Genniston Ironworks, of which only a very few are in use in this country, although its immense labour-saving qualities are sure to recommend it for wider adoption. This is Lockwood's automatic leather scouring and setting machine, by the use of which it has been found that the labour of one man per day can be easily exceeded twelve-fold.

Numerous firms exhibit engines of one kind or another, each having features, small or great, which entitle them to separate attention, but which, of course, cannot be treated of here. Amongst these firms we noticed Messrs. Thomas McCulloch and Sons, Kilmarnock; James Black, Auchentoshan; S. Pollock and Sons, Paisley; John Binnie, Glasgow; Alley and MacLellan, Glasgow; Duncan Stewart and Co., Glasgow; Greenwood and Batley, Leeds; Forrest and Welsh, Manchester; Glen and Ross, Glasgow; J. Copeland and Co., Glasgow. Several interesting exhibits of boilers are made, amongst the most noteworthy being a six-horse power vertical boiler, showing Russian practice, by Richard Smith, Moscow, Russia; Babcock and Willcox boiler of 136-horse power, fitted with a chain grate mechanical stoker; Galloway boiler—1875 patent—300 indicated horse-power, suitable for evaporating 6000 lb. of water per hour with about 600 lb. of coal. Messrs. Robey and Co., of Lincoln, show some of their portable engines, and fixed Robey engines and locomotive boiler combined. Several firms show a variety of machine tools, nothing of conspicuous novelty appearing, however, unless we except the patent bevelling machine for angles, tees, and bulbs, shown by Messrs. Davis and Primrose, of Leith, and now gaining entrance into shipyards. There is a large number of exhibitors in the class of machinery used for washing, wringing, mangling, and carpet beating; and the Singer Sewing Machine Company exhibits a variety of its machines at work.

With respect to marine engineering and shipbuilding, the Exhibition does not so fully represent those important industries as the near contiguity of the principal shipbuilding centre in the kingdom would have led one to expect. In fact, so far as England is concerned, the representation is almost *nil*, while even the Clyde and Scotland are but indifferently to the front in these departments. This is doubtless to be accounted for on the grounds of the Liverpool Exhibition being the chiefest attraction for exhibitors in the industries named. Notwithstanding this shortcoming, however, of the Exhibition falling below what one is justified in expecting in an exhibition so near the chief shipbuilding centre, there are exhibits enough to impress one with the progress made in these most important branches of industry. Most of the leading shipbuilders of the Clyde send a selection of models representing their finest vessels.

LETTERS TO THE EDITOR.

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

LONDON SEWAGE.

SIR,—When you referred to the Canvey Island scheme on a former occasion, you were good enough to afford me space for some comments, and as you have treated the matter with perfect fairness in a further article which you published on the 16th inst., I venture to trouble you only with remarks on the general policy involved. I would fain leave the issue between the Metropolitan Board and the complainants, who obtained judgment from the Royal Commission in 1884, to be settled, as I am sure will be the case, in favour of Canvey Island, after a summer, or, at most, two hot years' trial of the experiments arranged by the Board; but experimental expenditure to no purpose, and to the tune of a million pounds or more, must be a serious consideration for the ratepayers, and contracts to a large amount are about to be let for permanent works and plant which will be useless when the extension of outfall recommended by the unfettered advice of Sir Joseph Bazalgette —in his evidence to the Royal Commission—shall eventually have been found indispensable.

In this view, the Works' Committee's report ignoring an offer of Canvey Island, may indeed, as you say, "seem hardly fair" to their constituents, and considering the excessive prices which have necessarily been paid by many towns requiring land for sewage disposal, an offer of undeniably suitable land in sufficient quantity at the low rate of £50 per acre seems hardly one to be rejected without even naming it to their Board.

One would, at any rate, have thought that the idea of discharging the proposed steam barges on the island, and there finally and miraculously disposing of their filthy cargoes, after only one-third of the intended voyage to sea under all the unforeseen conditions of that experiment, might have occurred to some member of the committee, and led to inquiry whether such a convenient graveyard would not be cheap at the price, and so dovetail in with the present views of the Board, independently of any extension of the outfall sewers, which at present they deem unnecessary. Owners of dynamite hulks, which are hardly less objectionable neighbours than sewage works, have long found the creeks of Canvey Island suitable mooring places for their craft, and its insulation, combined with accessibility by land and water, point out this locality as the inevitable destination to which all the nuisances on the narrow reaches of the Thames from Woolwich downwards must eventually gravitate. But there are powerful interests involved in postponing the inevitable move, and in favour of retaining the outfalls in a situation where they serve as the scapegoat for many companies and wealthy individuals polluting air and water, who find it convenient to have their respective nuisances overshadowed and their position defended at the cost of the metropolitan ratepayers, against complainants who might probably attack other nuisances in detail if the more obvious and overpowering one were removed.

Doubtless the Board consider also that any postponement of capital expenditure on a radical remedy must be popular with western and northern ratepayers, who know nothing by actual experience of the state of the river, and do not stop to calculate the probable aggregate of successive charges for litigation and chemical palliatives, which are in one way or other good for trade, while they postpone for a short period a necessary expenditure of capital, however reproductive it would be in the early future; but a voyage down east on a warm day, such as that which entailed a succeeding night's illness upon three out of five Royal Commissioners, might move influential west-enders to sympathy with the inhabitants of Erith, Woolwich, and other riparian places, and the press might do good service by keeping the sufferings of the latter before the public.

Financial considerations are, however, paramount to all others, and we all know how commonly experiments cost much more than the estimates on which they are undertaken; indeed, Mr. Gladstone is just as likely to be able to buy out the Irish landlords for his £50,000,000 as the Board are to keep within treble the total of the modest estimates for experiments at Barking and Crossness submitted by their Works Committee in defiance of the figures computed by a practical man like Mr. Phillips, who has had so much experience in shipping coal, and whose plan has the economical advantage of employing coal barges on their return voyage to Newcastle over the Board's proposal to build a fleet for the special and unremunerative freight of sludge to sea.

In conclusion, may I add to your expression, "the chemical referees, if we may so term them," that it is the first time I ever heard of an appeal lying, from the decision of a judicially constituted body, to referees consisting of three witnesses for the defendant and one member of the jury, together coming to the conclusion that each of the four was wrong in his judicially expressed opinion, and that the defendant can avoid the judgment of the court below by doing something quite different, and observe that you omit the important qualification with which these "referees" open their award, viz.:—"We have, in the first place, to express our regrets that the shortness of time within which it is desired to receive from us an expression of opinion has not allowed of our making such a comprehensive examination of the matter as its importance would have rendered desirable." Is that, I would ask, a satisfactory basis for entering upon an expenditure of a million or so in masonry and permanent plant?

Hafod-y-Wern Farm, ALFRED S. JONES.
Wrexham, April 24th.

PILE DRIVING.

SIR,—Mr. Donaldson's ways with formulæ are past finding out. No one but he would have attempted to calculate results from my formulæ by taking tons as the unit for P and W, and pounds for E. To multiply words on this would be useless. His sophisms about what is the modulus of elasticity are not worth discussion. If he chooses to take two definitions of modulus of elasticity, and apply them both to the same problem, he must expect anomalous formulæ. My use of E did not need definition, being fully in accordance with usual conventional application to cases of strain. The only points I conceive remaining to consider are whether those losses referred to in your editorial article, and which I neglected, such as the generation of heat, and what I may call the precession of strain, would interfere with the accuracy of my formulæ. Concerning the former, there are absolutely no data to go upon, and we are therefore compelled to neglect it. I am inclined to consider, however, that this may be a source of important loss. If we take 2 lb. of a substance of specific heat ·5, and raise its temperature 50 deg. F., we must have expended nearly 17 foot-tons of work. If this has been done in twenty blows, we have lost $\frac{17}{20}$ foot-ton per blow. But I cannot tell how far this is applicable to piles.

I have used the words precession of strain, because if I understand you aright in that part of your article which refers to the transmission of waves of compression, you suggest that work in the monkey may be absorbed by compression of the top of the pile before the reaction from below the pile has had time to come into play. I regret that pressure upon my time is likely to prevent me from entering upon an interesting discussion of this kind at present. It will not suffer by being left to abler pens than mine. I shall feel much interest in reading your own and correspondents' remarks, and shall only regret not being able to join in. I imagine the two cases of rupture named in your article will be found to be considerably divergent from the case of a pile. The bursting of the gun is, I think, not due to the presence of the cork, or a plug of mud, but to the absence of a projectile, or to the projectile not being rammed home. I conceive an explosion to be a central force from which a large number of small particles are ejected at a high velocity in all directions. If there is not at hand close to the centre of force a mass free to move, and thus to absorb the work by acquiring a high velocity in a very short interval of time, the work must expend itself against the envelope or the support of the explosive. If there is no projectile, the explosive may expend itself against the breech before the velocity of the particles has enabled them to travel along the barrel far enough to compress the air to the amount necessary to remove the cork, even if pressure were transmitted instantaneously through the air. SCRUTATOR.

April 26th.

[Guns exploded with the muzzles stopped up have had either a bullet or a charge of shot properly rammed home in them.—ED. E.]

HEATING FEED-WATER AT SEA.

SIR,—Your article on "Heating Feed-water at Sea," which appeared in your issue of the 16th ult., will no doubt be interesting to marine engineers and shipowners, and as this is the first time any paper has attempted giving a common-sense view of the principle involved, and as our system has been mentioned in your article, we think an explanation of the principle will not only be interesting to your readers, but will also serve to correct any erroneous impressions that may have got abroad. The startling results of Mr. Kirkaldy have no place in our experience, for we have had hundreds of boilers fitted and now working where the feed-water is heated directly by the steam in the boiler, the feed heater being put in the steam space; therefore there could be no possibility of loss from radiation such as there is sure to be in the case of the steam pipe leading to the heater and the pipe leading the hot water to the boiler. We were, however, never able to discover either loss or gain.

This system of feeding was applied by us for the purpose of removing the dissolved gases in the feed-water, but as to calling it feed heating we never dreamt of such a thing, for in principle and effect it is the same as supplying the boiler in the usual way; besides, our feed heater never gave any other result than that due to the system, neither better nor worse. Secondary influences have had very considerable effect on reported results, in some cases as high as you mention, in others lower than the actual saving. The variations are traceable to different causes, sometimes to the boilers, sometimes to the condenser.

Before going into the explanation of our system of feed heating, we wish to point out clearly that in generating the power for propelling a steamship two entirely distinct sets of apparatus are engaged—the boiler for producing the steam, and the engine for converting the force of the steam into useful work. The efficiency of a boiler is the amount of water it can evaporate by a given amount of fuel, viz., the pounds of steam per pound of fuel at a given temperature of feed and steam, or, in other words, the units of heat passed out of the boiler with the steam per pound of fuel consumed. The efficiency of an engine is the weight of steam used to exert 1-horse power in a given time between the boiler and the feed-water temperature, or, in other words, the units of heat used per indicated horse-power per minute. The more units of heat passed out of the boiler per pound of fuel the higher the efficiency, and the less units of heat used per indicated horse-power per minute the higher the efficiency, therefore a good engine and a bad boiler may give the same result as a bad engine and a good boiler. It follows, then, that the usual test applied to engines—the pounds of coal consumed per indicated horse-power per hour—gives the combined result not only of the engine and the boiler, but also of the coal.

Our system of feed heating is solely and entirely an improvement on the engine. It increases the efficiency of the engine; in a common compound engine, for example, from 4 to 5 per cent., in triple expansion from 6 to 7 per cent., and in quadruple expansion from 7 to 7½ per cent. The best definition of this principle of feed heating is this—the quantity of steam condensed by the feed-water represents an amount of steam that has been wrought in a theoretically perfect engine. This is the case because after doing work the whole remaining heat, both latent and specific, is returned to the boiler. The measure of the quantity is the amount the feed-water can condense, and the efficiency of this quantity is the amount of work it performs previous to being condensed by the feed-water. It is specially noticeable that the steam condensed by the feed, amounting to about one-ninth to one-tenth of the whole, has only existence in the high-pressure cylinder of a common compound engine, having passed through which it is removed again by the feed.

The amount of steam the feed-water takes from the low-pressure receiver it puts into the high-pressure cylinder through the boilers, and no difference is made on the quantity passing through the low-pressure cylinder, the heat that has been converted into work and the loss by radiation being fully made up for in a manner to explain which would take up too much of your valuable space. With triple and quadruple expansion engines, the work done between the boiler and the low-pressure receiver is proportionately greater than in common compound engines, therefore the saving is in direct proportion to the amount of work done before and after the steam is condensed by the feed.

The first trustworthy experiments in the matter were made by Mr. A. Kirk, of Robt. Napier and Sons, and by Mr. Brock, of Messrs. Denny and Co., of Dumbarton. The tests were made by measuring the waste heat carried off by the circulating water. The results obtained are all perfectly definite as to a considerable saving, but the percentage may at times be slightly inaccurate, as the exact quantity of discharge water is not easily attainable. Within the last two years, however, a very exhaustive series of experiments has been and is still being carried out by Mr. Brock on all the engines turned out by his firm, the feed-waters being carefully measured, and all the temperatures noted and the powers correctly taken under his own personal supervision by a most efficient staff, the sole object being to get at scientific truth. By these means the exact value of the slightest improvement is ascertained, and the results show the correctness of our system of feed heating. Could Mr. Brock be induced to publish an account of his experiments it would undoubtedly be a most valuable contribution to engineering science. Besides this, it would be of substantial advantage to shipowners, as it would determine beyond doubt the value of any inventions applied. They have been so often victimised that it is no wonder they are in the habit of discounting the large percentages of certain reports, and passing over those which show a smaller, but in reality a greater saving. Regarding your reference to the Peninsular and Oriental Company, your information is entirely at fault, as they have only one ship fitted with our heater, and as she has ample boiler power, the one half of the saving would be nearer the truth. I may mention, in conclusion, that since we fitted the Queen Margaret in 1875, hundreds of our feed heaters have been in use, principally on the larger class of engines in ships of the Orient, Union, Glen, Monarch, and other lines. Nearly all the larger class of triple and quadruple expansion engines made and making are supplied with them, the hot feed being put into the boiler by pumping donkeys specially designed for the high pressure now in use. G. AND J. WEIR.

2, Commerce-street, Glasgow, May 3rd.

FORTY-KNOT SPEED SHIPS.

SIR,—I was present last Friday night at a discussion held at the Society of Junior Engineers, Westminster, on a paper by Mr. C. Hurst explanatory, among other things, of the power necessary to obtain a speed of 40 knots in steam vessels. The mode of computation by which the result was arrived at will probably be interesting to your readers. Mr. Hurst explained that the power necessary to be introduced into steamers of light construction in order to obtain any required speed could not be determined by the old method of reckoning the resistance as proportionate to the midship section, but was to be ascertained by Reech's law, taking the actual speed and proportions of a first-class torpedo boat as the basis of comparison. It is, no doubt, known to many of your readers, that according to Reech's law the speed attained by a model with any given power will illustrate the speed attainable in a large vessel having the same proportion of power, the speed of the large vessel being in all cases greater than that of the small in the proportion of the square root of the increased dimensions. Thus, if we take a first-class torpedo boat for our model, 110ft. long, 12ft. broad, 6ft. 3in. draught of water, and 52½ tons displacement, the speed, with 470-horse power, will be 21¾ knots, and these elements will enable us to determine what the speed of a vessel would be of the same form and of the same proportionate power, but three times larger every way. Such a vessel will be 330ft. long, 36ft. broad, and 18ft. 9in. draught of water; her displacement will be 3^3 or twenty-seven times greater, or it will be $52\frac{1}{2} \times 27 = 1417\frac{1}{2}$ tons. As each 52½ tons displacement must have 470-horse power, the total power will be $470 \times 27 = 12{,}690$-horse power. We shall then have two vessels in all respects identical, except that one is constructed on three times the scale of the other. Although, however, the power is strictly proportionate in the two cases, the speed will not be the same, but by Reech's law the larger vessel will be the faster in the proportion of the square root of 1 to the square root of 3, or 1·732 times. If, then, the speed of the smaller vessel be 21¾ knots, that of the larger will be $21\frac{3}{4} \times 1{\cdot}732$, or 37·6 knots per hour. If we take the larger vessel as four times the size of the smaller, the speed, with the same proportionate power, will be twice greater, or it will be $21\frac{3}{4} \times 2 = 43\frac{1}{2}$ knots per hour. The power necessary to attain this high speed will be 4^3 or 64 times 470 = 30,080-horse power. The displacement of the larger vessel will be $4^3 \times 52\frac{1}{2} = 3360$ tons, and the displacement due to the machinery will be 805·71 tons, taking the weight at 60 lb. per horse-power as in Thorneycroft's engines. The total number of horse-power required will be $470 \times 4^3 = 30{,}080$ horse-power. The displacement will be 134·4 tons per 1ft. of draught. The weight of the machinery will therefore increase the immersion by 5·9ft., and if we take the weight of the hull as equal to the weight of the machinery, the draught of water with water in the boilers and the vessel ready for sea, except coal and stores, will be 11·8ft., leaving a balance of 13·2ft. for coal and stores. If we take the consumption of fuel at 2 lb. per horse-power per hour, the consumption of coal will be 26·8 tons per hour for 30,080-horse power; and if we take the speed of the vessel at 43½ knots per hour, equal to 49·4 statute miles, the time required for a voyage of 3000 statute miles in length will be $3000 \div 49{\cdot}4 = 60{\cdot}8$ hours – consumption of coal to be provided for will be $26{\cdot}8 \times 60{\cdot}8 = 1629{\cdot}44$ tons as total consumption for the voyage. This weight of coal will depress the vessel 12·12ft., which brings up the draught to 23·92ft., leaving a margin of about 150 tons for extra fuel and for stores. The result of the whole calculation is to show that a speed of 40 knots, or thereby, is attainable on an Atlantic voyage with a vessel of moderate size and light construction and without any inordinate consumption of fuel, and it rests with those who challenge the accuracy of this computation to show wherein it is erroneous if they can. In merchant vessels advantage has not hitherto been taken of the quality of lightness for the attainment of high speed, and it is important that this essential condition should now be taken into account.

Student College Practical Engineers, JAMES C. PAULSON.
Chiswick, May 3rd.

EFFECT OF FROST ON ROADS.

SIR,—I have read with interest the article on the action of frost on roadways in THE ENGINEER for April 30th. As regards the macadam system, you write of side drains as an invariable part of a road prepared on this plan. Would that it were so! What will the majority of your readers think when they learn that in certain "road districts" in Scotland the policy pursued by the trustees is to fill up all side ditches, inserting a field tile previously, of varying diameter, in the ditch? In the district in which I have the honour to be a trustee we saw the effects during last winter in a most uncomfortable way during thaw, when the only thing wanting to complete the illusion that one was out a-fishing was the general absence of fishing gear, the river being only too visible. I am aware the plea on which this is done is danger, but I think an evident ditch is better than a concealed one, for there is nothing done to harden the surface. ROAD TRUSTEE.

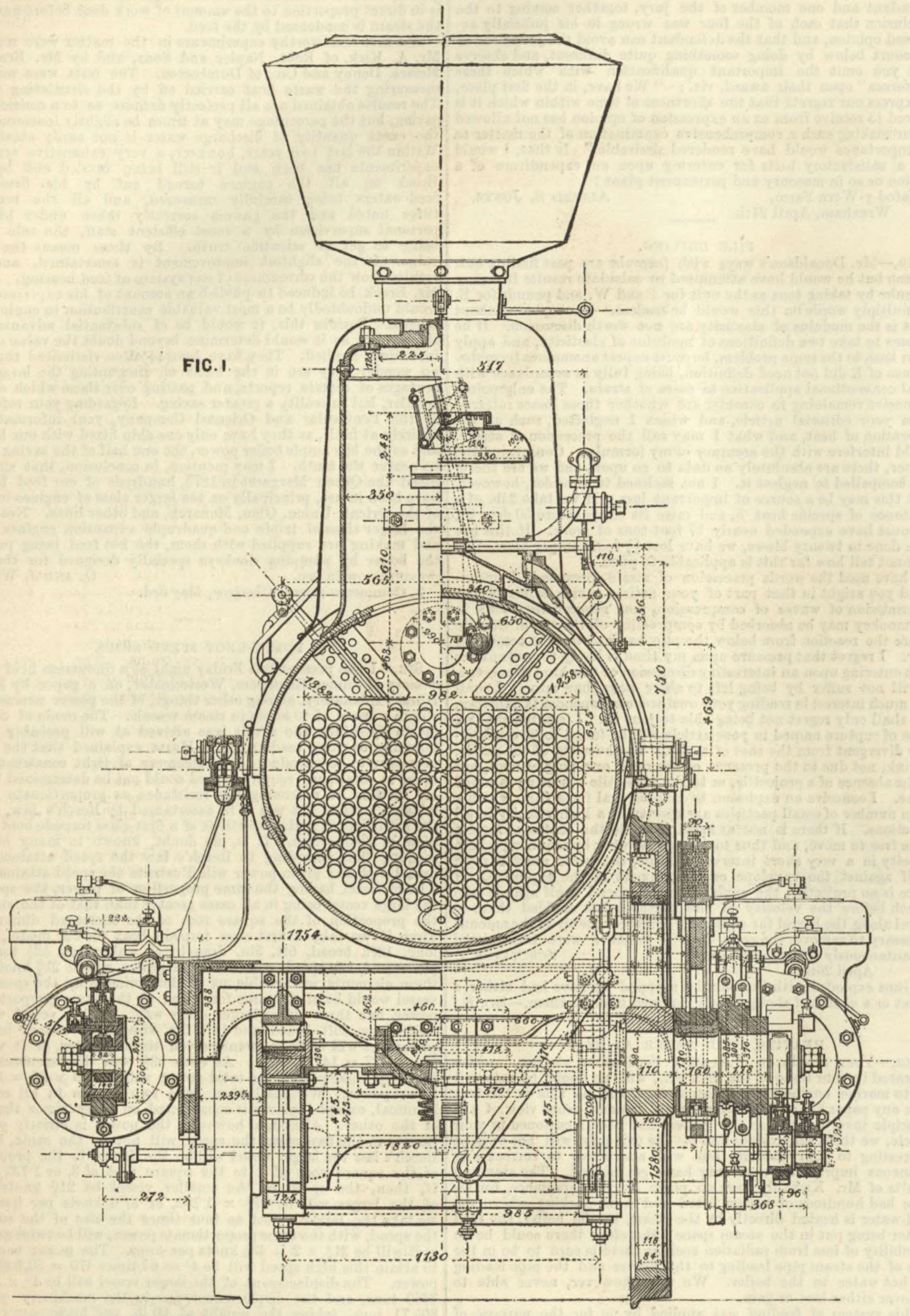
May 3rd.

