICITY METERS, W. Lowrie and C. J. Hall, London.
12,636. DISSIPATING ELECTRICITY for PRINTING MACHINES, L. E. Bathrick, London.
12,637. MEAT CUTTER, O. D. Woodruff, London.
12,638. FLOORING for BRIDGE WORK, A. W. Rammage, London.
12,639. BUILDING COMPOSITE BOATS, J. G. H. Hill and J. White, London.
12,640. SELF-LOWERING METALLIC, &c., FIREPROOF SHUTTERS for THEATRES, &c., F. Barnett, London.
12,641. KNITTING MACHINES, F. Mellor, London.
12,642. MAKING PAPER, R. Squire, London.
12,643. CORSET, A. M. Clark.—(*R. Ulrich-Vivien, fils, France.*)
12,644. THEATRICAL PROSCENIUM CURTAINS, F. Piercy, London.
12,645. CARRYING ELECTRICAL BATTERIES, W. D. Sandwell, London.
12,646. HATS, &c., A. C. Barratt and T. H. Embleton, London.
12,647. VELOCIPEDES, G. Barron, London.
12,648. UTILISING GRAVITATION to ACTUATE MACHINERY, J. S. Wallace, London.
12,649. SOLITAIRES, &c., H. Dalgety, London.

19th September, 1887.

12,650. KINDERGARTEN TILES, W. Mills, Liversedge.
12,651. TENNIS RACQUET PRESSES, A. Shaw and A. Shrewsbury, Nottingham.
12,652. RAILWAY CHAIRS, C. J. Morley and R. Turnley, Derby.
12,653. LOCK-NUTS, G. A. Goodwin and W. F. How, Liverpool.
12,654. FASTENERS for WINDOWS and DOORS, H. Lomax, Halifax.
12,655. HOLDING TOP CROSS-BARS on CRUSHING MACHINES, J. Harper, jun., Aberdeen.
12,656. SELF-CLAMPING WINDING HEADS for GUN SIGHTS, C. F. Cooke, Bishophill.
12,657. WORKING and MOULDING DOUGH, J. Beatty and S. Forbes, Belfast.
12,658. TUBE SCRAPERS, R. Howarth, Wolverhampton.
12,659. FOOTBALLS, W. Sykes, Horbury, near Wakefield.
12,660. OPERATING RISING and FALLING BOXES of LOOMS, A. Sowden, Halifax.
12,661. MILLING MACHINES, J. Garvie, jun., London.
12,662. TENTERING MACHINES, A. Shaw, Halifax.
12,663. CHAIN CABLE STOPPERS, R. J. Rae, London.
12,664. TWISTING ROPES, G. H. Holden, Manchester.
12,665. HOLDING UMBRELLAS in SHOPS, J. E. Sheedon, Birmingham.
12,666. ORGANS, G. Fincham, London.
12,667. COLOURING MATTERS, C. S. Bedford, Liverpool.
12,668. LINEAR MEASURING INSTRUMENTS, E. Lyall, London.
12,669. MOUNTING TRANSPARENT PAINTINGS, F. Gill, London.
12,670. MECHANICAL MUSICAL INSTRUMENTS, J. M. Draper, London.
12,671. FIRE-LIGHTER, C. Lamb and A. S. Cohen, London.
12,672. UNITING a SHELL and a SOLID SHOT, W. T. Chamberlain, London.
12,673. TOOTH-BRUSH, W. F. Shields, London.
12,674. SODIUM-AMMONIUM-SULPHITE, W. L. Wise.—(*G. M. Tauber, Saxony.*)
12,675. CORSETS, F. Morris, London.
12,676. DYNAMO-ELECTRIC MOTORS, W. T. Goolden and L. B. Atkinson, London.
12,677. LUBRICATOR, J. Stevenson.—(*C. Anderson, Denmark.*)
12,678. CASTORS, E. Burling, London.
12,679. STORAGE of OILS, T. H. Gittins, Liverpool.
12,680. CUTTING SHAFTS, L. Liebrecht, Liverpool.
12,681. SMALLWARE LOOMS, J. Coackley, London.
12,682. LIFE RAFT, G. Thorne, London.
12,683. SPONGY LEAD, F. M. A. Laurent-Cely, London.
12,684. BILLIARD TABLES, P. A. Staley, London.
12,685. FURNACES, D. Mellor, London.
12,686. PULP, J. Ellis, London.
12,687. PRESSES, A. C. Nagel, R. H. Kaemp, and A. Linnenbrügge, London.
12,688. CLASP STUD for SHIRTS, E. G. Staniforth, London.
12,689. SPRING for VELOCIPEDES, A. Burdess, London.
12,690. PAD OR MAT for COUNTER USE, G. H. Smith, London.
12,691. WINDOW SASH SILENCER, L. G. Chinnery, London.
12,692. COLOURING MATTERS, J. Imray.—(*La Société Anonyme des Matières Colorantes et produits Chimiques de St. Denis, Alcide Francois Poirrier, and Zacharie Roussin, France.*)
12,693. SCUTCHING, &c., FLAX, &c., J. McGrath and E. Manisty, London.
12,694. CABINETS, W. H. Pearse, London.
12,695. CLOSING GATES and DOORS, C. Groombridge, London.
12,696. PETROLEUM ENGINES, G. A. List, V. List, and J. Kosakoff, London.