[*For continuation of Letters see page 362.*]

EXPRESS LOCOMOTIVE, HUNGARIAN STATE RAILWAYS.

CONSTRUCTED IN THE HUNGARIAN STATE RAILWAY WORKS, PESTH.

FIG. 1.



EXPRESS LOCOMOTIVE, HUNGARIAN STATES RAILWAYS.

THE greater portion of the Pavilion of the Ministry for Public Works at the Budapest Exhibition, held last year, was devoted to the exhibits of the Hungarian States Railway Works in Pest. These works, originally founded by a Belgian Hungarian company in 1867, passed in 1870, after three years' fruitless struggle, into the hands of the Government as repairing shops. The extension of the States Railways in 1874 necessitated their extension and conversion into erecting shops, and in 1880 they were amalgamated with the iron and steel works in Diósgyör, and since the separation of the Hungarian from the Austrian portion of the States Railway Company in 1884, have been under the superintendence of the Ministry for Public Works. In their earlier years of existence the works were compelled to produce a miscellaneous variety of articles to provide constant employment for the workmen; but of late years the direction has been enabled to limit their competition and reduce the manufacture to certain specialities, such as locomotives, stationary and portable engines, thrashing machines, bridges and roofs. In the last three years they have turned out sixty normal gauge locomotives, three narrow gauge locomotives, fourteen stationary, and 270 portable engines, 280 thrashing machines, 409 bridges of a total weight of 3642 tons, and four roofs of a total weight of 2196 tons.

We illustrated last week an express engine, Category 1/d, No. 707, and we now give cross sections of this engine above and on page 356. As will be seen from the drawing there are four coupled driving-wheels, and four bogie wheels. The frame in which the axles of the latter are carried swivels on a large gun-metal pan 19½in. diameter, for better distribution of the load on the springs. The fire grate is considerably raked; the fire box and tube plate of the smoke box are made of copper, the tubes of Rhonitz iron, and the other plates of Hungarian iron. The chimney is fitted with a spark-catcher perforated in the centre to allow a free passage to part of the exhaust, whereby the smoke is carried higher than usual. The adjustable exhaust nozzle, patented by Mr. Kordina, one of the engineers of the works, relieves the counter pressure on the piston. The coupling between engine and tender is of the so-called triangular form. The brake used is Hardy's vacuum. The maximum speed allowed is fifty-six miles an hour; during the trial 74·5 miles were made with sufficient steadiness. The construction of the bogie allows sharp curves to be passed at a speed of thirty-seven miles per hour.

The principal dimensions are as follows:—

Length of stroke	25·6in.
Diameter of cylinders	16 9in.
Diameter of driving wheels	5ft. 7½in.
Diameter of bogie wheels	3ft. 4½in.
Steam pressure	150 lb.
Maximum load	475 tons.
Area of fire-grate	21·5 sq. ft.
No. of tubes	199
Outside diameter of tubes	1·77in.
Length between tube plates	13ft.
Heating surface of tubes	1200 sq. ft.
Heating surface of fire-box	92·5 sq. ft.
Total heating surface	1292·5 sq. ft.
Total wheel base	19·2ft.
Total length of engine	28·7ft.
Total width of engine	10ft.
Total height of engine	15ft.
Weight of engine empty	37·8 tons.
Weight of engine in service	41·3 tons.
Load on driving wheels	25·4 tons.
Pressure on brake blocks	10·7 tons.

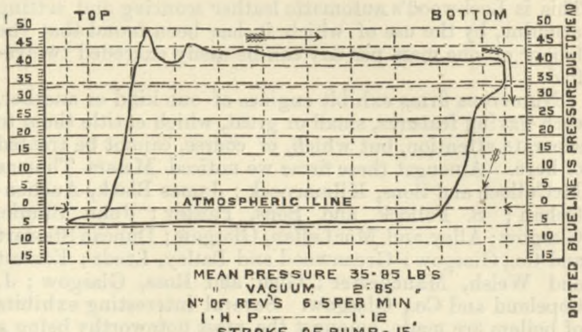
The tender is six-wheeled, of the usual type in use in Austro-Hungary. The chief dimensions and weights are as follows:—

Water space..	442·4 cub. ft.
Fuel space	282·5 cub. ft.
Wheel base	10·36ft.
Brake pressure	17 tons.
Weight of empty tender	12·7 tons.
Weight of tender in service	31·5 tons.

We shall refer to Kordina's adjustable exhaust nozzle in a later impression.

DIAGRAM FROM A SLURRY PUMP.

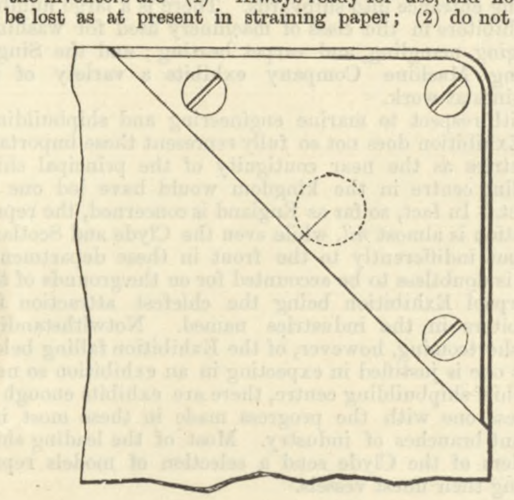
THE annexed diagram sent us by Mr. Charles Potter, of the well-known firm of Messrs. Addison, Potter, and Son, Portland cement manufacturers, Newcastle-on-Tyne, is of interest to many of our readers. It is taken from a cement slurry pump. He says:—"Slurry is a mixture of chalk, clay, and water ground down to a very stiff cream; its specific gravity is about 1·7. The pump valves are of india-rubber, and were in good working order when the diagrams were taken. These valves are slow in closing owing to the slurry being so stiff; the up-and-down lines on the diagram are very much sloped; this is probably accounted for by there being a considerable quantity of air in the slurry



in the form of small bubbles. Immediately the pump stops at the bottom the pressure falls 7 lb., showing that the friction of this slurry is high; delivery pipes 7in. diameter, head 48ft."

SCHONHEYDER AND MAGINNIS' IMPROVED DRAWING PAPER CLIPS.

THE accompanying engravings illustrate a neat and useful clip for fastening paper to drawing boards, and dispensing with the use of drawing pins. It can easily be seen that such a thing must present many advantages, and amongst those claimed by the inventors are—(1) "Always ready for use, and no time to be lost as at present in straining paper; (2) do not make



holes in the paper; (3) do not injure the edge of T-square; (4) facility in fixing or removing drawing or tracing paper; and (5) drawings having been removed may be easily replaced exactly in their former position." It will be seen that the plate against which the pinching screw presses may be fixed by any draughtsman to the ordinary drawing-board. They are sold by Mr. James P. Maginnis, Carteret-street, Queen Anne's Gate, Westminster.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Leonard Backler, fleet engineer, to the Asia, additional; George Sullivan, staff engineer, to the Euryalus; Walter J. Featherstone, engineer, to the Himalaya; Martin Stuart, assistant engineer, to the Inconstant; Lawrence Bell, assistant engineer, to the Himalaya; Henry B. Robinson, fleet paymaster, to the Euphrates; Henry Humphreys, assistant engineer, to the Calypso; John S. Gibson, assistant engineer, to the Rover; and Benjamin J. Watkins, assistant engineer, to the Volage.

SOCIETY OF ENGINEERS.—At a meeting of the Society of Engineers held on Monday evening, May 3rd, a paper was read on "Induced *v.* Forced Draught for Marine Boilers," by Mr. W. A. Martin. To test the applicability of the induced air system practically the author had obtained a marine boiler of modern construction, and set it in his factory on the same conditions as in a vessel. On this he had made careful experiments and trials, some of which were extended over long periods. The appliances used were shown by diagrams and working models, and the results went to prove that the system was effectual in producing high rates of steam generation without sacrificing economy or injuring the tube plate and orifices of the tubes, as was the case with forced draught. The combustion in the furnace was so complete that all the heating surfaces were acted upon regularly, and every pound of coal took up its proper supply of air.

NEW IRON SHIPYARD ON THE CLYDE.—Negotiations have just been completed whereby the shipyard at Troon, hitherto chiefly, if not altogether, devoted to shipbuilding and ship repairing in wood, has been let for the purpose of iron shipbuilding and repairing, to be conducted on an extensive scale. The new lessees are Messrs. McCreadie and Wallace, the former having been for some time a partner with Mr. M'Knight at the Ayr Shipyard, and latterly manager to the Marquis of Ailsa at his shipyard of Culzean. The latter is at present chief draughtsman and assistant-manager to Messrs. A. and J. Inglis, of Pointhouse Shipyard, where he has been for the past fifteen years. The Duke of Portland, from whom the yard is rented, has agreed to expend a considerable sum of money in extending it and improving its working capability, so as to enable the largest class of merchant vessels to be built. The greater part of the old buildings will be taken down and new buildings suitable for iron shipbuilding erected. A quay will also be formed so as to enable vessels to be finished alongside the yard. Ship repairing will be continued as formerly, but the efforts of the new firm will be chiefly directed to the construction of iron vessels, work for which the large experience of both gentlemen eminently fits them for undertaking. A branch of railway from the main Ayrshire line at present enters the yard, and the contiguity of the district to the coal mines, ironworks, and new steel works of Ayrshire should place it at an advantage compared even with yards nearer Glasgow. It is not, however, expected that practical operations will be begun before the end of summer or beginning of autumn. The announcement that a large number of workmen will be employed in all branches has created general satisfaction in the district, where there is a large idle surplus.

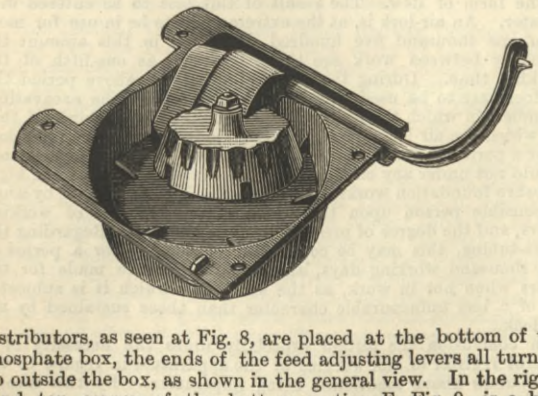
NEW SEED, CORN, AND MANURE DRILL.

EXCEPT in some slight modifications the English corn and seed or manure drill has received very little improvement for many years. There has been no strong stimulus to inventive effort, and the best known makers have for years practically gone to sleep in all that concerns drill development. They have so long worked in much the same groove that they have arrived at the conclusion that the absence of novelty is proof of finality. It is very questionable if the leading makers during the past ten years would have listened with much patience to any inventor with a good novelty. They would probably have said that their drills sell as well as those of any other maker, that they lasted a long time, and that there was no necessity for alteration. The Royal Agricultural Society has abdicated its position as leader in encouraging the production of the best implements and machines, no maker has any unwholesome fear of being eclipsed at a competitive trial, and all makers have given their foreign rivals plenty of time to take stock of the English articles and to beat them on their own grounds, and to replace them in foreign markets.

The drill we illustrate is an example of the result of want of stimulus in this country; of an effort to strike out new paths. It is not too much to say that this drill, made by the Chadburn and Coldwell Manufacturing Company, of Newburgh, N.Y., and 223, Upper Thames-street, London, would probably take the first prize in any competitive trial with all the English makers in the field.

After the American system, the Chadburn-Coldwell Company has taken up the drill as a thing to be perfected, and then manufactured upon a system that permits the most economical reproduction on the large scale. Several inventors, whose names do not appear, have been employed, and they have devoted themselves to the several chief parts by which an excellent combination has been made, and is now offered to the English purchaser with good prospect of commercial success. We will endeavour to describe some of these, with the aid of the perspective view annexed and the detail engravings Figs. 1 to 11. The perspective view shows the general arrangement, and will aid us in describing the action of the parts. The grain and seed distributors are illustrated in detail by Figs. 1 to 6. One of the complete distributors is shown at Fig. 7. It consists of a vertical rotary feed wheel, Fig. 3 and C Fig. 7. This wheel is saucer-shaped, and runs with its convex side in the frame casting, Fig. 2, the hollow side being covered by the casting, Fig. 1. The lever A, Fig. 7, seen complete in Fig. 4, has a cam disc upon it which fits in this wheel and turns upon a pivot cast upon it, which rests in a notch in Fig. 1, and in the notch in Fig. 6. By placing the lever A in the position seen at Fig. 7, the cam more or less fills one side of the hollow of the wheel, Fig. 3, and thus allows more or less of the seed or beans to pass, the quantity being minutely regulable. There does not appear to be much in this distributor, but there is probably not another piece of machinery with a feed wheel, cam slide, and regulator, with one part threading within another and then finding its bearings, that is literally and actually made in the foundry as this is. Immense pains have been taken to make up such a thing so as to require no fitting, and to produce it in a shape and by patterns that enable it to be made at the cheapest possible rate for labour. A number of these distributors—as many as there are runs—are threaded up a spindle running under the seed-box, and all the lever arms A, Fig. 7, are brought up in a row at the side of the box and there connected together by a connecting-rod, so that the feed of every one is adjustable by one movement after they have in the first place been set, every one being also separately adjustable by the simplest means. The grouping of these levers is not seen in the perspective view above, but the similar arms of the artificial manure distributor are there seen. On the side of this box toward the right-hand end is seen a graduated plate. This is a plate by which the position of the levers is set so as to sow or distribute any given quantity, and the quantity is, we are most credibly assured, adjustable to sow to within a few ounces of seed per acre, and the dials show pounds, bushels, and ounces for the manure, grains, and seeds. It will be observed that change wheels and loose parts are entirely dispensed with, an advantage which every farmer will know best how to appreciate. Grass seed distributors of the same form are placed either in front or behind the coulters. Turning now to the artificial manure and phosphate distributors, one of which is seen in perspective in Fig. 8 and in detail in Fig. 9. Here, again, we have a remarkable piece of designing; the result, however, is one of design and of painstaking tentation. The

Fig 8



distributors, as seen at Fig. 8, are placed at the bottom of the phosphate box, the ends of the feed adjusting levers all turning up outside the box, as shown in the general view. In the right-hand top corner of the bottom casting F, Fig. 9, is a hole through which the phosphate drops in quantities, which depend upon the position of the gate G on the end of the lever G^1. In Fig. 9 this gate is shown lifted to the highest position, and in the complete distributor, Fig. 8, it is shown in the position in which it lets the smallest quantity pass. At the bottom of the casting F is a support for a feed wheel H. This wheel simply drops into its place and fits. Above this wheel, on a cranked stud spindle, is a scraper wheel J, which always works in the position shown at Fig. 8. Now the whole of these parts are castings which go together, and the only bit of fitting work is that necessary to drill a hole in the end of the cranked stud in the wheel J, and put a pin in it which shall take up an inclined surface at the bottom of the boss in the middle of casting F. The other holes are all cast in. The underneath side of wheel H is provided with a toothed ring, by which it is driven by a pinion on a shaft, which is common to, and has a pinion for,

Fig. 10

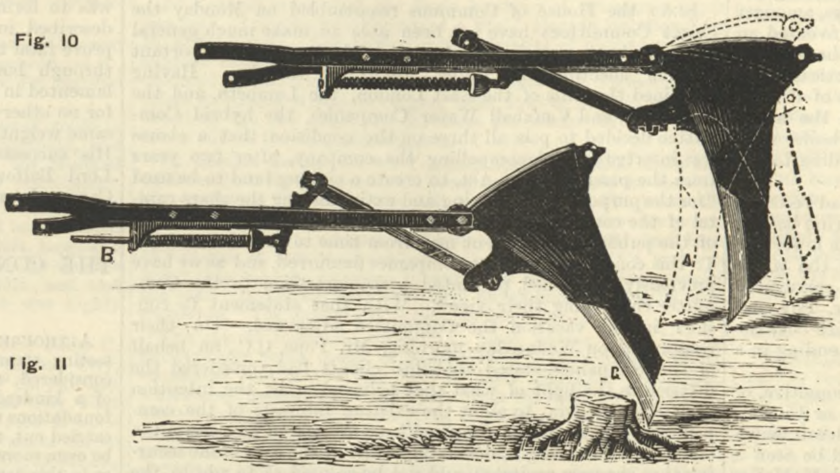
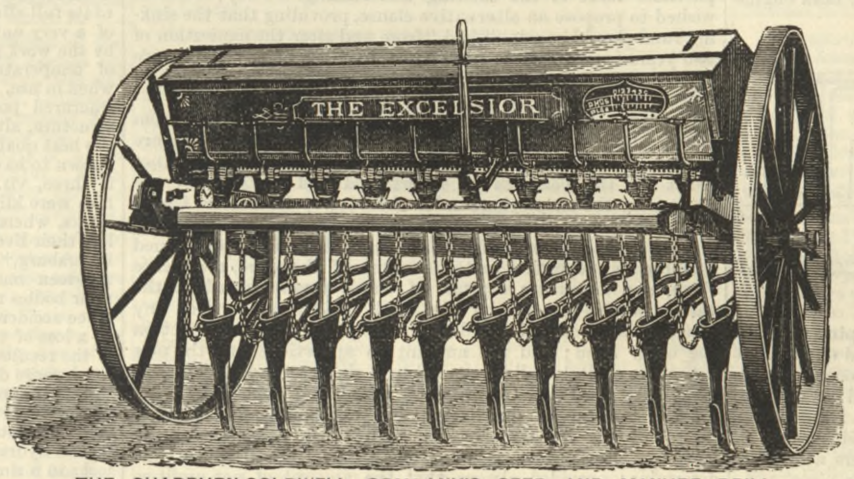


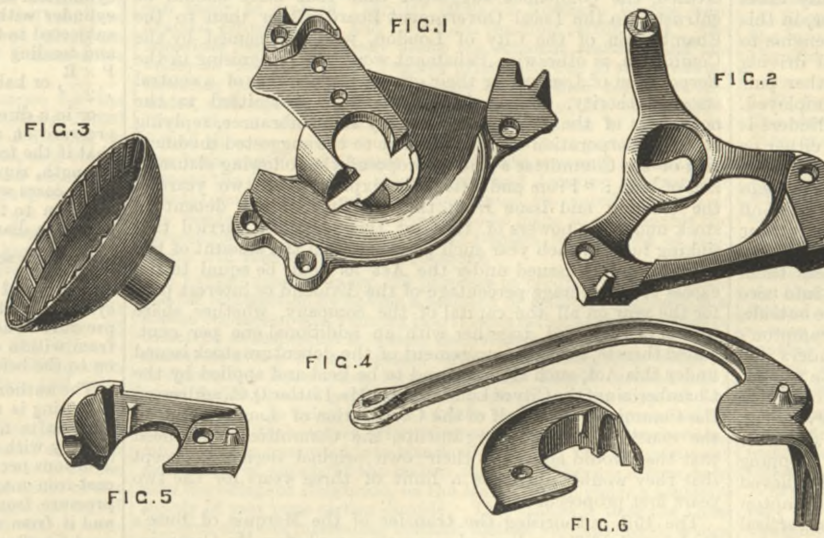
Fig. 11

AUTOMATIC AND ADJUSTABLE TRIPPING COULTER.



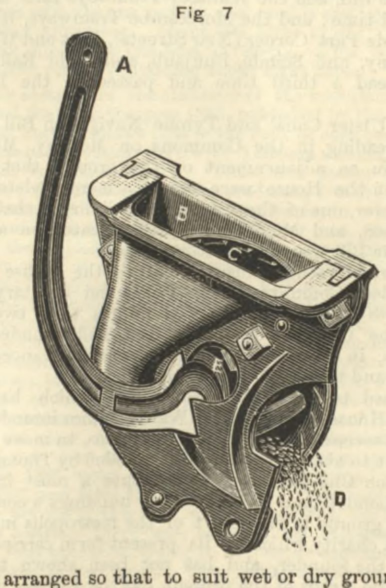
THE CHADBURN-COLDWELL COMPANY'S SEED AND MANURE DRILL.

every one of the distributors in the row. The scraper wheel J is operated by the teeth on the top of the wheel H, which it scrapes. This manure distributor will distribute anything a little less tough than close clay, and the quantity is minutely adjustable without anything more than the flap gate or tongue G; no change wheels are necessary.