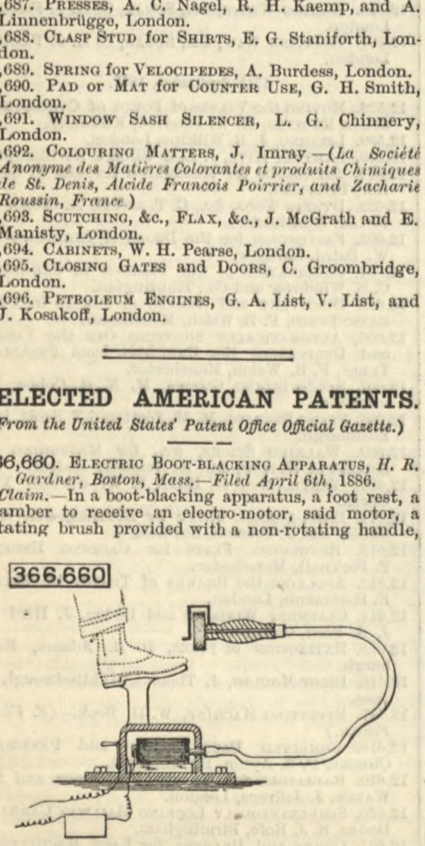
SELECTED AMERICAN PATENTS.

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

366,660. ELECTRIC BOOT-BLACKING APPARATUS, *H. R. Gardner, Boston, Mass.—Filed April 6th*, 1886.

Claim.—In a boot-blacking apparatus, a foot rest, a chamber to receive an electro-motor, said motor, a rotating brush provided with a non-rotating handle,

366,660

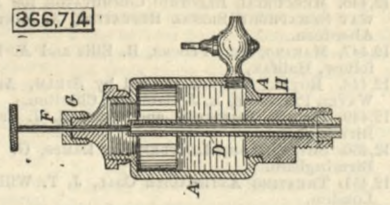


and a flexible rotating shaft connecting said brush with said motor, substantially as described.

366,714. LUBRICATOR FOR STEAM MACHINERY, *G. Z. Clark, Topeka, Kans.—Filed April 16th*, 1887.