Every part of this drill has some new and ingenious dodge, but we can only refer to a few more. The coulters with their

Fig 7



tubes are arranged so that to suit wet or dry ground, heavy or light soil or character of seed, they may in an instant be placed in a row, as shown, or to any degree zigzag. The coulters are made as shown by Figs. 10 and 11; that is to say, they may be instantaneously set by means of the lever and the notches under the projection from the front of the coulter tops, so as to take either of the three positions, shown by Fig. 10, as may be necessary for deep or shallow work. In the position shown in Fig. 10 the short lever connected near the coulter top is almost in line with the pivotted piece to which it is connected. It is thus for all ordinary pulls a fixture in this position, and is maintained there by the spring shown. When, however, an extraordinary pull comes on the coulter it is enabled by this arrangement to give way, as shown in Fig. 11, and to replace itself. Wood pegs are thus dispensed with, and the coulters require no attention. The coulter points are reversible. The wheels are mounted on a straight steel axle and communicate power to the drill parts by ratchets to both wheels, so that the drilling continues when turning corners, and the drill leaves no gaps. There is much more that might be said of this drill, but we must refer readers to the drill itself. They will have seen enough already to get a good illustration of the effect of the baneful action of a clique in the Council of our Royal Agricultural Society, which is now one for the discouragement of improvement of the mechanical appliances of agriculture.

CRAMPTON'S NEW DESIGN FOR LOCOMOTIVE ENGINES.*

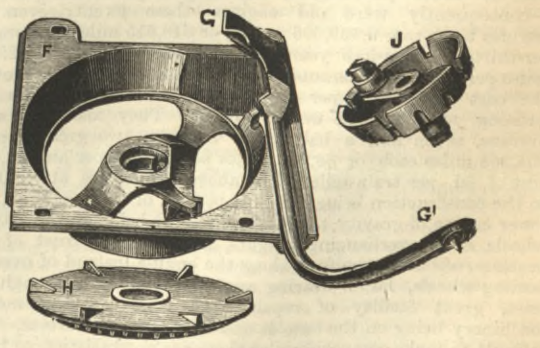
AT a recent meeting of the Société des Ingénieurs-Civils—Mr. T. Russell Crampton, M.I.C.E., being in Paris—the President called the attention of the meeting to the fact, and asked the meeting to listen to Mr. Brüll, who spoke in Mr. Crampton's name, giving a description of this veteran locomotive engineer's new express engine.

Mr. Brüll, apologising for interrupting for a moment the course of the meeting, said:—"Our eminent colleague from London, Mr. Crampton, is in Paris for a few days, and has entrusted to me the pleasant task of describing shortly his new type of locomotive. It will be remembered that in 1848 Mr. Crampton came to Paris, and brought a new locomotive which had for its object the working of express trains. The locomotive of Mr. Crampton differs from others in the dimensions of the driving wheels, whose diameter is 2·10 metres, and which, with a limited number of revolutions, allow of great speed being attained. These wheels are situated in rear of the fire-box.

"The machinery is all external; not only the pistons and cylinders, but also the distribution of the mechanism, as well as the axle-boxes, being so situated as to be under the immediate view and superintendence of the driver. At that time, moreover, one most particular point was insisted upon by Mr. Crampton, and that was the importance of placing the connecting-rod slides as near the centre of gravity of the locomotive as possible, for the purpose of avoiding the vertical action due to the oblique action of the connecting rod, and which was liable to cause the locomotive to jump and destroy the permanent way. This Crampton locomotive, with which all were conversant, has found favour in our country; most of the principal lines have adopted it where a single pair of driving wheels give sufficient adhesion, and where they are not applicable his system of outside mechanism and large wearing surfaces have been very extensively applied to all classes of locomotives with marked success. The advantages gained by the application of this system have been considerable. In the first place, the express service has been very regularly worked by these locomotives; then the cost of maintenance, thanks to the external arrangement of the machinery with the large wearing surfaces, has been reduced, and the consumption of fuel has been favourable. Mr. Crampton has lately obtained from the Compagnie de l'Est some statistics on these points (see note * at the end) which are highly satisfactory. The company has thirty-nine Crampton locomotives, which have been in regular work since 1855. They have been during this long period subject to the most regular observations, from which it appears, in taking the mean of these thirty-nine locomotives, whether in service or under great repair, that the average cost of repair and of renewal of one locomotive amounts to 1½d. per train mile. Further, the consumption of fuel per train kilometre has been a little less than 7·5 kilograms, as a general mean, or 27 lb. of coal per train mile. These two figures say a great deal for the merit and value of the invention of 1848.

"But this Crampton locomotive of 1848 has grown old; the conditions of working railways have changed; the permanent way is much more substantial than formerly. The weight of 10,000 kilograms on the driving wheels has become insufficient.

Fig 9



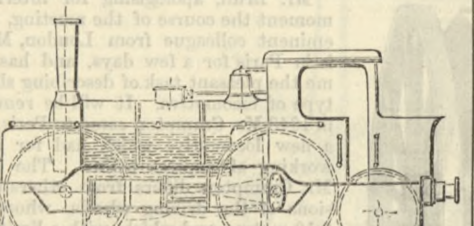
Speed has somewhat increased, as well as the number of people who wish to travel fast—so much so, that in order not to increase the number of express trains too much, it has been necessary to load them more heavily. Hence the numerous schemes for increasing adhesion of all engines. The weight upon the driving axle has been increased in some cases to 14 or 15 tons, or more; but that is only one form of relief, and it was soon

* Translation of "Proceedings" of Société des Ingénieurs-Civils, Paris.

found necessary to design a locomotive having much greater adhesive power. Our express engines of the present day have nearly all two pairs of driving wheels of large diameter coupled; but this solution of the question does not give complete satisfaction. Mr. Crampton, who so well succeeded in his combination of 1848, might have rested satisfied; and in fact he had almost completely ceased to interest himself in locomotives, in order to pay more attention to works some of which are well known to this society, such as the researches he undertook on the establishment of submarine telegraphs; the utilisation of dust fuel, and his ingenious machine for driving submarine tunnels automatically. But during the last year, perceiving the modern requirements of economical working of railways, amongst which was a new system of locomotives, he has invented an engine for express service and heavy trains, of which he gives us to-day the first information. This locomotive is practically the 'primitive Crampton' doubled. It has two pairs of driving wheels, about 2·10 metres in diameter, and between the axles, distant from one another about 4 metres, he places a boiler with 140 or 150 square metres of heating surface, according to the desired traction and speed.

"To solve this new problem, Mr. Crampton has had recourse to a well-tried class of boiler, the high-pressure marine boiler; that is to say, a boiler composed of two portions; the lower one enclosing a circular fire-box without stays, which is the whole length of the boiler, and made in some cases of corrugated plate, as constructed in England at the works of Mr. Fox, and surrounded by water on all sides, and above the fire-box, the tubes are placed of the length required, the whole ending in a funnel, or rather a double funnel.

"Besides the two pairs of driving wheels, the locomotive, of which the weight will probably exceed twice 13, 14, or 15 tons, other carrying wheels will be necessary. This is a detail which can be overcome in many ways. On the board will be seen a tank engine, and also one with a separate tender, which M. Mallet has kindly drawn to ¼-scale. This sketch shows the tank engine



only. To drive these two pairs of wheels, Mr. Crampton employs four small cylinders; the two on the right, placed one behind the other, drive the front wheel, to which the connection is made on two crank pins, set 180 deg. apart, and as close as convenient together. In this arrangement, which till now has never been successfully used, there is considerable advantage; it is this, that the power of the steam, in the cylinders which are placed laterally close to each other, and cast in one piece, notwithstanding that it is transmitted through two pistons and two rods, attached to two crank pins adjoining one another, only produces the effect of a simple torsion, almost free from action on the guides of the axle boxes. Moreover, the torsion exercised upon the axle is always produced in the same direction, and not first in one, and then in the other direction, as usually takes place to the detriment of strength of the axles; in fact, in this system there are no cross strains from one side of the engine to the other—a most important consideration. The hind driving wheels are worked in the same manner by the other pair of cylinders on the left, no coupling rods being employed. The machinery connected with these two pairs of cylinders is all external. The platform of the driver is placed at either or both extremities of the boiler, which allows, if necessary, the fire to be fed from either or both ends, and giving ample room for placing the cylinder for working the brake-pushing-off apparatus. In order that the waste steam from the four cylinders shall not interfere with one another in the chimney, Mr. Crampton makes use of two chimneys. He places them side by side; that is to say, the chimney is divided into two parts transversely. All the mechanical parts are on the outside, and in this respect all the advantages of Mr. Crampton's original creation are preserved. Each pair of cylinders can receive the steam from the boiler direct, or they can be worked with great facility on the compound principle. One objection would occur naturally to some people. These two cylinders, which are attached to the two extremities of the same diameter of one and the same wheel might refuse to work by stopping on the dead centre. This problem, for which Mr. Brüll believed that up to now there is no practical solution, Mr. Crampton suggests a new means of treating. He uses a little vertical steam cylinder, which can also be used to work the brake. The stroke of the piston causes the extremities of two horizontal rods to rise and fall, which turn upon the axes of the driving axles. These rods each carry an ordinary silent feed apparatus acting on the flanges of the wheels. The starting of the locomotive is thus insured; a few strokes of the piston of this little apparatus changes the position of the wheels in a few seconds, so that the action of the steam in the driving cylinders may come into action."

* After twenty-seven engines had run 8,250,124 miles, or 305,560 miles per engine, including repairs and renewals —consequently were old engines—these twenty-seven old engines then ran 9,439,606 miles, or 349,615 miles per engine, for thirteen and a-half years, 1871 to 1884 inclusive, or 25,898 miles per engine per annum, also including repairs and renewals, the cost being 1¼d. per train-mile; these engines are still running, and in good working order. They also ran, on an average, seven and a half years between two great repairs, 254,268 miles each, or 33,900 miles per engine per annum, at a cost of ⅝d. per train-mile. The above results are attributable to the construction being different to that of other engines, viz., lower centre of gravity, the greatest weight being on the extreme wheels, little overhanging weights, the angular thrust of connecting-rods acting halfway along the engine instead of over the leading wheels, large wearing surfaces, and last, though not least, great facility of repairs, the whole of the moving machinery being on the outside and in view of the driver. It is difficult to make comparisons, as there are no statistics, so far as is known, of the same number of renewed ordinary engines having run the same distances in thirteen and a-half consecutive years; but a record has been made of six of the largest railways in Great Britain, having in operation a large number of engines which ran an average for twelve and a-half years, 1868-1880 inclusive, of about 19,000 miles per engine per annum, at a cost for repairs and renewals of rather more than 3d. per train-mile, but whether they were new or old engines to commence with is not stated; whereas Crampton's engines in 1871 were old ones, and had done a large amount of work previously, as is stated above. Where the system of running engines for long distances by exchange of drivers is in force, it is important that the new driver, on taking charge, shall have everything requiring attention pointed out to him by the driver going off duty. All moving parts being outside and in view in this system, this is easily effected without inconvenience; but where the moving parts, or any of them, are difficult of access, such facility does not exist.

PRIVATE BILL LEGISLATION.

Since the House of Commons reassembled on Monday the Select Committees have not been able to make much general advance, but one of them has arrived at a most important decision affecting the water supply of London. Having examined the Bills of the East London, the Lambeth, and the Southwark and Vauxhall Water Companies, the hybrid Committee decided to pass all three on the condition that a clause was inserted in each compelling the company, after two years from the passing of the Act, to create a sinking fund to be used "for the purpose of purchasing and extinguishing the share capital of the company, and for such other purposes for the benefit of the public as Parliament may from time to time determine." To this condition the three companies demurred, and as we have previously mentioned, presented a memorandum to the Committee embodying their views. With that statement to consider in the vacation the Committee adjourned. On their resumption on Wednesday morning, Mr. Pope, Q.C., on behalf of the companies, stated that his clients had considered the decision in the light of what they believed to be the intention of Parliament, viz., to allow the existing interests of the companies to remain uninterfered with, so as not to depreciate the value of the existing undertaking, while at the same time securing that the new capital should not be so used as to add to the purchase value of the existing undertaking. They therefore wished to propose an alternative clause, providing that the sinking fund should be established "from and after the expiration of two years from the issue from time to time of any debenture capital authorised under the provisions of the Act," instead of "from the passing of the Act;" the clause to run thus:—"Whenever in any year after the expiration of two years from the creation and issue from time to time of any debenture capital, authorised under the provisions of this Act, the net profit for the year—to be ascertained and certified by the auditor for the time being under the Metropolis Water Act of 1871—shall exceed the net profit for the year ending the——day of——1888, the excess of such net profit shall be apportioned rateably, in proportion to the amount of the share, preference share, and debenture capitals of the company issued at the passing of this Act on the one hand, and the amount of any new debenture capital raised under the provisions of this Act on the other hand; and the amount so apportioned to the new debenture capital shall be carried to a sinking fund, which shall be held by the Local Government Board, and applied by them for the purpose of purchasing and extinguishing the share capital of the company, or for such other purposes for the benefit of the public, as Parliament may from time to time determine; provided always, that the amount of net profit so ascertained and certified by such auditor as aforesaid shall be final and conclusive of such amount." Mr. Pope observed that this basis of calculation it was proposed to substitute for the excess of average percentage of the dividend or interest proposed by the Committee. As to the trustee of the sinking fund to be created, the companies suggested that that office should be entrusted to the Local Government Board rather than to the Chamberlain of the City of London, who was named by the Committee, as otherwise Paliament would be recognising in the Corporation of London, or their officer, the position of a central water authority. This clause had been submitted to the opponents of the Bills, and the City Remembrancer, replying that the Corporation could not assent to the suggested modification of the Committee's clause, proposed the following clause in lieu of both: "From and after the expiration of two years of the creation and issue from time to time of any debenture stock under the powers of this Act there shall be carried to a sinking fund in each year such percentage on the amount of the debenture stock issued under the Act as shall be equal to the excess or the average percentage of the dividend or interest paid for the year on all the capital of the company, whether share capital or borrowed, together with an additional one per cent. added thereto, for the management of the debenture stock issued under this Act, such sinking fund to be held and applied by the Chamberlain of the City of London, &c." Mr. Littler, Q.C., addressed the Committee on behalf of the Corporation of London, and on the conclusion of the arguments, the Committee announced that they would adhere to their own original decision, except that they would substitute a limit of three years for the two years first proposed.

The Bill authorising the transfer of the Marquis of Bute's Docks at Cardiff to a limited company came before Mr. Campion, Examiner of Petitions for Private Bills in the House of Commons, on Monday, and was declared to have complied with the Standing Orders.

The South Hampshire Railway and Pier Bill, Edinburgh Improvement Bill, and the Wallasey Tramways Bills have been read a second time; and the Morecambe Tramways, Ripon Corporation, Hyde Park Corner (New Streets), East and West India Dock Company, and Scinde, Punjaub, and Delhi Railway Bills have been read a third time and passed in the House of Commons.

When the Ulster Canal and Tyrone Navigation Bill came on for second reading in the Commons on Monday, Mr. Biggar tried to obtain an adjournment on the ground that the Irish party then in the House were only "a mere skeleton." Mr. Sexton, however, one of the "Irish party," urged that the Bill should proceed, and Mr. Biggar being defeated on a division (127 to 6), the Bill was read a second time.

In a report of rather unusual detail to the House of Commons, the Select Committee upon Police and Sanitary Regulations Bill state that they disallowed no less than twenty-nine clauses in the Carlisle Corporation Bill, and amended several other clauses, in consequence of objections advanced by the Home Office and the Local Government Board.

With regard to the Charterhouse Bill, which has passed through the House of Lords, Mr. Walter James intends, on the order for the second reading in the Commons, to move that "it is inexpedient to abolish the hospital founded by Thomas Sutton in the London Charterhouse, to mutilate a most interesting relic of Old London, and to cover with buildings a considerable area of open ground in the heart of the metropolis in order to reconstruct a charity which in its present form carries out the intention of the founder, and has not been shown to be unsuitable to the needs of the present day, or to have given rise to abuses."

The death of the Earl of Redesdale is an event so intimately associated with Private Bill legislation that it may be fitly alluded to here very briefly. For over thirty years he has had, as Chairman of Committees, more sway over this class of legislation than any other man, and owing to his keenness and rigid adherence to the stricter principles applicable to both private and public enterprises, he has been the terror of promoters alike in the House itself and in the Committee rooms. Any party securing his approval was pretty certain to win in the end; and, on the contrary, any Bill of which he disapproved had slender chance of success, no matter who supported it. The first failure of the Manchester Ship Canal was really due to his action, and he has been a thorn in the side of the Canal Company ever since. His last public act was to formulate a resolution on the payment of interest—described in a recent article—which was more than likely to prove fatal to the Canal Bill, despite its having at last passed through both Houses of Parliament. His death, sincerely lamented in almost every direction, largely removes that danger, for no other peer who might take up the matter will have the same weight and influence as Lord Redesdale would have had. His successor has not yet been appointed, but the names of Lord Balfour of Burleigh, Lord Monson, and the Earl of Camperdown are mentioned for the vacancy.

THE CONSTRUCTION AND TESTING OF AIR-LOCKS AND SHAFT-TUBES.*

By L. Brennecke.

Although the question of the best method of design and of testing steam-boilers is one which has been generally carefully considered, and receives universal attention, a like investigation of a kindred subject, viz., that of the apparatus used for sinking foundations under a high air-pressure has nowhere hitherto been carried out, although the consequences of an accident are likely to be even more disastrous in the latter instance than in the former, as in this case the men are actually enclosed in the apparatus, and so situated that they must in the event of an explosion be subject to its full effects. Also the strains which an air-lock sustains are of a very unfavourable character, owing to the vibration caused by the work proceeding in its interior, and the constant changes of temperature and of pressure to which it must be subjected when in use. The bursting of an air-lock is instanced, where the fractured portions on examination showed a highly crystalline structure, although the iron used in its manufacture had been of the best quality. Up to the present time the number of accidents known to have occurred in consequence of the bursting of air-locks is three, viz.: first, in 1865 at Zeche Rheinpreussen, where two men were killed in the lock; second, in 1873 on the Tay Bridge works, where six men who were below in the excavating chamber lost their lives; third, in 1877 on the Alexander Bridge works, St. Petersburg,† when ten men were blown into the air and killed, and nineteen men below in the excavating-chamber were drowned, their bodies not being recovered till twelve months later. These three accidents, spread over a period of twelve years, were the cause of a loss of thirty-seven lives, which, compared with the statistics of the results of boiler explosions, show that air-lock accidents are much more disastrous; these considerations lead to the conclusion that this apparatus should receive as much attention in the way of periodical examination and testing as is applied to steam-boilers, an easy matter, as those now engaged constantly in testing steam-boilers hydraulically could equally well carry out the testing of air-locks in a similar manner. There should also be rules formulated for enabling the strains upon the air-lock shafting, &c., to be easily found. The author intends publishing a series of calculations in reference to the strains upon the various parts of the whole apparatus in an early edition of the *Deutschen Bauhandbuch*; and he in this paper enters minutely, by a series of equations, into the question of the strains around the opening made in the wall of the cylindrical air-lock for the door, based upon the principle that a cylinder with closed ends, under pressure from within, is mainly subjected to two strains, the one $P \times R$ acting circumferentially and tending to split the cylinder wall vertically, and the second $\frac{P \times R}{2}$, or half the intensity of the first, acting at right angles to it—or in a direction parallel to the axis of the cylinder—where P = pressure on area of wall and R = radius, from which is deduced that if the frame around the rectangular doorway be of insufficient strength, rupture will commence at the angles; and he advises that in all cases with either rectangular or circular doorways that, in addition to the framing at the side of the door, a ring of flat bar iron of a diameter equal to the diagonal of the rectangular door, and with a sectional area of $\frac{3}{4}\,\frac{p \times R \times a}{k}$ (where a = height of door-opening, and k = unit strain) shall be rivetted to the wall of the cylinder. This will take the main strains above alluded to. The pressure in addition to the above, acting upon the back of the door from within outwards, may be met by rivetting an angle-iron ring on to the before-mentioned bar-iron ring.

The author suggests that adoption of certain rules—of which the following is an abstract—with regard to the working of air-locks and shafts might be of service, viz.: the iron to be of the best quality with a tensile resistance of 22·86 tons per square inch, and 21·6 tons per square inch with and across the fibre respectively; cast-iron may only be used for the tubes, which, if subjected to pressure from within, do not exceed 12in.—30 cm.—in diameter, and if from without 24in.—60 cm.—in diameter, and may not be used for those parts subjected to vibration; pipes of brass or copper may not exceed 4in. in diameter; the coefficient of safety to be at least five times the strain; shaft-tubing, in calculation, to be assumed as subject to occasional pressure from without. A manometer to be provided in each air-lock, also a plate affixed to the latter, giving the name of the manufacturer, the working pressure for which it is calculated, and the date of the trial test.

At every new installation and also at intervals of not more than twelve months, while in use on the same works, the whole apparatus to be tested under a hydraulic pressure of twice the intended working pressure. In testing, the full pressure shall be continued for at least ten minutes without producing signs of weakness, by the buckling of plates or escape of water other than in the form of dew. The result of this test to be entered in a register. An air-lock is, at the extreme, not to be in use for more than one thousand five hundred days, and in this amount the intervals between work are to be reckoned as one-fifth of the working time. During the second half of the above period the air-locks are to be used only in conjunction with the excavating-chamber, in which the pressure does not exceed two-thirds of that for which the air-lock was originally intended. As before remarked after a period of one thousand five hundred working days, a lock should not under any circumstances be continued in use for high-pressure foundation works, and a register should be kept by some responsible person upon the works of the number of working hours, and the degree of pressure from day to day. Regarding the shaft-tubing, this may be considered serviceable for a period of five thousand working days, and a full allowance made for the hours when not in work, as the strains to which it is subjected are of a less unfavourable character than those sustained by the air-lock.

In conclusion the author especially urges the necessity of a careful register of the working of the apparatus, in regard to the particulars above mentioned being imperative. By this means, in the case of the apparatus at the completion of works being disposed of, those taking it over may be fully acquainted with the amount of wear and tear to which it has been subjected.

D. G.

* Abstract "Proc. Inst. C.E." vol. lxxxiii from *Zeitschrift für Bauwesen*.
† Minutes of "Proceedings" Inst. C.E., vol. lxxv., p. 286.

RAILWAY MATTERS.

STEEL sleepers are being laid by the Midland Railway Company on a mile of the main line at Kettering.

THE second reading of Mr. Mundella's Railway Regulation Bill is down fifth in the orders of the day for the 19th May.

A ROYAL COMMISSION on railways and public works is to make a special report on the Derwent Valley—Tasmania—Railway.

THE Midland Railway Company has opened the Teversall branch for passenger traffic. Alfreton and Mansfield are the terminal stations.

RECENT news states that the Singapore Tramway Company expected to have some of its cars running by the end of April or beginning of May.

AT a meeting of the Institution of Civil Engineers of Ireland held on Wednesday last a paper by Mr. W. Greenhill, C.E., was read, giving a description of a creosoting yard for railway purposes.

THE Midland Railway Company carried 383,909 tons of goods in and out of Sheffield in 1870, and the Manchester, Sheffield, and Lincolnshire line 52,604 tons. In the year 1884 the Midland tonnage had increased to 564,197 tons, whilst the Manchester, Sheffield, and Lincolnshire's total had fallen to 18,006 tons.

THE Werribee Viaduct, the longest work of its kind in Australia, has been tested. It is a lattice-girder structure, 1230ft. long, and 125ft. above the level of the Werribee river. The bridge consists of fifteen spans of 60ft. each and thirteen spans of 30ft., and cost £120,000. The *Colonies and India* says the test was highly successful.

WRITING on freight cars drawn by electricity, Mr. John C. Henry, of the Henry Electric Railway Company, Kansas City, Mo., writes to the *Scientific American* as follows :—"On January 29th, I hitched our electric car Pacinotti, to a Kansas City, Fort Scott, and Gulf coal car, weighing 17,500 lb., and took it up a 2½ per cent. grade. Yesterday I coupled the same motor car to Chicago, Burlington, and Quincy box car 19,178, weight, 24,500 lb., and started it without jerking on a 3 per cent. grade. I claim the distinction of being the first to haul regular standard gauge freight cars by electricity, and would be pleased to have you record it."

THE railway line to Tarsus, forming the first section of the Mersina, Tarsus, and Adana Railway, was formally opened on Tuesday last in the presence of Raif Pacha, the Governor-General of the province of Adana, the British Vice-Consul, Mr. Collinson, vice-president, and Mr. Ross Taylor, engineer of the company, and Sir Thomas Tancred, the contractor. Rails have now been laid for a distance of 56 kilos., and the line, the total length of which is to be 67 kilos , will be completed in about two months. Much rain having fallen in the district, the crops promise well, and the first season's traffic over the railway is therefore expected to be heavy.

TWO accidents caused by the failure of the vacuum brake are reported this week—one in this country and the other on the Continent. A London and North-Western train came into collision with the buffer stops at Sutton Coldfield, which it completely demolished; and the express train from Cologne to Paris, composed of Northern of France Railway Company's carriages, ran through the frontier station of Tergnier and left the line, after colliding with another engine. Various people were injured, and Count Munster—the German Ambassador to Paris—and his family had a narrow escape. It is clear that the particular person who must be killed before certain changes are made has still a future before him or her.

MR. MUNDELLA'S Railway Rates and Canal Traffic Bill has been condemned by the railway servants in Mr. Mundella's own division —Brightside, Sheffield. The Midland Railway servants, to the number of 150, have held a meeting at which they passed resolutions against the Bill on various grounds, but chiefly because it would have the effect, if passed in its present form, of reducing railway workers' wages, one speaker estimating the reduction at from 10 to 15 per cent. As the meeting was in Mr. Mundella's constituency, it was considered they could not very well ask him to present a petition against his own Bill. It was therefore ordered to be sent to Mr. Howard Vincent, the Conservative member for the central division.

HERR BENJAMIN VON KALLAY, Minister of Finance for the Empire, and Administrator of Bosnia and Herzegovnia, inaugurated the new line of rail between Doboj and Siminhan, in Bosnia, on the 28th ult. The length of this line is 67 kilometres, and it was built at a cost of about 18,000fl. a kilometre by the engineers, Borosch and Bafarhely. At Doboj the line crosses the Bosna over a handsome iron bridge 160 metres long. There are fourteen stations on the way, including the terminus. The first rail was laid on May 1st, 1885, and a great part of the work has been done by Bosnian villagers employed within their respective districts at wages of 80 kr., or about 15d. a day. The new line is a prolongation of that which runs from Brod, on the Hungarian frontier. It will be carried on to Serajevo, and there meet the line which will go by way of Mostar and Metkovic to the sea. The Mostar-Metkovic line was inaugurated last year. To Austria-Hungary a railway crossing the whole of Bosnia has great military and commercial value.

ACCORDING to the return of accidents on Indian railways for the third quarter of 1885, just issued, about 700 accidents of all kinds are reported, more than a third of these being due to the presence of cattle on the line—the most fruitful source of accidents in the country. On the other hand, only one railway servant was killed and fifteen servants and passengers injured. The Rajputana-Malwa railway has slain more cattle than any other. Its average is a high one at all times, owing to the long stretches of the line unfenced. The Indus Valley State Railway—a wood-burning line —heads the list in fires on trains, the bursting of boiler tubes, and the failure of springs and machinery of engines. The casualities to passengers from their own carelessness, &c., amount to thirty-two altogether, eight men being killed and twenty-four wounded. Twenty-six railway servants were killed and 114 injured in the discharge of their duty; while eighteen outsiders committed suicide, and two were injured in attempting to do so. The grand total of people killed from causes of all kinds connected with the working of trains is 105, as compared to eighty in the corresponding quarter of the previous year. But only one passenger met his death from causes beyond his own control.

THE London, Chatham, and Dover Railway Company's new bridge over the Thames at Blackfriars, which we have illustrated and described, and the St. Paul's Station—for both of which the Act was obtained in 1881, but not commenced until March, 1883—will be opened for traffic on the 10th inst. The Chatham and Dover Company will then have four City stations, viz., Holborn Viaduct, Snow-hill, Ludgate-hill, and St. Paul's, which are served by seven lines on the new and four lines on the old bridge, which latter was opened for traffic in June, 1864. Two of the seven lines on the new bridge will be carried on to Ludgate-hill, joining the existing lines at Queen Victoria-street bridge; three will be used as terminal passenger lines, and the remainder for engine or goods sidings; whilst on the Surrey side there will be a quadruple junction with the old lines at Blackfriars Station, which has been almost demolished to make room for the new lines, only small portions being left for goods sheds, apart from the company's warehouses and offices at this depôt. There are between 5000 tons and 6000 tons of iron in the bridge, which consists of five arches, three of which are of 185ft. span, and two of 175ft. each, whilst the height from Trinity high-water to soffit is 26ft. The new station has a frontage of 135ft. on Queen Victoria-street, immediately opposite the *Times* office, and adjoins and communicates with the present Blackfriars Station of the District Company. The estimates for the bridge, as originally designed for four lines of rails, were £300,000, but the widening has added considerably to that sum.

NOTES AND MEMORANDA.

IN Greater London during the week ending April 24th, 3155 births and 1766 deaths were registered, corresponding to annual rates of 31·0 and 17·5 per 1000 of the population. Last week 3208 births and 1837 deaths were registered, corresponding to annual rates of 31·5 and 18·1 per 1000.

MR. J. BUCHANAN has determined the thermo-electric power of carbon, the value found being $e_c = -390 - 1{\cdot}87t$ C.G.S. units, and this shows that the place of carbon in the thermo-electric series is between zinc and silver. It was found that the thermo-electric power of carbon was changed by keeping that substance at a moderately high temperature.

AT a recent meeting of the Paris Academy of Sciences, a paper was read, "On the Equilibrium of a Fluid Mass in Rotation," by M. Matthiessens. The author claims priority of discovery of the annular figures which M. Poincaré lately stated had first been observed by the English geometricians Tait and Thomson. He refers to a series of papers ranging from 1845 to 1883, in which he describes the two rings and discusses the whole theory of these forms and of the ellipsoidal figures.

IN London during the week ending April 24th, 2505 births and 1460 deaths were registered. Allowance being made for increase of population, the births were 283, and the deaths 332, below the average numbers in the corresponding weeks of the last ten years. The annual death rate per 1000 from all causes, which had been 19 8 in each of the two preceding weeks, declined to 18·4, and was lower than the rate recorded in any week since the beginning of the year. In London last week 2515 births and 1472 deaths were registered. The annual death-rate per 1000 was 18·5.

THE deaths registered during the week ending April 24th in twenty-eight great towns of England and Wales corresponded to an annual rate of 19·8 per 1000 of their aggregate population, which is estimated at 9,093,817 persons in the middle of this year. The six healthiest places were Hull, Leicester, Bristol, Birkenhead, Brighton, and Sunderland. The deaths registered last week in 28 great towns of England and Wales corresponded to an annual rate of 20·2 per 1000, estimated at 9,093,817 persons. The six healthiest places were Brighton, Hull, Bradford, Birkenhead, Sunderland, and London.

EXPERIMENTS have been made on the cause of irregularities in the action of galvanic batteries by H. V. Hayes and J. Trowbridge —*Amer. J. Sci.*—by means of an apparatus for photographing the deflections of a galvanometer needle. The authors tested a number of batteries, all variations of current being accurately registered. Irregularities were found to be caused by two separate actions, a diminution in the current strength, caused by the pores of the partition becoming filled with the base; and secondly, a diminution of the acid at the positive pole. Both these difficulties are overcome by making a partition of as large surface dimensions as possible, and by using very porous material.

AT the January meeting of the Russian Chemical Society, Professor Mendeléeff communicated some results of his investigation into the thermic effects of dilution of sulphuric acid with water. The maximum evolution of heat and the maximum contraction of 100 parts of the solution both correspond to the solution containing from 65 to 75 per cent. of H_2SO_4, which is very near to the hydrate $H_6SO_6 = S(HO)_6$. Together with some other observations, this leads the author to the conclusion that there exist at least five more or less constant hydrates of sulphuric acid, as H_2SO_4, H_4SO_5, H_6SO_6, and two more containing a large amount of water, as $H_2SO_4 + 100\,H_2O$.

A DIVISION has been organised, under Major Powell, of the United States Geological Survey, for inquiring into the geological history and physical conditions of the swamp lands of the United States, with a view to their redemption and improvement. It is expected that by the year 1890 all available agricultural land will have been occupied, and the tide of immigration turned from the rich frontier country to lands passed in the swift march westward. In the region east of the Mississippi upwards of 50,000 square miles can easily be drained. Similar lands in Northern Europe were drained centuries ago, and now form the most fertile fields. The American lands are chiefly along the Atlantic seaboard and the valley of the Mississippi, swamps principally due to close-growing flowering plants, especially common cane, which hold back the water, although the land has a proper incline of 2ft. to the mile. From the mouth of James River to the mouth of Albemarle Sound there is a district of 4000 square miles, a portion of which has been easily and cheaply drained, as it was only necessary to remove the dense mat of stems, roots, and decaying fragments of plants, closely interlaced, which prevented the speedy overflow of the rainfall. A thorough survey is to be made so as to enable the Government to replace in the Public Domain large tracts of land which will then be open for settlement.

A PATENT recently taken out proposes to produce carbon dioxide gas for liquefaction by having a solution of sodium bisulphate in a leaden container, and running into it some carbonate or bicarbonate dissolved or suspended in water, the evolved carbon dioxide being drawn off over a drying mixture into a gasometer, from which it is drawn for liquefaction by compression. Liquid carbonic acid, equal to 600 litres of gas at ordinary pressure, can be supplied for one shilling. In using this for various purposes, it is proposed to pass the gas that escapes after using over moist sodium carbonate, which is thus converted into bicarbonate, which can be again used as a source of supply of the carbon dioxide. There is a bore hole near the village of Burgbrohl, on the Rhine, which yields a constant supply of very pure carbon dioxide. This village is near the Lake of Larch and the interesting volcanic district surrounding it, where there are a very large number of mineral springs and exhalations of carbon dioxide. This bore hole was sunk some two years ago, and has given a constant supply of gas amounting to about 2160 cubic metres per twenty-four hours. The *Brewers' Guardian* says apparatus has been erected for liquefaction of the dioxide, and this is now regularly carried on close to the bore hole. The water which rises with the gas is very cold, and is employed to cool the compressing apparatus. About 500 litres of gas are compressed per minute into about one litre of liquid. This is sent away in wrought iron vessels containing about eight litres.

A BRIEF abstract of the statistics of the manufacture of coke in the United States in the year 1885, published by the United States Geological Survey, shows that in the rank of coke-producing States Pennsylvania still stands first, with Alabama second, West Virginia third, and Tennessee fourth. These four States hold the same rank as in 1884. The largest coke-producing locality in the country is the Connellsville region of Pennsylvania, in which was made 3,096,012 of the 5,106,696 tons, or 60·6 per cent. of the coke produced in the United States in 1885. The second largest producing district is what is called the Irwin-Latrobe, which lies along the Pennsylvania Railroad, from Larimer to Blairsville, and is in part the northern extension of the Connellsville coking field. The number of establishments has slightly decreased. Part of this decrease is due to the consolidation of establishments, but chiefly to the abandonment of works of but little importance. The number of ovens in 1885 is 20,116, as compared with 19,557 in 1884, an increase of 559, 2·8 per cent. There are, however, only about half the number of ovens building at the close of 1885 that there were at the close of 1884. While the production of 1885 has increased over that of 1884, it is not as great as in 1883, the production in 1885 being 5,106,696 tons, as compared with 4,873,805 tons in 1884, and 5,464,721 tons in 1883. There was no increase in the value per ton of this coke in 1885 over 1884, nor has there been for three years. There was, however, an increase in the total value in 1885 over 1884, owing to the larger amount of coke produced in the former year. The yield of coal in coke has also increased somewhat during the past year, it standing at 63 per cent. in 1885 as against 61 per cent. in 1884. The yield in 1883, however, was given as 64 per cent., the largest average yield of coal given, the yield for 1880, 1881, and 1882 being but 63 per cent.

MISCELLANEA.

THE Bath and West of England Society's show next year will be at Dorchester.

ON Saturday two unusually large ropes were despatched by Messrs. George Cradock and Co., Wakefield, weighing each about 24 tons, and being respectively 8400 and 8300 yards.

IT is said some very likely looking specimens of quartz have been found at a reef not four miles from Latrobe, Tasmania. The quartz is similar to that found at Beaconsfield, and is heavily charged with mundic.

AN exhibition of fire extinguishing apparatus was opened at the Aquarium, but there are not many noteworthy exhibits, except a clumsy escape that distinguished itself by its unwieldiness, even on a boarded floor, and extinguished itself by tumbling over and killing a man.

THE Bath and West of England Society's Show will be held on the Durdham Downs, at Bristol, from the 2nd of June till the following Monday evening. Here a splendid site has been enclosed, and the necessary shedding is being erected by the Society. The entries for implements are in numbers extremely favourable.

THE Royal Agricultural Society's Show will be held in July at Norwich. The yard is being rapidly prepared. In the implement department a total length of 10,812ft. of shedding has been allotted. As compared with previous years this length of shedding will be found to be lower than for any of the four previous shows. Until the Society behaves better to the agricultural engineers, it will continue to decrease, and engineers, even those who do not want trials, are saying that the shows are yearly less service to them. Shows are useless without trials.

THE following having satisfied the examiners at the examination held by the Association of Municipal and Sanitary Engineers and Surveyors in London on the 16th and 17th ult., certificates of competency are granted them by the Council of the Association :— Messrs. J. A. Angell, of Leytonstone; H. Ashmead, Clifton; H. G. Coales, King's Lynn; W. C. Fenton, Sheffield; A. D. Greatorex, Toxteth Park; A. Harland, Charlotte-street, W.; F. Osborne, Dover; E. E. Saunders, Walthamstow; J. W. Witts, Skelton-in-Cleveland.

AN American paper says, a new form of tin called by the inventor, Albert Assman, of Rahway, N.J., "assayme," is produced by a special treatment of tin. It has all the good qualities of the latter, can be pressed into any shape, or cast into statuary, or used for plate ware of any description. A beautiful bronze colour can be given to the metal, or any shade from bronze to a silver colour; and as it does not in the least corrode, it is specially valuable as a silver solder. It melts at a temperature of 432 deg., or 18 deg. less than tin. We are not told what alloy it is or what process is adopted.

A RETURN issued by the Marine Department of the Board of Trade as a Parliamentary paper shows the number of lives lost in steamers belonging to the United Kingdom by casualties at sea during the years 1883-4 and 1884-5. The total number of lives lost in steamers during the year 1884-5 was 707, as compared with 614 in the year before. These 707 lives are accounted for thus—by founderings, 121 seamen and 1 passenger; by missing vessels, 388 seamen and 10 passengers; by strandings, 46 seamen and 4 passengers; by collisions, 74 seamen and 23 passengers, and from other causes, 37 seamen and 3 passengers. The number of missing steamers in 1883-4 was 11, and in 1884-5 it was 16.

THE mining owners of Ostraw Rarwin have decided to offer a prize of 1000 ducats for the best invention for preventing accidents in firing and blasting in dusty or gaseous coal mines, or rendering the operation harmless. The invention should fulfil the following conditions, namely :—(1) Its use, effects, or explosion should not cause the coal dust to ignite. (2) It should not produce after the explosion or use more injurious gas than through the methods heretofore employed. (3) No specially difficult, dangerous long preliminary arrangements or complicated apparatus should be required in using, setting up, loading, transporting, or lighting. (4) Should not by its use and result be much more expensive than the former blasting methods. Applications should be sent before the end of 1886 to the K.K. Berghauptmannschaft at Vienna.

THE ordinances of the Plumbers' Company, dating from A.D. 1365, fix St. Mark's Day as the first quarterly meeting of the year. The observance of this ordinance has continued unbroken since that date, and by reason of St. Mark's Day falling this year upon Sunday, arrangements had to be made for holding the meeting upon the Bank Holiday, at the Guildhall Tavern, Gresham-street, which was opened specially for the purpose. A court assembled, and among the aged women admitted to the annual pension and relieved by a grant of £5 5s. was Charlotte Hardcastle, who produced the indentures of apprenticeship and freedom of her father, a liveryman of the company, dated 1765. The quarterly returns of the United Operative Plumbers' Association of Great Britain and Ireland—numbering 3000 plumbers in various parts of the kingdom —were submitted to the court, with a communication from the general secretary, expressing the satisfaction of the executive council of the association with the system of registration established by the Plumbers' Company.

THE spring meeting of the American Society of Mechanical Engineers will be held in the city of Chicago, Ills., on the 25th-29th inst. Besides excursions and visits of much technical interest, the following papers will be presented for discussion at this meeting :— Wilfred Lewis, "Experiments on Transmission of Power by Belting;" Wm. O. Webber, "Relative Efficiency of Centrifugal and Reciprocating Pumps;" Horace See, "Production of True Crank Shafts and Bearings;" Geo. H. Babcock, "Substitutes for Steam;" Chas. W. Barnaby, "New Steam Engine Indicator;" F. G. Coggin, "Novel Chimney Staging;" Thos. S. Crane, "Water Purification for Manufacturing and Domestic Consumption;" H. R. Towne, "The Engineer as an Economist;" H. Metcalfe, "Shop Orders and Accounts;" C. M. Woodward, "Manual Training Schools;" O. Smith, "Inventory Valuation of Machinery Plant;" Fred. W. Taylor, "Value of Water-gas and Gas from Siemens Producers for Melting in Open Hearth Furnaces;" Wm. P. Trowbridge, "Ventilation by Heated Chimneys and Fans;" Thos. D. West, "Irregularities in Contraction of Duplicate Castings;" C. M. Giddings, "Dynamometer for Measuring Power Required to Move Slide Valves;" J. H. Cooper, "Grain Handling in California." If some reorganisation in our Institution of Mechanical Engineers were effected, it might be able to present such a programme as this.

THE annual report of Mr. G. B. Jerram, A.M.I.C.E., surveyor to the Walthamstow Local Board, contains notes on important works which have been executed for the completion of the drainage of the district and disposal of the sewage. The works include underdraining of about 35 acres of land, the construction of 1 mile 180 yards of concrete and earth carriers for the distribution of the effluent water over the south-westerly portion of the sewage farm, so that now over 100 acres of land of good and suitable soil are available for the purpose of deodorising the sewage, in addition to the oxidising influences which are exercised in the effluent water over two miles of open carriers before it is discharged into the Dagenham Brook. The works also comprise the erection of brick mixing shed, offices, boiler and engine houses, with machinery for grinding the chemicals, and automatic arrangements whereby the varied flow of the sewage regulates the inflow of the proper amount of chemicals, securing a regular and even pureness of effluent sewage. Machinery has been made to effect a more convenient disposal of the sludge, which is now pumped into troughs and passed on to the virgin soil at the rate of one acre a month, and there dug or ploughed into the land at the south-easterly portion of the farm. To prevent a large amount of rain water entering the sewers and passing on to the sewage disposal works, 4⅓ miles of surface water sewers have been constructed. Over five miles of sewers have been constructed to provide for the drainage of the northern and western portion of Higham Hill and other areas.

EXPRESS PASSENGER ENGINE, HUNGARIAN STATE RAILWAYS.