Claim.—In a lubricator for steam machinery, the combination, with an oil-cup A, open at both ends and provided with screw-threaded stoppers, of the oil tube D, provided with a collar or enlarged lower end seated

366,714

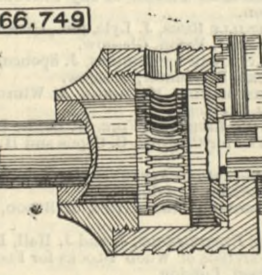


steam-tight upon the plug H, a nut with an opening through it for securing the tube firmly to its seat, the pointed screw pin F, to regulate the flow of oil into the tube D, and the nut G, substantially as set forth.

366,749. LATHE CHUCK, *L. E. Whiton, New London, Conn.—Filed November 17th*, 1886.

Claim.—(1) In a lathe chuck, the combination of a central core provided with a scroll thread and worm teeth and an outer case for carrying the jaws, provided with two or more openings to receive the key, so arranged that the key may be applied to turn the case in either direction with reference to the central core, substantially as described. (2) In a lathe chuck, the combination of a central core provided with worm teeth, an outer case having two or more openings to receive the key, and a key consisting of a screw-

366,749



threaded shaft and handle for turning, all arranged to cause the case to turn in either direction with reference to the central core by means of the key, substantially as described. (3) In combination, a core fitted to be fixed to a mandrel or lathe spindle and engaging with the jaws of a chuck, said core having a series of worm teeth around itself, and a case carrying the jaws, adapted to turn freely on the core, formed to be grasped by the hand for rapid opening and closing and provided with openings whereby a key may be inserted to engage with the worm teeth on the core, all substantially as described.

366,813. GRIPPING IMPLEMENT, *A. E. Brown, Cleveland, Ohio.—Filed March 15th*, 1887.

Claim.—The combination, with a duplex suspender device or double hook-supporter A, of clamping fingers C, formed or provided with means for the

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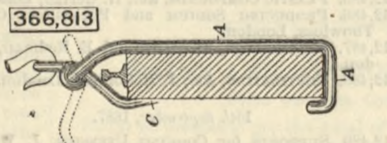
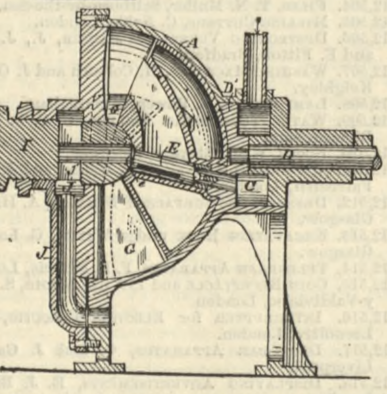


attachment thereto of the hoisting rope or chain, and arranged to co-operate with the upper portions of the hooks A to confine the beam or girder being lifted laterally, all substantially as hereinbefore set forth.

366,894. STEAM ENGINE, *E. S. Smith, Buffalo, N.Y.—Filed January 12th*, 1887.

Claim.—In an engine, the combination, with a casing having the form of a spherical segment, of a similarly-shaped piston filling said case partially and leaving a space for the actuating fluid between the face of the piston and the head of the case, a shaft arranged in line with the axis of the case, and a crank pin connecting said shaft with the piston in the axis of the latter, substantially as set forth. The combination, with the case A, having the form of a spherical segment, of a similarly shaped piston B, arranged obliquely in said case, a chest C, arranged at the convex end of the case A, a shaft D, disc D^1, and hollow wrist pin d^1, arranged in said chest, a