CONSTRUCTED IN THE HUNGARIAN STATE RAILWAY WORKS, PESTH.

(For description see page 352.)

FIG. 3.

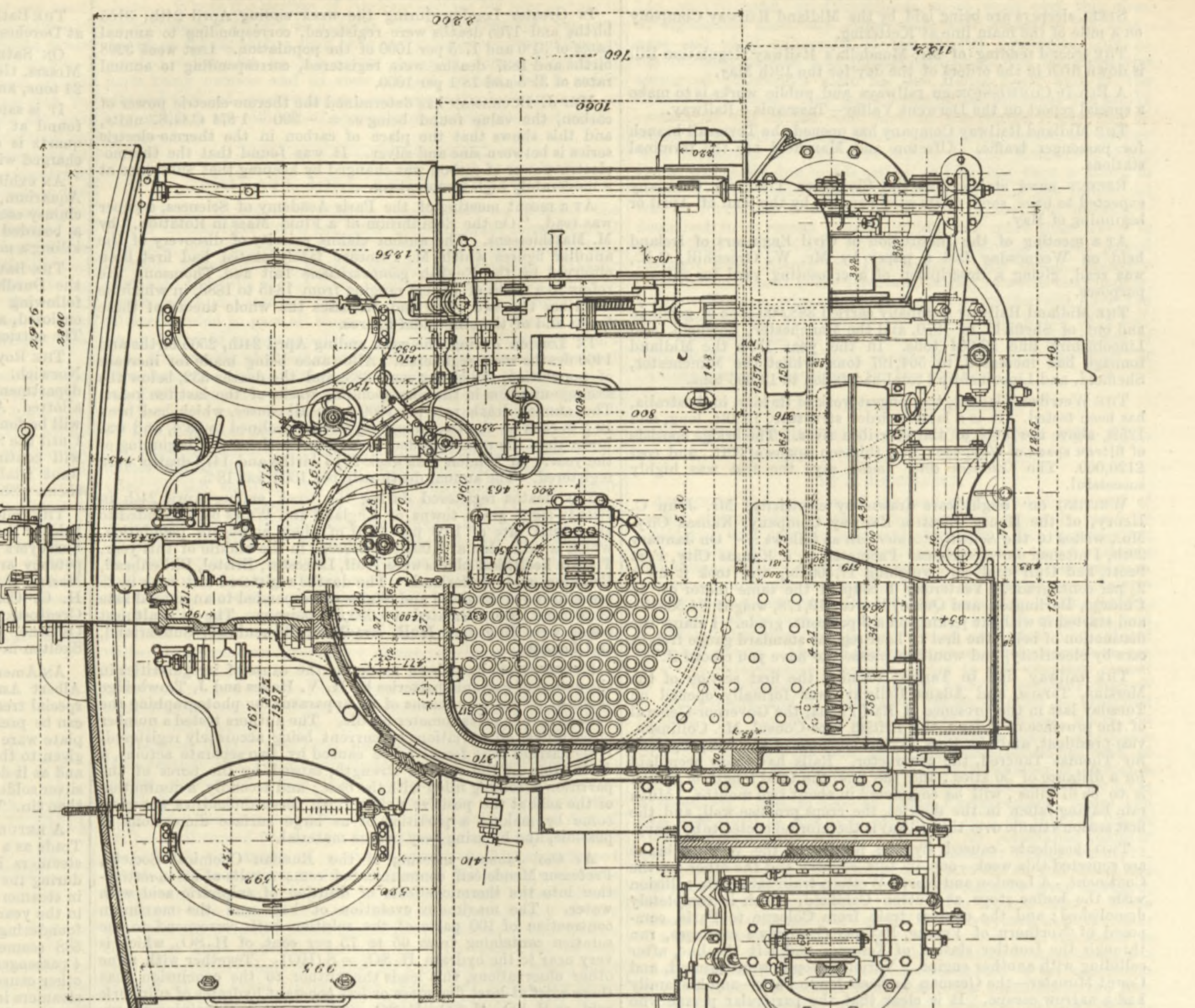
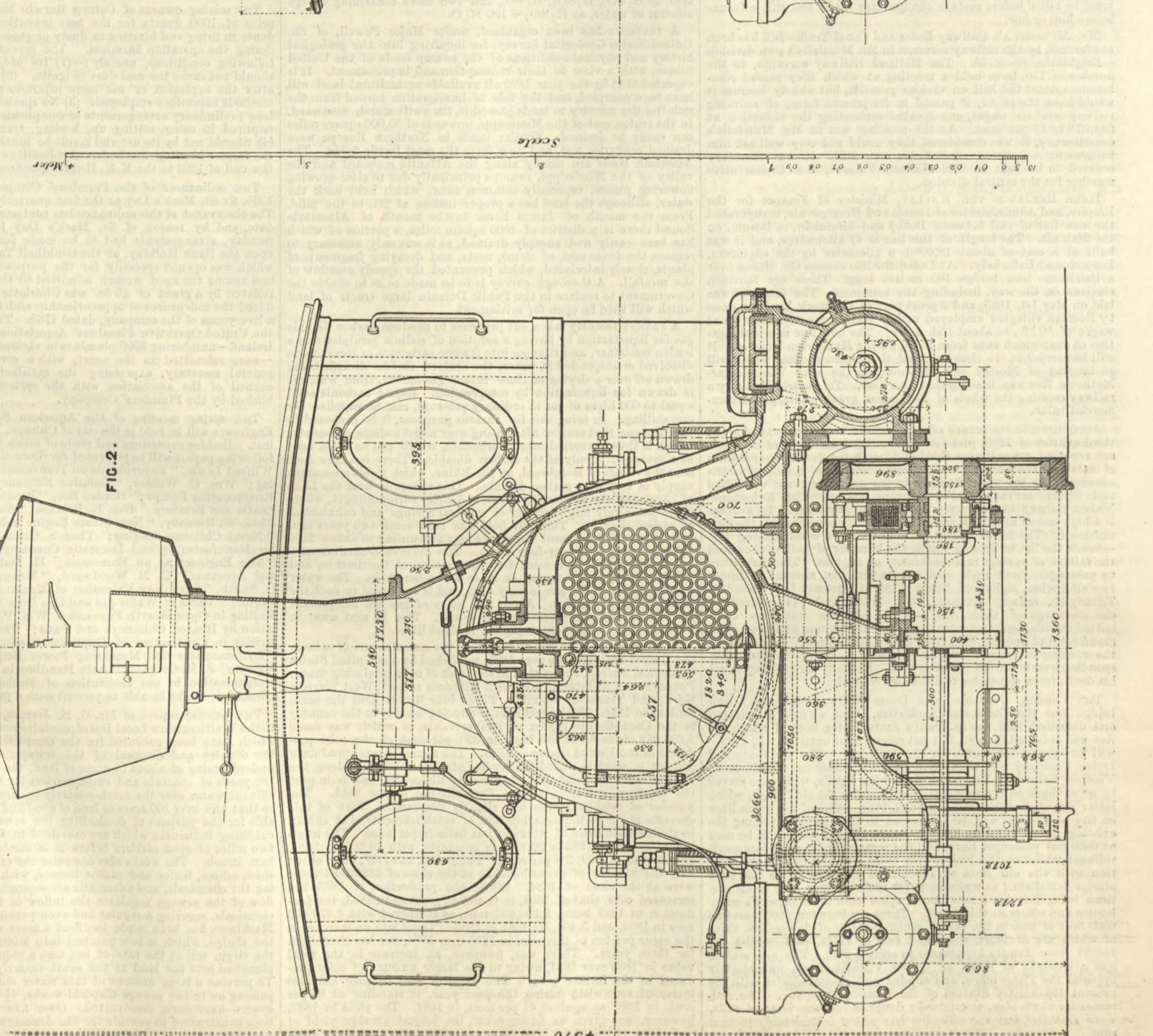


FIG. 2.



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-street.*

CONTENTS.

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

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

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

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

PHOS.—*There is nothing to prevent any one from writing C.E. after his name.*

QUININE MACHINERY.—*A letter on this subject awaits the application of "Johns."*

CHAFF CUTTER.—*Letters on transmitting power still await the application of this correspondent.*

E. E. G. D.—*Complete lists of the prize numbers were published in the Belgian newspapers long since. If you cannot obtain one, write again.*

VALVE.—*You can obtain any patent specification from H. Reader Lack, Patent-office Sales Department, Cursitor-street, Chancery-lane, but you must state number and year, and must remit cost.*

STATICS OF BRIDGES.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers give me the name of the writer of the series of articles "On Statics of Bridges," published in the *Civil Engineer and Architects' Journal* of 1861? MOUSE.
London, April 30th.

PLANT FOR COMB MANUFACTORY.

(*To the Editor of The Engineer.*)

SIR,—We should feel much obliged to any of your readers who would be good enough to inform us where we could obtain a quotation for the plant necessary to install a small comb manufactory? C. AND L.
London, May 5th.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Tuesday, May 11th, at 8 p.m.: Ordinary meeting. Papers to be further discussed, "The Mersey Railway," by Mr. Francis Fox, of Westminster, M. Inst. C.E. "The Hydraulic Passenger Lifts at the Underground Stations of the Mersey Railway," by Mr. William E. Rich, M. Inst. C.E. Paper to be read, time permitting, "Modern Machine Tools and Workshop Appliances for the Treatment of Heavy Forgings and Castings," by Mr. William W. Hulse, M. Inst. C.E.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS, 25, Great George-street, S.W.—Thursday, May 13th, at 8 p.m.: Paper to be read, "Long Distance Telephony," by Mr. W. H. Preece, F.R.S., Past President.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—The last general meeting will be held in Newcastle-upon-Tyne, on Wednesday, May 12th, at 7.45 p.m., when the discussion "On High-Speed Engines" will be resumed. It is also intended to discuss and pass proposed alterations in bye-laws. The retiring president, Mr. W. Boyd, will declare the result of the ballot for the officers for the ensuing year, and will vacate the chair, which will then be taken by the president elect.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, May 10th, at 8 p.m.: Cantor Lectures. "Animal Mechanics," by Mr. B. W. Richardson, M.A., M.D., F.R.S. Lecture II.—Some details of animal mechanisms—the valve, the pulley, and the joint. Tuesday, May 11th, at 8 p.m.: Special Lecture. "Japanese Art Work," by Mr. Ernest Hart. Lecture II.—Japanese porcelain and pottery. Wednesday, May 12th, at 8 p.m.: Twenty-first ordinary meeting. "The Proposed Fishery Board," by Mr. J W. Bund Willis-Bund. Sir Edward Birkbeck, Bart., M.P., will preside. Thursday, May 13th, at 8 p.m.: Applied Chemistry and Physics Section. "The Scientific Development of the Coal Tar Colour Industry," by Professor R. Meldola, F.C.S. Professor James Dewar, M.A., F.R.S., will preside. Saturday, May 15th, at 3 p.m: Special Lecture. "Electricity," by Professor George Forbes, M.A, F.R.S.E. Lecture V.—Induction.

THE ENGINEER.

MAY 7, 1886.

THE BURSTING OF A 43-TON GUN ON BOARD H.M.S. COLLINGWOOD.

OUR readers will have read with regret that a 43-ton breech-loading gun burst on board H.M.S. Collingwood, while the armament of the vessel was being tested off the Isle of Wight, on Tuesday, May 4th. The gun is one of four, mounted in barbette towers, this one being the left gun of the after barbette. A scaling charge having been fired, the gun was loaded with a firing charge of 221¼ lb. and a shell filled with water, reported as weighing 214 lb., but about this there must be a mistake, the projectile for this gun weighing about 720 lb. On firing, the gun "went" at about 5ft. from the muzzle, the steel tube in front of the strengthening hoop being broken to pieces, the fragments severing the structure of the ship near the muzzle, but happily injuring no person. Being a trial day, Admiral Herbert, Admiral Hoskins, the Director of Naval Ordnance, as well as Captain Fisher, commanding H.M.S. Excellent, and representative officers from the Gun Factories, Ordnance Committee, and Admiralty, were present; also Mr. Vavasseur, on behalf of Sir W. Armstrong and Co.

We can supply the facts of the case correctly. The piece in question was one of twelve ordered on first approval of the pattern. It is known as Mark II., Mark I. differing chiefly from it in being a land service gun with trunnions. This is a trunnionless gun made of wrought iron and steel, being one of the guns that had steel coils in front of the trunnions. After the introduction of these two guns, slower powder came in, yielding results with lower maximum pressures, but of course continuing high pressures further forward in the bore. This in conjunction, no doubt, with the difficulties attending the introduction of steel ordnance on a large scale, led to the guns being found too weak near the muzzle. One gun burst on board H.M.S. Active near the muzzle just as this one has done on board the Collingwood. Consequently, on February 3rd, 1885, the Ordnance Committee was assembled, and had associated with them a number of specially selected authorities, including Sir W. Armstrong, Sir F. Abel, and Captain Noble, and Mr. Leece, of Whitworth's, as well as Colonel Maitland. It was then decided to strengthen guns in course of construction in the chase, and to make a stronger pattern for future manufacture. The case of the 43-ton gun, which now concerns us, was dealt with as follows:—"12in. Marks I. and II. (steel tube and front coils, wrought iron jacket and breech piece) to remain unaltered, but the charge of 295 lb. cocoa powder not to be exceeded. Marks III. and IV. steel to be hooped to the muzzle. This will enable these guns to fire increased charges if desired, they being of steel and of sufficient strength at the breech. Mark V. (steel) for No Man's Fort, at present under consideration, to be made on a design having the chase made of a double tube, or tube in two thicknesses. Guns for future construction to be made on a design with a chase formed of a double tube." Thus, there exist five patterns of 43-ton or 12in. breech-loading guns. Mark I. for L.S. and Mark II. for S.S. classed as less strong and limited as to charge. Mark III. L.S. and Mark IV. S.S., chase hooped to the muzzle, and Mark V. made double-tubed to the muzzle.

The Collingwood gun being Mark II. is the less strong sea-service pattern. It is greatly to be regretted that it should have burst. Such an accident must shake credit and confidence in our guns, especially occurring with so large a piece. We have no notion of speaking as if we meant to be special pleaders for English guns, much less for the gun factories. Nevertheless, we must be glad to see any features that qualify or mitigate the misfortune; and we are glad to find that, as we hoped on first hearing of the accident, that the gun is of a pattern which has been superseded as not so strong as desirable, though no doubt believed to be strong enough to fire a charge of 295 lb., and not to burst with one of 221¼ lb. The difficulty has crept on us from the improvement in powder. The general tendency is unavoidable. This failure is to be regretted, but is not so difficult to understand as one in any other direction. The steel doubtless was weaker than usual from a flaw or some unperceived cause; and the margin of strength was not sufficient to cover such a casualty.

Probably it may lead to the eleven others of the same pattern having their case specially dealt with. On those guns since made with chase hoops added, with a view to meet this known tendency arising from the use of the new powder, we trust this accident has no bearing. We have said that we do not wish to be special pleaders for English guns. We think there is no need to apologise now for them. It happens that just now we have had evidence from our special correspondent at Spezia of the fact that while our steel projectiles, especially in some respects, need attention, our heavy guns are second to none: indeed, we believe them to be now rather in advance of any. In another issue our readers will find a list of the 100-ton and 105-ton guns now being made, or made, for Italy. Some of these are nearly ten years old. They have fired projectiles with enormous energy, and with the exception of one of the first guns drawing asunder, without injuring any one seriously, no kind of accident has occurred. We are all waiting to see what Krupp's 120-ton guns will do. They seem to hang fire. Up to this point no other nation has publicly produced a gun with the energy that English guns have had for ten years past. Of course our heavy guns form only one phase of the question; we all know that previous to 1880 our service muzzle-loaders generally were dropping far behind Krupp's breech-loading guns. Even at that time we had experimental breech-loading guns equal to any. The introduction of these into the service has been a serious matter, and we have had accidents, happily almost entirely without loss of life—these accidents being chiefly of the type of the one now before us. If our readers, in spite of what we say, think our guns in a bad way, they must be disheartened, we fear, about all our armament, for except perhaps carriages, we know of nothing else that is of the best.

THE INDIAN AND COLONIAL EXHIBITION.

ON Tuesday her Majesty the Queen opened the Indian and Colonial Exhibition with much ceremony and state. The weather was all that could be desired, and the attendance was very large. The daily press has left nothing undone to render the Exhibition a success; and we have no reason to doubt that it will prove very attractive. But it is only necessary to walk through it to see that many of the statements made concerning it are, to put things mildly, statements in advance of the facts. In truth, the Exhibition is unable to give any adequate idea whatever of the importance of the countries which are supposed to be represented; or of the magnitude and dimensions of their industries. Nothing of engineering interest is to be found at South Kensington—at least, nothing sent from abroad. There is a magnificent collection of photographs, and these, and these alone, give an idea of the work that has been done by engineers in our Colonies. It is impossible for any intelligent person to examine the contents of the building with care, and not to arrive at the conclusion that if the things exhibited really indicate the nature and magnitude of the industries carried on, then our Colonies are very third-rate countries indeed. Let us take, for example, the great gold-mining industry of Australia. It is represented solely by certain pyramids and columns of gilded wood, intended to represent the bulk of the gold obtained during certain periods; and by a collection of quartz and other gold-bearing strata, decorated here and there with little bits of gold-leaf, to convince the ignorant who might be sceptical as to the truth of the statement that the common-looking stones shown really do contain gold. It might have been worth while, we think, to have shown a stamp mill and a set of mining machinery employed in working gold-bearing quartz; but nothing of the kind is to be seen. The enormous wool industry of the country is represented by a few fleeces under glass cases. The same statement holds good in substance of all our Colonies.

If we regard the Exhibition as a temporary ethnological museum, there is more to be said in its favour. Great credit is due to those who have devised and arranged the various groups and figures. We have here a species of multiplied and glorified reproduction of the now antiquated groups of savages and animals, which at one time formed, we believe, a great attraction at the Crystal Palace. Just inside the entrance to the great hall is a wonderful jungle scene—wonderful in more ways than one. Within a comparatively small space, intended to represent the primeval forest, are crowded together as many stuffed beasts, birds, and reptiles as could be got into it. We need hardly tell our readers that nothing can be more unlike nature than this assembling together in one little spot of bears, panthers, anacondas, elephants, tigers, crocodiles, alligators, goats, peacocks, tortoises, and parrots. The figure of a half-naked native stands in one corner, with his hands raised, and his mouth and eyes wide open, astounded, as well he may be, at the wonderful sight before him. We do not wish to speak severely of Mr. Ward, and we state with pleasure that the stuffing and the grouping of the animals, &c. &c., is admirable; but the whole affair lacks scientific interest of any kind. It will, of course, address itself to the populace, and by them it will be keenly appreciated; yet we venture to think that by more judicious treatment a more valuable result would have been obtained. In the Indian department groups have been arranged and Indian shops fitted up, which give a fair idea of Eastern life, and possess about the same value as that which would in Bombay invest, let us say, a model East-end greengrocer's shop, with an effigy of the greengrocer standing in the midst of wax and plaster cabbages and potatoes and oranges; while another effigy was supposed to ask the price of the commodities before him. All this kind of thing has been done with great art; but it is a low type of art, and when we are told that such things give a full idea of the life of a great Indian city, we cannot resist a smile. Such things are admissible in their way and have their uses, but the men who write about them in terms of fulsome praise demonstrate in so doing either their ignorance, their shallowness, or their insincerity. The great building which occupies the site in front of the principal entrance to Old London is the most interesting, and the most valuable thing in the whole Exhibition, because in it real natives are to be seen carrying on their various handicrafts. A family may be seen seated in a row in front of the loom or frame on which they are weaving one of those wonderful carpets which are the admiration and despair of our own carpet manufacturers. In another place may be seen the copper worker producing wonderful results by indomitable patience, with the aid of half a dozen rude tools, a few scraps of charcoal, and a goat-skin bellows. Here a great deal is to be learned, but there is far too little of this in the building. We see results, but the evidences of the means by which those results are brought about are wanting. The main south gallery has been fitted up from end to end as a huge bazaar for the display and sale of Indian wares. The shops extend so far out from each side that only a comparatively narrow roadway is left between them, while from the roof depends a multitude of flags of all colours, arranged apparently at haphazard, without regard to congruity, and so dwarfing the hall in height at to produce a perfectly disastrous effect. The incandescent lamps, which, arranged in rows along the roof, have at other exhibitions rendered darkness visible, have been discarded in favour of Brush arc lamps, which are pleasing in design, even if they are unsatisfactory in performace as the manner of Brush lamps always has been. In other departments the lighting is effected by Crompton arc lamps of enormous dimensions, which differ from the Brush lamps in that while they burn very steadily, they are, without exception, more hideous in design than any arc lamp yet produced, and this is saying a great deal. The power required for lighting the inside of the building will be supplied this year exclusively by Messrs. Davey, Paxman, and Co., of Colchester, who have entirely remodelled the arrangement of the shed in a way which we shall illustrate in an early impression. The Siemens dynamos and Goodfellow and Mathews' engines, which worked with doubtful success last year, and now form the subject of a lawsuit between the makers of the engines and the makers of the dynamos, stand idle in the West Arcade. The whole of the lighting outside will be done by Elwell-Parker dynamos, driven by two fine compound engines by Messrs. Galloway. New and very elaborate and beautiful effects will be produced with the fountains under Sir Francis Bolton's directions; and no stone will be left unturned to render the summer evenings spent at South Kensington yet more pleasant than those of last year.

The Indian and Colonial is the last of the series of annual Exhibitions. Some years ago a similar series on a small scale was organised and worked for a few years, when it died a natural death of sheer inanition. We cannot pretend to feel regret that the present series expires next October. There has always been something mysterious about these Exhibitions; no one knows who really "runs them"—to use an expressive American phrase; what becomes of the money received; or, indeed, anything at all about the commercial aspect of the undertaking. The Prince of Wales, we may rest certain, is perfectly sincere in his desire to make them valuable and interesting, and if he was not satisfied that everything was straightforward and above board he would not lend his name, or exert himself to help them on. The managers have only themselves to thank if, as we have said, an air of mystery pervades South Kensington. After all, however, it is really not the business of the outer world to know what becomes of the money. So long as the public have full value for a shilling in the way of entertainment it need not be too curious; and that it will have full value this year there can be no doubt whatever.

THE PAY AND POSITION OF DRAUGHTSMEN.

For some weeks past we have published a number of letters, of which the earlier dealt with workshop drawings, their successors by a natural transition referring to the title we have chosen for this article. We have given insertion to these letters, not because they in themselves contained anything new, nor because we expected that their publication would elicit others which would. The truth is, that the topic is trite and well-worn, and we have given publicity to our correspondents' views simply as possibly affording interest, and perhaps instruction, to students and pupils. Two points are involved, namely, the advisability of making proper and complete drawings; and, secondly, the qualifications, pay, and position of draughtsmen. As regards the first of these, every line of the letters dealing with it shows the writers to be enthusiastic, and, therefore, probably young. There is a total absence—if we may venture to say so, without the faintest desire to hurt the feelings of our correspondents—of perception of the forcible truth of that to which a successful man attributed his success. "I never took the world," said he, "as it ought to be; I invariably took it as it is."

In some respects we agree with the views and suggestions made by "R. G. H." as to the method of getting up working drawings. Where a new tool or machine is being schemed out, of which a great number is to be made, and for which a set of standard drawings is required; or in the case—a rather rare one—where a very large and expensive machine, such as a crane to lift great weights; a caisson; a floating dock, &c., are in hand, the drawings ought to be got out with great elaboration. But in such examples the magnitude of the work will admit of the cost, and imperfect drawings may entail very heavy avoidable expenses. For general average drawings such elaboration is unnecessary; it causes needless expense, and is just as likely as not to defeat the object in view, and by excessive complexity to create confusion. Nothing will compensate for a lack of simplicity in a drawing; and this lesson is the one most slowly learned by young draughtsmen. They enter a drawing-office fresh from school or college, brimming over with enthusiasm. They cannot, or will not, approach the simplest question involved in their work without going into unnecessary elaboration of detail. If one of them be asked to calculate the proper length of lever for a safety valve, all other data being given, he will cover sheets of paper with equations, and probably, after some hours' weary work, bring out a result altogether wide of the thing required. An excellent example of this was supplied by Mr. Macfarlane Gray, in a discussion before the Institution of Naval Architects. He spoke of a man who sent in six pages of foolscap covered with calculations of the strains in a three legged stool, and this not in joke, but in perfect sincerity.

We cordially agree with our correspondents that things might be better done in many drawing-offices, but then that is not the affair of any person save the "powers that be." When, as we hope for their own sakes may soon be the case, our correspondents who hold these views come to have works and a staff of their own, they will perhaps view things differently. Some of our correspondents make complaint of managers and foremen, and of their intense desire to have their own way. That is but human nature; all men have the same desire. All draughtsmen have to do is zealously and faithfully to put in shape the ideas of their employers, and if they begin by doing this in a proper manner, afterwards, when they have gained the confidence of those over them, they may, in a nice and modest way, point out certain difficulties in the way of carrying out a scheme, and they will be listened to with respect, a discussion on the point will ensue, and they will learn something. The question of practical *versus* theoretical men does not need discussion in this connection. Each class will hold its own views. Both have useful duties to fulfil, and the draughtsman who is wise will try to conciliate the works manager and the various foremen, all of whom can give him invaluable information not to be learned in college or the office; and our experience of these heads of departments is that they are always ready and willing to give information and explanations to pupils or draughtsmen if only the latter will approach them in the proper spirit.

There is one misleading feature about some of the letters we have published which we may as well correct. One or two writers seem to imply that the entire onus of the successful construction of a machine is thrown upon the shoulders of the particular draughtsman making the drawings. This is not correct. In every office having the smallest pretensions to be properly conducted, both the works manager and the foremen are consulted about the arrangement of details, so as to insure inexpensive production as well as correctness from a practical point of view. As to the pay and social position of draughtsmen, these are points which no amount of paper and ink discussion can ever settle. Like all other industrial questions, it is simply one of supply and demand. If manufacturers are so blind to their own interests as to prefer incapable men because they get them at low salaries, why that is their own affair. One or two of our correspondents give, themselves, the remedy for the evils complained of, namely, to get out of the drawing-office as soon as anything better offers.

THE SAFETY OF WELL-DECKED STEAMERS.

The reference to the question of the freeboard of well-decked steamers in The Engineer gives interest to the statement of the experience of one of the clubs for mutual insurance in the north-east which has been formed two years ago or so for the insurance of that type of steamers alone. It includes a very large number of vessels, and for the two years ending with 1885 its experience has been shown in a series of tables which indicate the vessels lost and the causes of the loss. In the two years there were 59 losses through stranding; 29 through collision; 4 "missing," and 2 foundered. The vessels lost through stranding were of 66,453 tons; the tonnage varied from 391 to 1886. Those lost through collision were 30,891 tons in the total, the vessels varying from 360 tons to 1826 tons. The missing vessels had an aggregate tonnage of 2539; and they varied from 367 tons to 1035 tons; whilst the loss from foundering included two vessels of 807 tons and 664 tons respectively. Cases of collision and stranding are those in which any blame for the occurrence is not attributable to the type of vessel; and hence it is of interest to notice that 93·62 per cent. of the vessels lost were lost through these causes, whilst the remaining 6·38 per cent.—missing and foundered—is occasioned by causes to which the type of vessel may or may not be contributory. The percentage of the tonnage is more in favour of the vessels; 96·04 per cent. of the losses in tons being attributable to the stranding and collision cases, and the remaining 3·96 per cent. to the cases of vessels missing and those reported as foundering. The experience of other clubs insuring equally vessels "well-decked" and others not of that type, and managed in the same town or district, has been compared, and the results have been declared to be satisfactory to the owners of the well-decked type. We need not, however, enter into that comparison here, as it is needless to enter into the question of the merits of the two types of vessels. The fact that over 93 per cent. of the number of vessels lost were lost through stranding and collision, and that out of a number of some hundreds, must be taken as a proof that the largest part of the loss of this type of vessels, at least at sea is due to causes over which the owners cannot be said to have any control, as they occur when they are out of their control, and under the care of officials for whose seamanlike qualities the Board of Trade vouches. It would be an interesting feature if the experience of the great assurance clubs and companies could in a like manner be tabulated and published. We are far from having exhausted the resources of civilisation in the attempt to lessen the loss of life and property at sea; but one reason is that there is no endeavour to gather together the teachings of the experience of the past, nor to indicate and group the records which show in individual cases the type of vessels lost, the causes, the states of the weather, and other particulars. In the cases of mine explosions we have this done yearly, and the elaborate statements of the mine inspectors from year to year, the record of the loss of life, the nature of the accident, and the variations of these from year to year form part of a valuable fund of information which has its uses in showing how the endeavours to grapple with the various kinds of accidents have been productive of good. We need something of the same kind in relation to losses at sea, and especially the information as to the type of vessel and the material. On this line the return of the Well-Decked Association of the north ventures; and it is thus of value and may lead to the obtaining of fuller and more general information.

ITALIAN COMPETITION.

Since it was arranged by the Italian Government with Sir W. G. Armstrong and Co. that the latter firm should put up a new engineering factory in Italy, a somewhat similar understanding has been arrived at with Messrs. Hawthorn, Leslie, and Co. An order has also been given them for the engines of an ironclad, the value of which will be very considerable, and will keep the works at St. Peter's occupied for a considerable length of time. This policy of the Italian Government, harmonising as it does with that of most other foreign Governments, indicates intentions which cannot but fill all connected with industrial operations here with concern, if not alarm. It may suit the pockets of the owners of first-class engineering works in England to plant competing works in countries which have hitherto been our best customers, and to educate the unskilled of those countries into skilled labour, and to attract thither some of the best engineering and operative talent from this and other countries. They may have such an immediate and heavy profit in view as to make secure their own fortunes, and they may not concern themselves with the effect on other people's interests, or even in the interests of their own successors. But is it not worth while to pause for a moment and consider what this policy will lead to from a national point of view? The Italian Government are avowedly "giving a sprat to catch a mackerel." They are buying not only engines, ships, and guns, and paying for them—to which no one can object—but they are offering "messes of pottage for British birthrights," and are succeeding in bringing their offers to business. Indeed, to speak the truth, the holders of "birthrights" seem to be keenly competing with one another as to who shall most fully and completely part with them for the coveted "messes of pottage." Englishmen generally are complaining bitterly just now that foreigners will make for themselves articles and products formerly supplied by us; and not only so, but they will send their surplus manufactures into neutral markets and undersell us there. Nevertheless, there are other Englishmen doing their best to expedite a precisely similar change, and make it complete, with regard to one of the few important foreign customers still left to us. Perhaps all this is unavoidable. Perhaps, if Englishmen did not turn instructors and organisers and suppliers of capital to foreigners, in order that the latter should learn to do without them, and even compete with them, perhaps Germans or Americans would do it, and pocket the profit attached to the business. Perhaps it is an unavoidable incident in what Napoleon III. used to call "the inexorable logic of events." It is highly probable that most of those who complain the loudest about the loss of our foreign trade, and the competition of foreigners in neutral markets, would do as the above-named eminent firms are said to be doing in Italy, if only they had the chance in return for adequate remuneration. Be that as it may, it is surely not unwise to look for a moment before these leaps are fully taken, rather than suffer the consequences quietly to mature themselves, and then complain bitterly that Italy also has ceased to be our customer.

A RAILWAY ACCIDENT IN SOUTH AUSTRALIA.

It would seem that our Colonial relatives are in a better position than many of their friends in England when enjoying an Easter Monday excursion. News comes by cable that a long excursion train containing over 400 passengers was placed in imminent peril near Adelaide, and that but for the Westinghouse brake a terrible calamity would have occurred. The pleasure seekers and their friends were no doubt duly grateful, and the Government also are probably congratulating themselves on having recognised their responsibility in not permitting such valuable freight to be carried without proper safeguards. It may be that in a new and rising colony human beings are more valuable than in our own overcrowded country, but however this may be, we need hardly remind our readers that there are still numbers of trains in this country equipped with very inferior appliances which on long trains would be of comparatively little use in great emergencies. It is chiefly, perhaps, on long excursion trains that the want of prompt and simultaneous action can be best illustrated, and at the most terrible cost, and it was no doubt owing to the singular possession of these peculiar qualities in the Westinghouse brake that the above accident was averted. In the midst of many changes the laws of the universe remain fixed—at all events, for the present; and for so long will pressure brakes excel vacuum brakes in rapidity of action, and consequently in their superior capacity for saving life in those emergencies which are, and will no doubt continue to be, the accompaniments of the ever increasing growth of our railways.

LITERATURE.

A Concise Dictionary of the English Language. Literary, Scientific, Etymological, and Pronuncial. By Charles Annandale, M.A., LL.D. London: Blackie and Son. 1886.

This dictionary is based on Ogilvie's well-known imperial dictionary, and seems to be comprehensive. We may, perhaps, be permitted to judge to some extent of its efficiency by reference to words of scientific employment. Numbers of words not in concise dictionaries of a few years ago are to be found in this, and the meanings are generally satisfactorily explained. Acceleration might, however, have received a more precise and scientific definition—"the act of accelerating or state of being accelerated; increase of velocity." Adiathermic is given, but adiabatic is not. One of the definitions of force is "momentum." Ohm's law is not quite satisfactorily explained as "an important law referring to the causes that tend to impede the action of a voltaic battery." It is not, however, fair to judge of excellence from this point of view, especially as this seems to be an excellent dictionary for general use, well printed in clear type.

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ON AN UNNOTICED POINT IN DARCY'S EXPERIMENTS ON FLOW IN PIPES.

By Professor W. C. UNWIN.

PROBABLY no series of experiments ever produced so great an effect on hydraulic science as the experiments of Darcy on flow in pipes—unless, perhaps, we admit as the exception Mr. Froude's experiments on the resistance of bodies towed in water. But as regards the whole knowledge of flow of water, although many experiments have been made since—some on a larger scale than Darcy's—they have hardly done more than slightly correct the numerical co-efficient of resistance for certain cases. For all practical purposes the observations of Darcy remain the standard of comparison for all later experiments, and every attempt at advance in theory has been made to rely on Darcy's observations for confirmation. In no other experiments have the conditions modifying the laws of flow been so varied; no other experimenter has shown equal insight into the requirements of accurate research, or equal originality of method. M. Bazin has indeed completed Darcy's work with assiduous labour and marked ability. The extension of Darcy's methods to observations on the flow in open channels is important, no doubt. But the later work has led to no such important advance, either in method or in generalisation, as the earlier researches in Darcy's "Memoir" of 1857.

It is somewhat singular, therefore, that a curious and unexplained anomaly in Darcy's experiments has, so far as the writer knows, hitherto escaped notice. The pipes on which Darcy experimented were generally about 115 metres in length. The loss of head due to the resistance of the pipe was measured at five pressure columns. Two of these were near the feed reservoir, and may for the present purpose be ignored. The other three were placed, No. 3 at about 4·7 metres from the inlet to the pipe, No. 2 at 50 metres beyond this, and No. 1 at 50 metres beyond No. 2, and near the discharge end of the pipe. Hence, the difference of height of the pressure columns 1-2 and 2-3 each represented the resistance of 50 metres of pipe. According to all rules of hydraulics these differences of level should be equal, and Darcy states that he expected they would be so. The middle pressure column was therefore used as a check on the other two. When the difference of level 1-2 and 2-3 was not nearly equal, it was assumed that air in the pipes or some other cause was interfering with the flow, and measures were taken to remove the obstruction; when the two differences of height were nearly equal the experiment proceeded. That a small difference always remained is attributed by Darcy to possible accidental differences of diameter in the two 50-metre lengths to which the pressure columns were attached. On this it need only be observed at present that accidental differences of diameter would distribute themselves sometimes in one 50-metre length, sometimes in the other. Out of twenty-two pipes experimented on, it could not accidentally happen that the smaller pipes were always put in the second 50-metre length and the larger in the first. Yet in Darcy's experiments the greater piezometric difference is almost invariably between pressure columns 1-2, and the less piezometric difference between columns 2-3. Further, in the case of the drawn lead pipes and the wrought iron gas pipes, it is nearly impossible to believe that there could have been the difference of diameter necessary to explain the difference of the pressure column heights.

The following table contains the difference of head lost between pressure columns 1-2 and that lost between pressure columns 2-3. Wherever the difference 2-3 is greater than 1-2 a minus sign is prefixed. The table is divided into three parts, the first containing experiments with heads less than 0·1 metre, where the quantities measured are so small that irregularities in their difference may be taken to be accidental and without significance. In the second part are the experiments with heads of from 0·1 to 6 metres, measured with the water pressure columns. In the third part are the experiments in which the heads were over 6 metres, and were measured with mercury columns.

The lead pipes had piezometers at 25 metres distance, and the glass pipe piezometers at 22 and 23 metres. For comparison Darcy's numbers are reduced to equivalent numbers for 50-metre distances.

Difference of Head Lost in two Consecutive 50-metre Lengths between Gauges 1–2 and 2–3, in metres of Water.

Total head lost.	Drawn wrought iron.			Glass.	Lead.			New cast iron.			Old cast iron.	The same cleaned.
Diameter of pipe.	·0122	·0266	·0395	·04968	·014	·027	·041	·0819	·137	·188	·2432	·2447
Less than 0·1 metre.	·001	·003	·002	·002	·012	0	·002	0	0	·001	·004	·002
	0	·006	·010	·010	0	·004	·014	·007	·011	– ·005	—	·005
	—	—	·001	—	—	—	—	—	—	—	—	—
Between 0·1 and 6 metres.	·004	·016	·010	·014	·004	– ·008	·018	·002	·015	·008	·006	·008
	·019	·025	·012	·050	– ·006	·012	·074	·015	·027	·035	·003	·025
	·002	·027	·022	– ·081	– ·034	·024	·220	·020	·080	·060	·020	·035
	·091	·040	·015	·220	– ·066	·060	·482	·035	·135	·070	·030	·035
	·150	·074	·057	—	0	—	0	·048	·198	·100	·040	·050
	·114	·052	·078	—	—	—	—	·0615	·225	·428	·065	·333
	·107	·076	—	—	—	—	—	– ·105	·472	—	—	—
	·150	·081	—	—	—	—	—	·164	—	—	—	—
	·102	—	—	—	—	—	—	—	—	—	—	—
6 metres to 18 metres.	– ·062	– ·078	·239	—	—	—	—	·234	·818	·455	·327	—
	– ·134	– ·021	·407	—	—	—	—	·199	—	—	—	—
	—	– ·492	·446	—	—	—	—	·220	—	—	—	—

Here, tabulating the whole of the results, we find

Head lost between 1-2 greater than between 2-3 in ... ... 93 experiments
,, between 1-2 less than between 2-3 in ... ... 12 ,,
,, between 1-2 and 2-3 equal in ... 8 ,,

Or taking as the most reliable the experiments between 0·1 and 6 metres, where the loss of head was measured with the water-gauge,

Head lost between 1-2 greatest in ... ... 66 experiments
,, between 2 3 greatest in ... ... 6 ,,
Equal in both lengths ... ... 3 ,,

Hence it is clear that in eleven cases out of twelve in Darcy's experiments more head is lost in the second 50-metre length than in the first, counting from the inlet end. The differences are not only almost always positive, but they increase fairly regularly with the velocities of flow. Nor are their absolute amounts small. They reach at the greater velocities 0·1 to 0·5 metre, or 4in. to 20in. of water column—amounts which are enormous compared with the accuracy of measurement in these experiments. The bearing of these results will be better seen by reducing them to percentages of the head lost in 50 metres in each case. In doing this only the results for heads between 0·1 and 6 metres will be taken. The reason for trusting less the results for very small heads have already been given. For the very great heads not only was there a change of mode of measurement, but Darcy speaks of the extreme difficulty of these experiments.

Difference of Loss of Head in two Consecutive 50-metre Lengths in Percentage of Head Lost in 50 metres. Diameters given beneath Heading of Column.

Drawn wrought iron, new.			Glass.	Lead.			New cast iron.			Old cast iron.	The same cleaned.
·0122	·0266	·0395	·04968	·014	·027	·041	·0819	·137	·188	·2432	·2447
2·6	6·3	5·8	7·7	9·3	–2·0	4·5	1·7	13·5	4·3	5·8	3·2
6·8	4·8	3·6	9·2	–4·7	1·0	6·2	5·5	8·3	8·3	1·2	4·2
0·5	2·7	3·4	–6·5	–1·1	0·9	7·5	3·8	12·0	8·5	3·4	3·4
10·4	2·5	3·7	8·5	–1·2	1·1	8·3	3·1	11·5	6·0	2·6	2·5
10·9	3·3	3·6	—	0	0	0	3·0	11·3	5·1	2·5	2·6
6·3	1·6	3·5	—	—	—	—	3·0	10·9	7·5	3·1	5·7
4·7	1·5	—	—	—	—	—	–2·2	9·1	—	—	—
4·6	1·5	—	—	—	—	—	3·3	—	—	—	—
2·3	—	—	—	—	—	—	—	—	—	—	—
Mean 5·5	3·0	4·0	4·7	0·4	0·2	5·3	2·6	10·9	6·6	3·1	3·6

Here the mean difference is in every case positive—that is, the loss in the second 50-metres was greater than in the first, on the average, in every series of experiments. The percentages for each pipe are tolerably constant, and vary from 0·2 to 10·9 per cent. of the head in different pipes.

Consider Darcy's explanation, that the difference is due to accidental differences of diameter in the two lengths. The difference of resistance in pipes of different diameter for the same discharge varies inversely as the fifth power of the diameter. Hence, for a difference of 10 per cent. in the resistance, the difference of diameter would be about 2 per cent., and the difference of area about 4 per cent. That is, the average diameter in the second 50 metres of the 0·137 metre cast iron pipe must have been $\frac{1}{10}$in. smaller than the average diameter of the first 50 metres. But for the average diameter to have varied so much, the extreme diameters must have varied much more, and it seems impossible that such differences should have escaped Darcy's notice. Further, two measurements of each end of each length of this pipe are given by Darcy. Out of 196 measurements the smallest is 0·134, the largest 0·141—a difference of 5 per cent. But it does not seem possible from the table to pick out any twenty-five lengths the mean measurement of which would differ by anything like so much as 2 per cent. from the other twenty-five. Even if this could be done, it remains to be explained how all the smaller lengths accidentally accumulated into one 50-metre length, and all the larger into the other. More than this, it is absolutely inexplicable how, in all the twelve series of experiments, the same thing happened. The probabilities against such an accident would not be expressible in figures. Exactly the same argument would appy to any attempt to explain the difference of resistance by difference of roughness of the pipe in the two parts. Error in connecting the pressure columns to the pipes might be thought of. But not only was Darcy perfectly conversant with the importance of the mode of attachment of the pressure columns, not only were his arrangements, as he describes them, perfectly satisfactory, but no displacement of the direction of the pressure pipes would produce differences of reading as great as those noted. Besides this, it would still have to be asked why, in twelve different pipes, the error was always made in the same way. Difference of levelling will not explain the discrepancy, for the pressure columns were fixed side by side on the same plank.