366,894

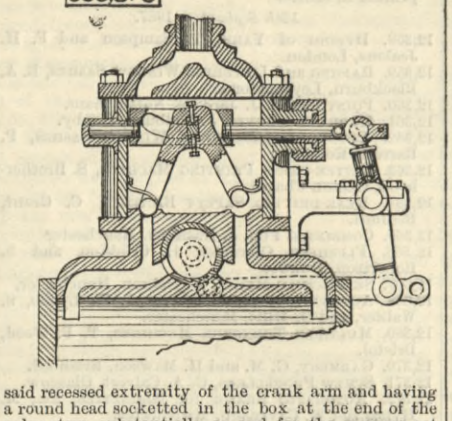


valve E, arranged in said piston and connecting with the hollow wrist pin, and a hollow knuckle I, secured to the case and communicating with said valve, substantially as set forth. The combination, with the case A, having the form of a spherical segment, of a similarly shaped piston B, arranged obliquely in said case and provided in its face with a spherical cavity *e*, and a spherical knuckle I, entering the cavity *e*, and made adjustable in the case toward and from the piston, substantially as set forth. The combination, with the spherical case A, and similarly-shaped piston B, arranged obliquely in said case and provided with a spherical cavity *e*, and a valve communicating therewith, of the knuckle I, provided with a bore *j*, and passages j^1, a chamber J, formed on the case around said knuckle, and a passage J^1, connecting with said chamber, substantially as set forth. The combination, with the spherical case A and the similarly shaped piston B, of movable abutments G, and cylindrical packing strips h^1 bearing against opposite sides of the abutment, substantially as set forth.

366,870. STEAM ENGINE VALVE, *A. J. Peirce, Madison, Wis.—Filed October 14th*, 1886.

Claim.—The combination, with a steam chest, a cylinder provided with suitable ports leading from the chest, and an exhaust valve, of a bifurcated rocker carrying valves for the cylinder ports and having friction rollers journalled to its head, a valve stem having a portion thereof in the form of hollow box, the sides of which are provided with cam slots to engage the friction rollers, and means for actuating said stem, substantially as and for the purpose set forth. The combination, with a steam chest, a cylinder provided with ports leading from the chest, a suitable valve for the cylinder ports, having one end of its stem provided with a box, an exhaust valve operatively connected with a pitman, a crank arm having one extremity thereof provided with a recess and its other extremity pivotted to said pitman, and a pintle loosely fitted in

366,870

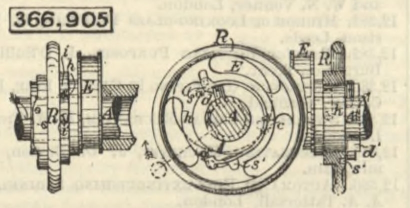


said recessed extremity of the crank arm and having a round head socketted in the box at the end of the valve stem, substantially as and for the purpose set forth.

366,905. REVERSING GEAR FOR ENGINES, *E. H. Whitney, Providence, R.I.—Filed March 22nd*, 1887.

Claim.—(1) The excentric formed with the hub *h*, formed with shoulders *d* d^1 to engage a stop pin on the shaft A, in combination with an operating wheel R, placed upon the hub of the excentric and having a limited independent rotary motion thereon, substantially as described. (2) The excentric E, having a limited independent motion upon the shaft A, in combination with the hand wheel R, connected to the

366,905

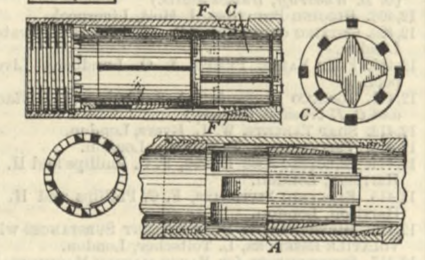


excentric and having a slight rotary motion independent of the excentric, substantially as described. (3) The excentric E, having a limited independent motion upon the shaft A, and a hand wheel R, having a rotary motion independent of the excentric, combined with spring catches *a* a^1, arranged to lock the hand wheel to the shaft, substantially as described. (4) The excentric E, formed with the hub *h* and shoulders *d* d^1, the shaft A, provided with a stop pin P, and the wheel R, placed upon the hub of the excentric and formed with the shoulders *i* i^1 and cams *s* s^1, in combination with the spring catches *a* a^1 and the pin *c*, all arranged to operate substantially as described.

366,914. CORE BREAKER FOR ANNULAR ROCK DRILLS, *A. Ball, Claremont, N.H.—Filed November 13th*, 1886.