It seems that it might be worth while to examine whether it would not be better to deduce the constants from the loss of head in one of the 50-metre lengths, instead of taking the average of the two 50-metre lengths, as Darcy did. By plotting the heads and velocities, it could at least be seen whether the variation of head with velocity is more regular in the one case than in the other.

P.S.—Since the above note was written, some two months ago, the author has plotted the results for sixteen of the pipes experimented on by Darcy, on a large scale. In plotting the results Professor Osborne Reynolds' method has been used, the logarithms of the velocities being plotted as ordinates and the logarithms of the heads as *abscissæ*. For any one pipe the points so determined should be exactly or, at all events, very approximately on a straight line, with a slope a little less than 2 to 1. The observations for the two 50 metre lengths of each pipe were plotted separately, and the general result is this:—(1) In almost all cases the line for the upper 50 metre length is above—in some cases considerably above—the line for the lower 50 metre length. In the few cases where the reverse is true the lines are close together. (2) The observations for the upper 50 metre length plot much more regularly into a straight line than those for the lower 50 metre length. In the latter case there are observations which will not plot into any possible curve, and which must be largely affected by errors. The conclusion seems inevitable that for some unexplained cause the observations on the lower 50 metre length in Darcy's experiments are unreliable. The author proposes shortly to rededuce the constants in the equation connecting the loss of head and velocity from the observations in the upper 50 metre length only.

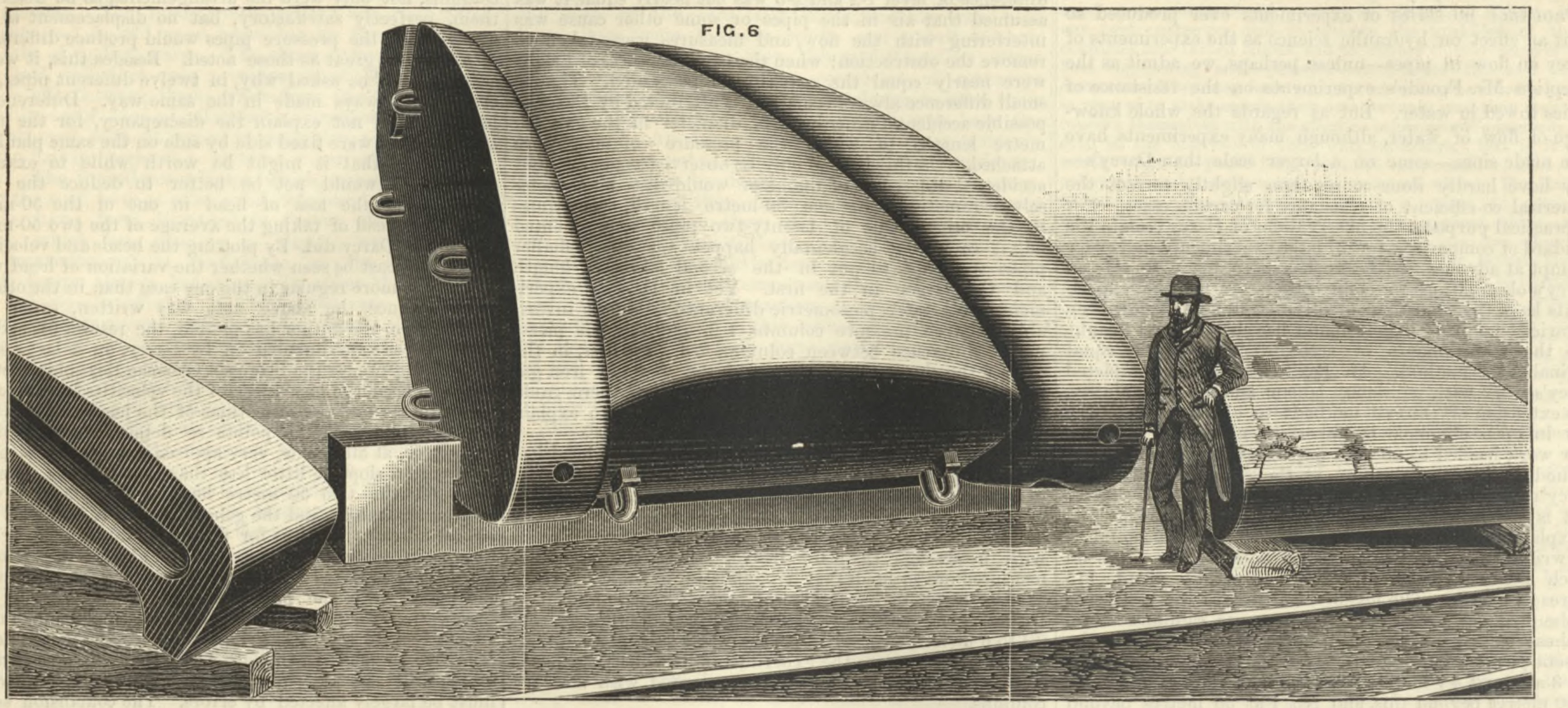
THE NEW CROSS RAILWAY ACCIDENT.

AN accident occurred on the 15th of February, near New Cross station, on the East London Railway. In this case, while the 8.51 p.m. Metropolitan Company's passenger train from New Cross (South-Eastern) station for Hammersmith was proceeding on its journey and passing through a cross-over road which connects the single line with the up line about 700 yards from the station, the last carriage left the rails on the off side, and after running over the ballast for about 94 yards, it came in contact with one of the centre girders of an under bridge, whereby the wheels were swept from under it, six hornplates torn off, all eight axle boxes broken, and the brake gearing torn off and damaged, the train coming to rest while the last carriage was still on the bridge, its body being partly supported on the top flange of the girder. The four leading wheels of the last carriage but one were off the rails on the near side when the train stopped. Four passengers and the rear guard were injured. In view of the frequency with which derailments are likely to occur, as the number of small curves in and round London grows every day, the report on this accident by Major-General Hutchinson is of much importance. He says, but for the comparatively rigid wheel base (16ft.) of the carriage which left the rails, it is probable that the accident would not have occurred, notwithstanding the defect in the curves above alluded to. When running round curves, the sliding arrangement of the axle boxes has a tendency to become jammed, in which case, with a left-handed curve pressure of the rear off wheels against the off or right-hand rail would be induced, with the probable result, where, as in the present case this rail was lower than it ought to have been, of forcing one of these wheels over the right-hand rail. Had the continuous brake with which the train was fitted been automatic, it would have been within the power of the rear guard to stop the train when he first felt the rear carriage leave the rails. As it was, it did not even occur to him to apply his hand brake. It will thus be seen that, according to General Hutchinson, a flexible wheel base instead of the rigid wheel base would have prevented the derailment, and an automatic brake would have prevented the accident from being attended with any very destructive effects. Specially we may mention the desirability of the early and general adaptation of a flexible wheel base on all the lines which have so many sharp curves as has the London, Chatham, and Dover Company between its new St. Paul's station and the Ludgate Hill, Holborn, and Snow Hill stations, a lot of curves which are enough to try the rail keeping temper of any but old and somewhat accommodatingly easy stock. At the same time we may express a desire to know what General Hutchinson's idea of a flexible wheel base is. All the Metropolitan stock has sliding axle boxes, and considering the millions of times which these carriages traverse sharp curves without derailment, we venture to doubt that Major-General Hutchinson has quite grasped the merits of the case in this instance.

ALARMING ACCIDENT ON THE LONDON AND NORTH-WESTERN RAILWAY.—An accident occurred on the London and North-Western Railway, near New-street station, Birmingham, on Wednesday afternoon. The engine became detached from the carriages from a London train due at New-street at 2.10 p.m., through the breaking of a coupling pin. The train was proceeding at a very rapid rate, and as there is a steep incline from Monument-lane through a long tunnel into New-street station, the speed became accelerated to an alarming degree. The driver was compelled to put on steam to prevent the carriages running into and over the engine, and the result was that the whole train dashed through New-street station—according to the accounts of persons who saw it—almost like a flash of lightning. Terror prevailed amongst the passengers, and one of them, James Robinson, in endeavouring to escape from the train during its rush through the station, fell on to the line and sustained a fracture of the skull and other injuries, and was taken to the hospital. The train was not stopped until it reached Banbury-street station. A number of passengers were injured by the shock. Mr. Chamberlain, M.P., is said to have been on the platform waiting for the train to proceed to London, and it may be hoped that he was satisfactorily impressed with the desperately useless character of the brake to which the London and North-Western Company assign the care of the lives of their passengers by high-speed trains. But for the presence of mind of the driver a fearful smash of everything would probably have resulted through the absence of an automatic continuous brake, which would have stopped the train immediately the coupling severed.

SEGMENTS OF HERR GRUSON'S TURRET.

FIG. 6



TRIAL OF GRUSON'S ARMOUR AT SPEZIA.

No. II.

BEFORE continuing the account of the trial of Grüson's shield, it may be well to mention a few facts with regard to the gun which attacks it, especially as several guns of about 100 tons weight have been made by Sir W. Armstrong and Co. for the Italian Government, and some confusion may easily exist with regard to them.

The Duilio and Dandolo have each four 100-ton muzzle-loading guns. It was one of these that attacked the Schneider-Cammell and Brown plates in 1882. These have a calibre of 17·72in.; they are made of wrought iron with steel tubes. The Italia has four trunnionless breech-loading 100-ton guns made of wrought iron and steel, with a calibre of 17in.; the bore is 26 calibres long. The first of these guns was fired at Spezia, in November, 1882. The Lepanto has four 100-ton guns, nearly resembling those of the Italia, but slightly longer. The chief difference is that they are wholly made of steel. It is one of these guns which is firing in the experiment we are now reporting. More powerful guns still are made for the Lauria, Doria, and Morosini—twelve in all. These differ chiefly from the Lepanto guns in being longer—that is, having a bore of 28 calibres in length; they weigh consequently 105 tons each. The only guns equal to them in power are the 110-ton guns ordered for the British Benbow; these are also made at Elswick, and are the most powerful guns existing. Since the first muzzle-loading 100-ton guns were tried at Spezia in 1876, then the Italian Government have received, or are in the way to receive from Elswick, eight 100-ton muzzle-loading guns all afloat in the Duilio and Dandolo; eight 100-ton breech-loading guns for the Italia now in commission, and the Lepanto nearly completed; and twelve 105-ton breech-loading guns for the Lauria, Doria, and Morosini, which ships are in course of construction.

To pass on to the turrets, and the shield which represents them. As before said, there are the two turrets to protect Spezia harbour, each mounting two 120-ton Krupp guns, whose exact power we do not know, and cannot ascertain certainly, seeing that there are different estimates, and that Herr Krupp not long since declined to give authentic information. They have, we believe, been fired at Meppen with results which are not made public. So far as we can learn, the power of this gun is nearly the same as that of the 100-ton breech-loading Armstrong, but inferior to the 105-ton and 110-ton breech-loading Armstrong guns.

The machinery for working the turrets is supplied by Sir W. Armstrong and Co. The armour is to be supplied by Grüson in the event of his shield coming up to the conditions specified for the trial, which, as before said, are very severe. The principal ones being, as we understand, that the shield is to receive three blows from the projectile of the 100-ton breech-loading gun, without portions of plate being dislodged from the interior face. The blows are to be delivered on points of the plate not nearer to each other than one metre. The projectile being a Krupp steel shell, the blow is the same as that which riddled the Schneider, Cammell, and Brown 18·9in. plates in 1884.

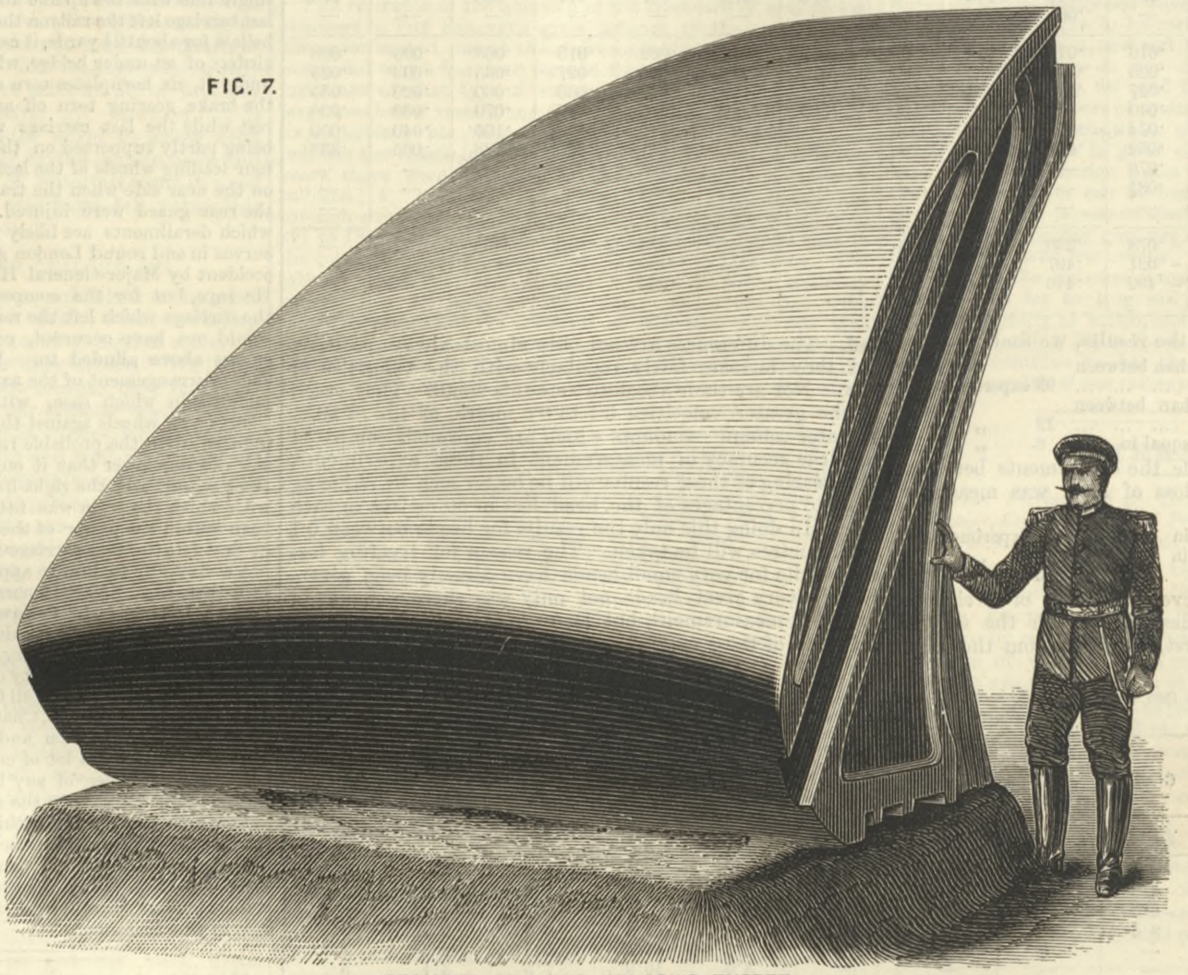
Fig. 12, page 361, gives a rough plan and section—drawn from verbal description—of the complete turret, of which we can now give the details more correctly than before. It will be seen that there are fifteen segment or sector-shaped shields, with two centre plates forming the crown. The interior diameter is 10 metres—32·8ft. The periphery is not a circle, but is formed of fifteen arcs of circles, each struck with a radius of about 15ft. or 16ft., giving an outline suggestive of that of a pomegranate. Of the fifteen plates, twelve are similar to the shield under trial, each weighing about 87·950 kg., or about 86·56 tons. The remaining three are lighter, being pierced by the ports; the lightest being that between the gun ports. The twelve unpierced plates will thus weigh about 1039 tons. The two centre or crown pieces weigh together 130,000 kg., or 128 tons. The total weight of the armour is 1,400,000 kg., or 1378 tons. This leaves 211 tons for the three pierced plates, two of which will be something over and the other something less than 70 tons. The entire running weight of shield—1378 tons—is to be supported on an iron ring, worked by Elswick hydraulic machinery. Our special correspondent at Spezia is indebted to Herr Grüson for information as to his shield, which can be obtained most freely from any of his staff, so that any lack of information is owing to his neglect in asking for it. With the exception that he has had to construct the complete turret from verbal data, our correspondent was permitted to consult drawings for almost everything connected with the shields.

It may be well, in coming now to the continuation of the trial, to point out one thing about which there seems occasionally to be some confusion, namely, that while the attack of armour may be a very telling illustration of the power of a gun, it is no test of the gun, strictly speaking. The power of the gun is fully told by the energy of the projectile when leaving the muzzle. What happens after that concerns the projectile and the plate, but clearly has no further connection with the gun itself. In the trial now taking place the gun is not concerned, at all events directly, in whether the shield is broken or not. This may be a question between Krupp's projectile and Grüson's shield, or more really between Grüson's shield and what might be expected from Schneider's, Brown's, Cammell's, Marrell's, or Terni armour formed into some equivalent shield. Then, again, the effect of a steel projectile as compared with a chilled iron one, when attacking chilled iron armour, naturally arises in considering such a trial, and this is the especial point that interests us in England, and in this Elswick may be interested as manufacturers of projectiles. As gun makers they may be interested in the eventual consideration of what guns may be able to effect against shields, but immediately and directly their success as gun makers is limited to the energy with which they can discharge a projectile of a given calibre.

On Saturday, April 24th, the firing was continued. The gun on its raft was again brought into position at a range from the shield of 133·7 metres, or 438·7ft., as indicated in Figs. 10 and 11.

We can now give the details of the position of shield and gun more accurately than before. The projectile is intended to strike the shield in the same way as it would if the path of the shot were inclined downwards at an angle of 1 deg. and the shield standing on a horizontal base. For this purpose, as the gun fires slightly upwards the shield is, as it were, tilted very slightly forwards; that is to say, forwards to the extent of 1½ deg. in comparison to its position set on a truly horizontal base, 1 deg. for the supposed descending angle and ½ deg. for the difference in level of shield and gun. From what has been said as to the construction of the complete turret, it may be seen that the chilled plate actually receiving the blows, is the only part of the target which corresponds to the turret. All other parts are substitutes. For example, the two large iron side pieces serve to give a bearing on the masonry nearly corresponding to the support which would be afforded by the contiguous portions of the turret, which should be smaller in area but more rigid than masonry of the same extent. The mottled iron piece at the top of the shield does duty for the circular crown of the turret, while the mottled piece at the base takes the place of the plate forming the base of the turret. Even the small wrought iron packing plates in the joints are substitutes for the filling in of the joint by white metal or by keys fitting to the front plate. Lastly, the masonry glacis takes the place of the glacis with chilled iron "vorpanzer," shown in the approximate cross

FIG. 7.



SEGMENT OF HERR GRUSON'S TURRET.

section of the complete cupola, which, like the plan, is drawn from description, not copied from any drawing, and is therefore only approximate.

On April 24th the gun was fired under conditions as exactly similar to those existing on April 20th as possible. Having the details rather more fully and accurately now than when our special correspondent wrote before, we give them for both rounds together. In both the weight of the projectile was made up to 1000 kg., or 2204·6 lb. The charge was 375 kg. (826·7 lb.) Cologne prismatic "cocoa" powder. The velocity taken from the screens was in the first round 538 metres (1765ft.), and in the second 540 metres (1772ft. nearly), the respective energies being 47,620 and 47,990 foot-tons. The perforations through iron would be 31·2in. and 31·3in. respectively. This does not apply to a hard target which cannot be perforated but must be broken. The blows estimated on the principle of shock in proportion to mass of shield are 550 foot-tons and 555 foot-tons per ton of shield. The projectile was in each case a Krupp steel hollow projectile forged and hardened. The form and dimensions are shown in Figs. 13 and 14. Tool marks were visible from base to point. The projectile had, of course, been hardened subsequently to being tooled. There was a screw base plug somewhat resembling our own. The pressure in the gun was not taken. The actual angle of incidence of the first projectile with the tangent to the plate face at the point struck was 40 deg.

The projectile of the second round struck a few inches to the right, and high of the point aimed at—that is, it struck rather nearer to the point of impact of the first round than was intended, with an angle of incidence of 44 deg. As on the last occasion, the projectile was nearly entirely broken up into small fragments. One piece, however, of about 56 lb. weight was found; it had formed part of the base end. It is shown in Fig. 15. The quality of the steel appeared to be excellent. It was pretty hard throughout, though some metal in a softer condition than the rest was said to have been found about the centre.

The effect on the shield is shown in Figs. 8 and 9. As will be seen in Fig. 8, the shot made a more serious indentation than before, the depth of it being about 4in., while that of round 1 was only 2in. Several cracks were found made and opened in the plate (see "2" Fig. 8). Some cracks, marked A, B, C, D, were opened as wide as 1½in., and in some places the surface of the metal was chipped off. The wide cracks being low down, and cracks generally extending downwards, it is quite possible that these may come out at the bottom surface of the shield, so that they cannot be seen at the back. One iron side-piece was broken through. Fig. 9 shows the back of the plate with fresh cracks ϵ, γ, and δ, and a small chip off at β. These are all near the bottom, but it may be seen, if their course be considered (*vide* dotted lines in Fig. 8, shown as if the plate were transparent) that it is probable that ϵ and δ at back correspond with $d\ k$ and g in the front. If α at back corresponds with a and c in front, it follows that the junction of γ and α may be identified with point of impact 1 and of ϵ and δ with 2. One iron side piece was cracked, as shown in Fig. 8, and the supporting masonry was a very little shaken, so that a little space is opened behind the bearings of the shield. The plate has now received a considerable shock. It must, however, be considered to have stood admirably. No shield has ever yet received two such blows as this. The weight of the shield is, of course, great, so that the striking energy per ton is not very large. It must, however, be remembered that, owing to the excellence of the steel, a much larger proportion of the striking energy of projectile is impressed on the plate than usual.