Claim.—(1) A core breaking tool the breaking wedges whereof are automatically kept away from contact with the core during the process of drilling by means of a temporary core or latch, but are brought into breaking contact therewith by the core itself when the drill rod is pulled up, substantially as described. (2) In combination with a core barrel and annular drill head, the breaking wedges F and the wedge-driver around which the wedges are free to revolve, and which is adapted to grasp the core, substantially as and for the purpose described. (3) In combination with a core barrel, an intermediate shell A, a wedge-driver, wedges free to act around the same, a jacket or frame provided with grooves, and an annular drill

366,914

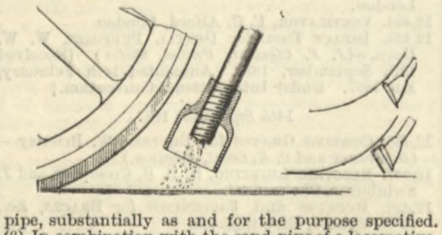


head, also provided with grooves, substantially as and for the purposes described. (4) In combination with an annular drill head and shell, a wedge-driver carrying wedges free to revolve around the same and a temporary core C, substantially as and for the purpose described. (5) In combination with a core barrel, an annular drill head and an intermediate shell, a wedge-driver, wedges free to revolve around said driver, a jacket or frame within which the wedge-driver works, and a spring latch I, substantially as and for the purpose described. (6) The combination, with an annular drill head and shell and a core-lifting device provided with spring clasps for holding the core, of a temporary core, substantially as and for the purposes set forth.

367,062. SAND PIPE FOR LOCOMOTIVES, *D. A. Reagan, Altoona, Pa.—Filed January 26th*, 1887.

Claim.—(1) In combination with the sand pipe of a locomotive, a bell-mouth secured thereto and having its edges curved or grooved, as specified, so as to deflect the water flowing on to it toward its bottom point. (2) In combination with the sand pipe of a locomotive, a bell-mouth secured thereto and projecting over but not coming in contact with the mouth of the sand

367,062

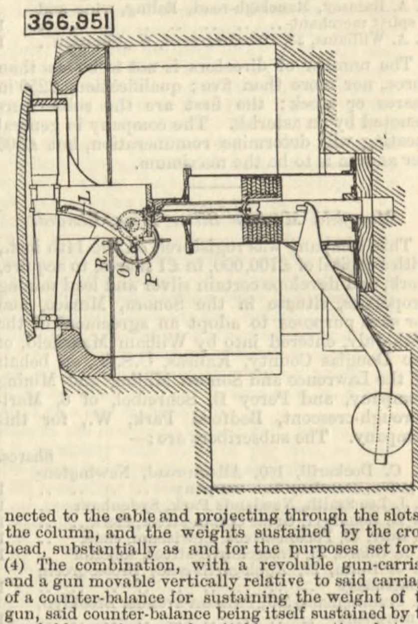


pipe, substantially as and for the purpose specified. (3) In combination with the sand pipe of a locomotive, a bell-mouth secured thereto, and a supplemental shield extending in front of the bell-mouth, as specified, to prevent water from splashing into the sand pipe. (4) In combination with the sand pipe of a locomotive, a bell-mouth secured thereto, projecting over but not touching the mouth of the sand pipe, and having its edges curved or grooved to form a gutter and direct the water to the lowest edge, substantially as and for the purpose specified.

366,951. GUN-CARRIAGE, *H. Gruson, Buckau, near Magdeburg, Prussia, Germany.—Filed January 10th*, 1887.

Claim.—(1) The combination, with an armour ring, of the gun and carriage situated within said ring, a central column by which said carriage is supported and about the axis of which it may be rotated, a lever upon one end of which said column rests, and a counter-balance upon the opposite end of said lever, the fulcrum of the lever being so situated that by depressing its weighted end the muzzle of the gun will be elevated above the armour ring and by elevating it said muzzle will be lowered within said ring, substantially as set forth. (2) The combination, with a revoluble carriage and a gun movable vertically relative thereto, of a counter-balance for sustaining the gun, said counter-balance being sustained by the revoluble carriage and distributed equally on all sides of the centre of motion thereof, so as to avoid lateral strain on the pivot, substantially as set forth. (3) The combination of the gun carriage, the vertical pivot about which it is revoluble, the hollow column supporting said pivot and having the vertical slots in its sides, the gun movable vertically relative to the carriage, the pulley supported by the carriage, the chain or cable passing over said pulley, having suitable connection at one end with the gun and extending at the other down into the hollow supporting column, the crosshead con-

366,951

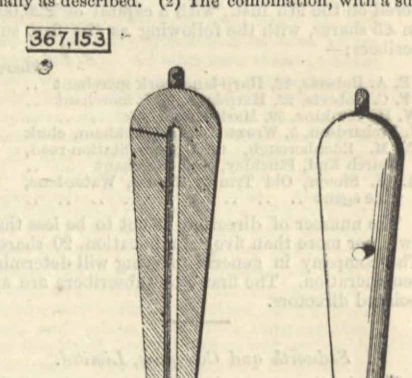


nected to the cable and projecting through the slots in the column, and the weights sustained by the cross-head, substantially as and for the purposes set forth. (4) The combination, with a revoluble gun-carriage and a gun movable vertically relative to said carriage, of a counter-balance for sustaining the weight of the gun, said counter-balance being itself sustained by the revoluble carriage, and suitable connection between the gun and counter-balance passing through the axis of motion of the carriage, substantially as set forth. (5) The combination, with a gun-carriage and a gun movable vertically relative thereto, of a rack bar connected at one end to the gun, a counter-balance having connection with the other end of said rack bar, a pinion engaging with said rack bar, and a hand wheel for turning said pinion, substantially as and for the purpose set forth. (6) The combination, with a gun pivotted forward of its trunnions, of a gun-carriage, the rack bar L having connection at one end with the gun, the pinion P secured to a shaft journalled in the gun-carriage and engaging the teeth of said rack bar, the hand wheel O, secured to the shaft of the pinion, the roller R bearing against the said rack bar on the side opposite the pinion, and the counter-balance having connection with the other end of the rack bar for sustaining the weight of the gun, substantially as set forth.

367,153. SUBMARINE GUN AND PORT THEREFOR, *R. H. Marsh, Cedar Vale, Kans.—Filed July 29th*, 1886.

Claim.—(1) The combination, with a gun, of a gun port, a sliding gate arranged between the inner and outer ends of said gun port, and a pivotted gate arranged to close the inner end of said port, substantially as described. (2) The combination, with a sub-

367,153

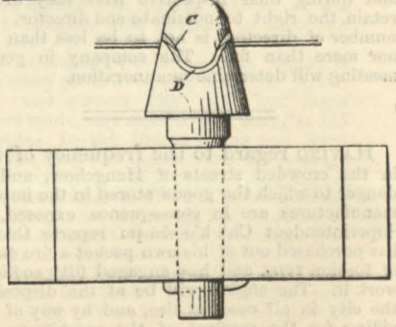


marine gun constructed substantially as described, and provided with a cylindrical portion at the muzzle thereof, and a flange for limiting its outward movement through the port, of a sliding gate *c* and collar c^1, against which the packing adjacent to the flange will abut, substantially as shown, and for the purpose set forth.

367,164. INSULATOR, *H. K. Ruger, Bay St. Louis, Miss.—Filed April 13th*, 1887.

Claim.—An insulator for electric wires, formed wit a U-shaped slot C, having curved or rounding upper and lower surfaces and terminating in vertical slots F

367,164



the bottoms of the slots F being curved or inclined downward and inward to the bottom D of the slot C and said bottom D being inclined downward and out ward, substantially as shown and described.