The cracks at the back are of course the beginning of the splitting up of the shield, which may rapidly take place on receiving future blows. Up to the present time anyone might have remained inside the shield in complete safety, because there is no langridge of any kind, the absence of bolts being a great advantage. We have mentioned as a condition that no portion should be detached on the

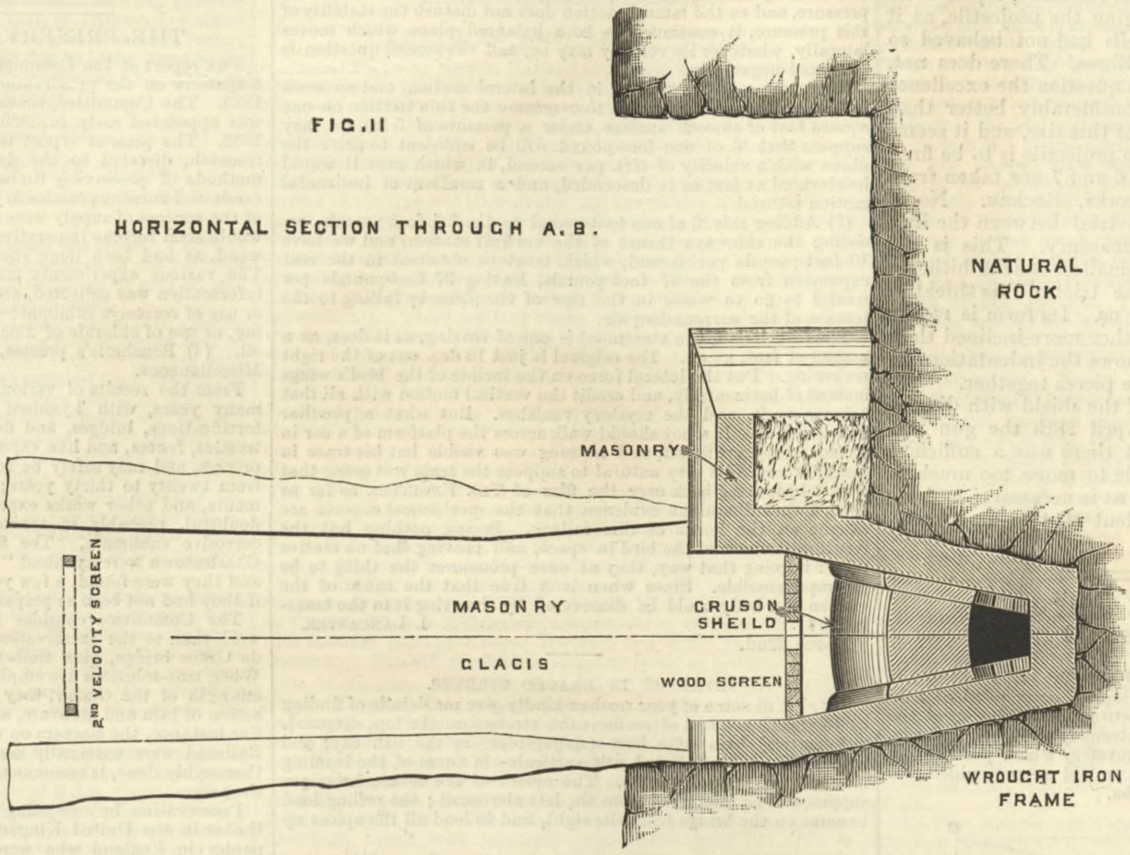


FIG. 11
HORIZONTAL SECTION THROUGH A. B.

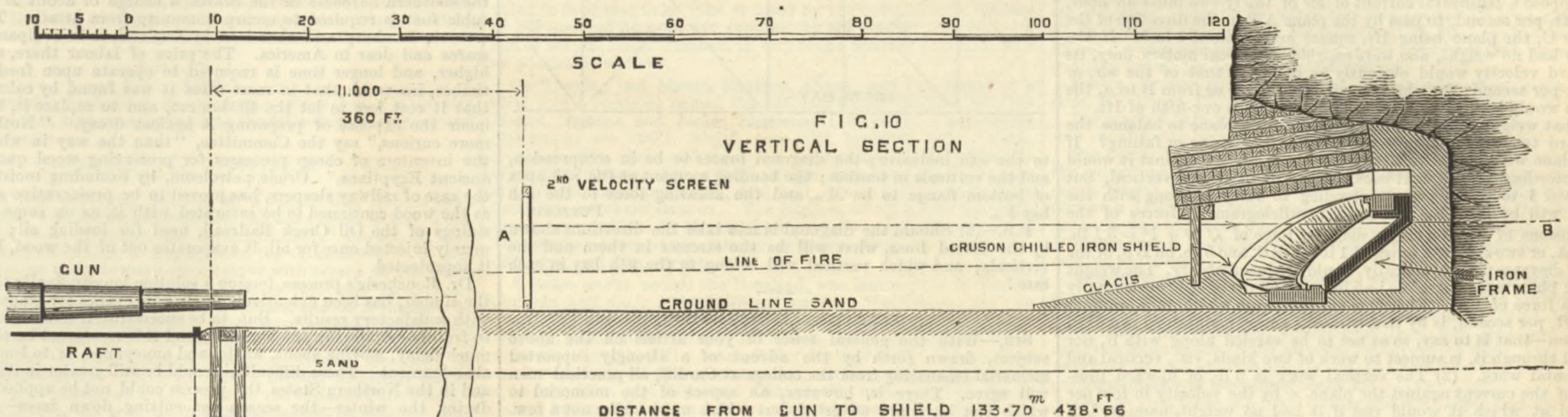
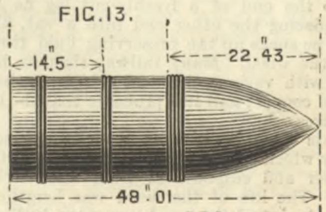


FIG. 10
VERTICAL SECTION

FIG. 13.



KRUPP-STEEL-PROJECTILE
-FORCED-

FIG. 14.

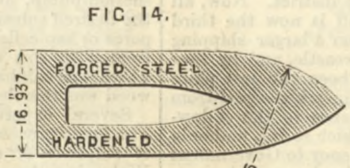


FIG. 15.


LARGEST FRAGMENT
ABOUT 56 LBS WEIGHT

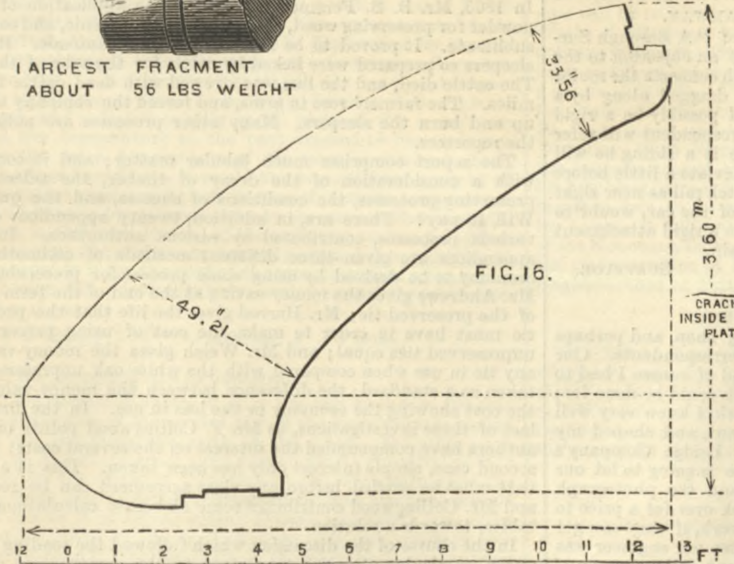
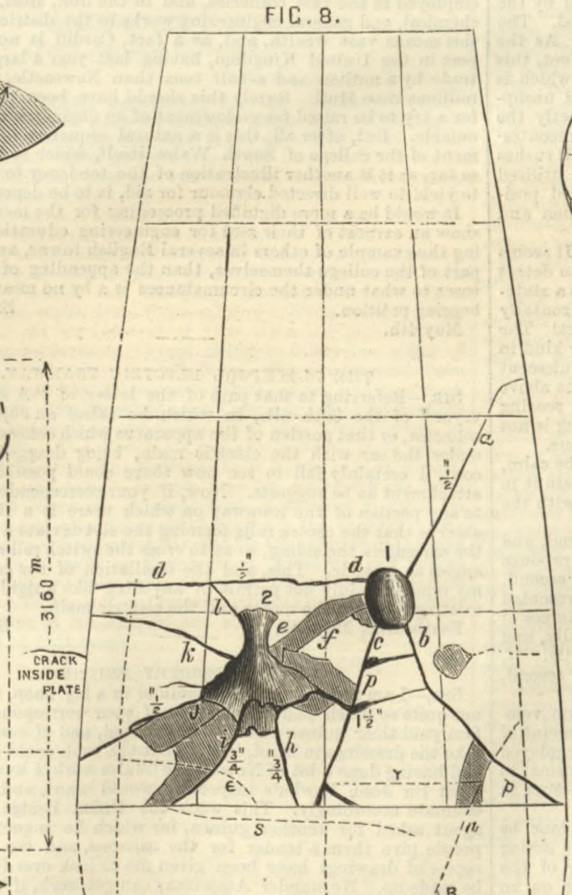


FIG. 16.

FIG. 8.



FRONT OF SHIELD DEVELOPED

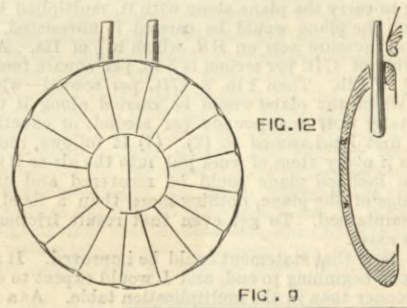
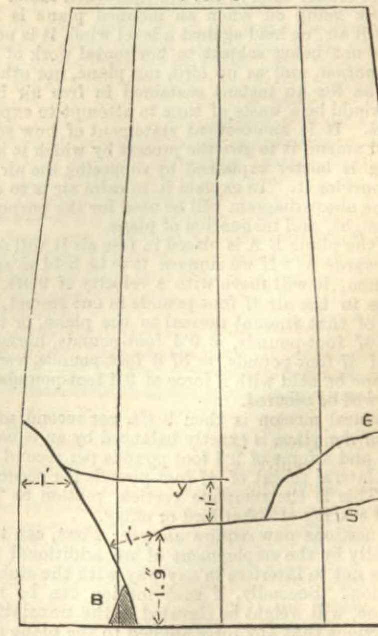


FIG. 12

FIG. 9



BACK OF SHIELD

inside; literally, this may be urged to have been done already, for the small scale close to the ground at β Fig. 8 is detached. On the other hand, the actual impressions of the projectiles' points are less than a metre apart. Practically neither of the conditions need be held to be broken. The firing was to be continued on Wednesday, April 28th. A question was raised about changing the projectile, as it was suggested that the Krupp shells had not behaved so well as in the case of smaller calibres. There does not, however, seem to be any reason to question the excellence of the steel, which is probably considerably better than would be found in any other shell of this size, and it seems to be decided that the third Krupp projectile is to be fired as originally intended. The cuts 6 and 7 are taken from photographs made at Grüson's works, Buckau. No. 6 shows the shield placed as in the trial between the iron side pieces for bearing on the masonry. This is the largest shield yet made. The smallest shield hitherto made is shown lying near it. The trial of this shield at Buckau was that last reported by us. Its form is rather more debased, and the surface rather more inclined than that of the large shield. Fig. 7 shows the indentations in the end of the shield for keying the pieces together.

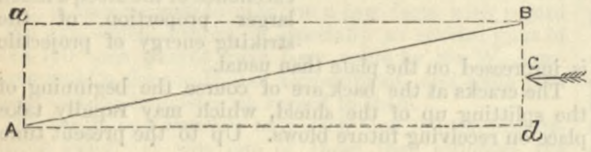
Fig. 16 shows a larger section of the shield with dimensions and details in form. On April 28th the gun was loaded and laid on the target, but there was a sufficient swell in the sea to cause the muzzle to move too much to enable the firing to be as accurate as is necessary, and we learn from our special correspondent that it was consequently postponed.

LETTERS TO THE EDITOR.

(*Continued from page* 351.)

THE PROBLEM OF FLIGHT.

SIR,—I recently received from an English correspondent substantially the following reasons for objecting to my solution of the problem of soaring flight. They are extremely well put, and are, doubtless, the scientific basis for the mystery which persistently shrouds the case. I recognise in them an old enemy, which cost me much trouble until I learned its tricks.



Suppose a horizontal current of air of thirty-two miles an hour, or 47ft. per second, to pass by the plane A B in the direction of the arrow C, the plane being 1ft. square and inclined 1 in 5. If the plane had no weight, and were capable of vertical motion only, its upward velocity would obviously be one-fifth that of the air, or 9·4ft. per second; for while the air moved 1ft., or from B to a, the plane would be displaced from A to a, which is one-fifth of 1ft.

What weight must now be applied to the plane to balance the upward tendency and prevent it from either rising or falling? If the plane were placed vertically the wind pressure against it would be, according to the text-books, 5 lb. As it is not vertical, but inclined 1 to 5, the pressure tending to carry it along with the wind will be $\frac{5}{5} = 1$ lb. and by a parallelogram of forces of the dimensions of $1 + 5$ a single diagonal force of $\sqrt{5^2 + 1^2} = 5{\cdot}1$ lb. on B A, or two separate forces of 1 lb. on B d, and 5 lb. on B a, of the above diagram placed vertically, would produce stability. The weight of the plane must therefore be 5 lb., and it must be held horizontally with a force of 1 lb. Therefore (1) the plane which in a current of 47ft. per second, is by that current's action maintained in a fixed position—that is to say, so as not to be carried along with it, nor to fall through it, is subject to work of two kinds, viz., vertical and horizontal work. (2) The vertical work is 5 lb. of upward pressure of the current against the plane × by the velocity in feet per second at which it would rise if it had no weight, namely, $\frac{1}{5}$ of 47ft. per second. This amounts to $\frac{1}{5} \times 47$ft. $\times 5$ lb. $= 47$ foot-pounds per second. (3) The horizontal work is the pressure of the current tending to carry the plane along with it, multiplied by the velocity at which the plane would be carried if unresisted. The wind's horizontal pressure acts on B d, which is $\frac{1}{5}$ of 1ft. As the pressure of a wind of 47ft. per second is 5 lb. per square foot, this multiplied by $\frac{1}{5} = 1$ lb. Then 1 lb. × 47ft. per second—which is the velocity at which the plane would be carried along if unsupported horizontally = 47 foot-pounds per second, or exactly the amount of the first kind named in (2). (4) It follows, incontestably, that even if every atom of work put into the air as it rushes underneath the inclined plane could be recovered and utilised upon the rear edge of the plane, nothing more than a fixed position could be maintained. To get even that result friction and eddies must not exist.

I do not see how that statement could be improved. It seems impregnable from beginning to end, and I would expect to detect a flaw in it no sooner than in the multiplication table. As a statement of work going on when an inclined plane is horizontally pushed on still air, or held against a level wind, it is perfect. The soaring birds not being subject to horizontal work of any kind in the lateral motion, and as no bird, nor plane, nor other quiescent body could be for an instant sustained in free air by the above method, it would be a waste of time to attempt to explain soaring on that basis. It is an excellent statement of how soaring is not done. I will amend it to give the process by which it is done.

As soaring is better explained by supposing the air to be calm, we will so consider it. To explain it in calm air is to explain it in wind, and the above diagram will be used for the purpose, with the same size, weight, and inclination of plane.

(1) When the plane B A is placed in free air it will descend, and also slant towards A. If we suppose it to be held so as to produce vertical motion, it will move with a velocity of 9·4ft. per second, and develope in the air 47 foot-pounds in one second, represented by one force of that amount normal to the plane, or two forces of one-fifth of 47 foot-pounds, = 9·4 foot-pounds, horizontally, and four-fifths of 47 foot-pounds, = 37·6 foot-pounds, vertically. If, then, the plane be held with a force of 9·4 foot-pounds per second, vertical fall will be secured.

(2) The vertical motion is then 9·4ft. per second uniform velocity, in which the plane is exactly balanced by an equal amount of air pressure, and a force of 9·4 foot-pounds per second is employed to resist the lateral thrust of 47 foot-pounds per second normal to the plane. This is the complete vertical motion as it occurs in every case of soaring of either bird or effigy.

(3) Two questions now require answer: First, can the plane be moved laterally by the employment of an additional force acting upon it, so as not to interfere in any way with the stability of the vertical motion? Secondly, if such motion can be made on an upward incline, will weight be elevated in the translation?

(4) It is obvious that any force applied to the plane at any angle from any direction above its surface would increase the velocity of the fall, and hence disturb its stability. If applied at any angle from any direction below the surface, the velocity of the fall would be diminished and its stability equally disturbed. It follows that the inclination of surface is a neutral plane, and no amount of force applied in that plane could in any way interfere with the stability of the vertical motion. As the action and reaction of plane and air is normal to the plane, it follows that a force acting in that plane is at right angles to the force doing the work developed in the fall, and hence neither of these forces can resist the other, and the first question must be answered affirmatively.

(5) If, then, a force be applied in the plane of the surfaces slanting upwards from A towards B, no weight will be elevated in the ensuing motion, as it is already exactly balanced by the air pressure, and as the lateral motion does not disturb the stability of this pressure, it continues to be a balanced plane which moves laterally, whatever its velocity may be, and the second question is answered negatively.

(6) As no weight is resisted in the lateral motion, and no work is done on the air but enough to overcome the skin friction on one square foot of smooth surface under a pressure of 5 lb., we may suppose that ·6 of one foot-pound will be sufficient to drive the plane with a velocity of 47ft. per second, in which case it would be elevated as fast as it descended, and a resultant of horizontal motion secured.

(7) Adding this ·6 of one foot-pound to the 9·4 foot-pounds, resisting the sideways thrust of the vertical motion, and we have 10 foot-pounds per second, which must be obtained in the rear expansion from the 47 foot-pounds, leaving 37 foot-pounds per second to go to waste in the rear of the plane by falling to the tension of the surrounding air.

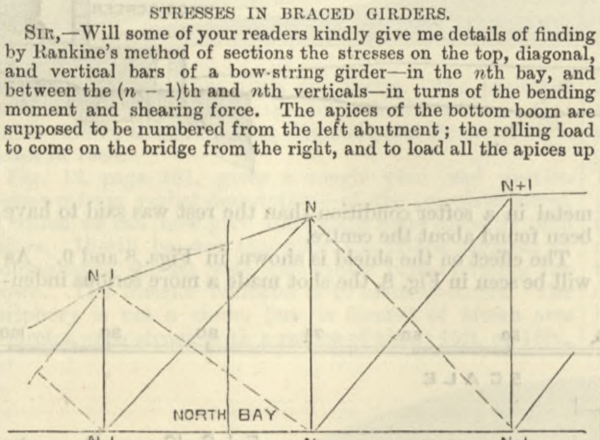
Thus amended, the statement is one of soaring, as it does, as a matter of fact, go on. The original is just 18 deg. out of the right reckoning. Put the lateral force on the incline of the bird's wings instead of horizontally, and credit the vertical motion with all that belongs to it, and the mystery vanishes. But what a peculiar delusion it is. If a boy should walk across the platform of a car in motion along a railroad, and nothing was visible but his trace in space, it would be very natural to suppose the train was going that way. In looking back over the files of THE ENGINEER as far as 1882, I find abundant evidence that the mechanical experts are caught on the horns of this fallacy. Seeing nothing but the resultant motion of the bird in space, and proving that no motive power is going that way, they at once pronounce the thing to be incomprehensible. Since when is it true that the cause of the motion of a body could be discovered by observing it in the translation?

I. LANCASTER.

March 22nd.

STRESSES IN BRACED GIRDERS.

SIR,—Will some of your readers kindly give me details of finding by Rankine's method of sections the stresses on the top, diagonal, and vertical bars of a bow-string girder—in the nth bay, and between the $(n - 1)$th and nth verticals—in turns of the bending moment and shearing force. The apices of the bottom boom are supposed to be numbered from the left abutment; the rolling load to come on the bridge from the right, and to load all the apices up



to the nth inclusive; the diagonal braces to be in compression, and the verticals in tension; the bending moment at the nth apex of bottom flange to be M_n, and the shearing force in the nth bay F_n.

PUZZLED.

P.S.—(2) Should the diagonal braces take the directions shown by the dotted lines, what will be the stresses in them and the verticals; and which vertical will belong to the nth bay in each case?

EDUCATIONAL PARASITISM.

SIR,—With the general tenor of your article on the above subject, drawn forth by the advent of a strongly supported memorial emanating from the college at Cardiff, all practical men will agree. There is, however, an aspect of the memorial to which you have not adverted, but which must strike not a few. The appeal for State aid to found an engineering school is supported by the assertion that no less than 90,000 skilled workmen are employed in the vast collieries, and in the iron, steel, tin, copper, chemical, and general engineering works in the district. Now, all this means vast wealth, and, as a fact, Cardiff is now the third port in the United Kingdom, having last year a larger shipping trade by a million and a-half tons than Newcastle, and by four millions than Hull. Surely this should have been the last place for a cry to be raised for endowment of an engineering school from outside. But, after all, this is a natural sequence to the endowment of the college of South Wales itself, which so far, and only so far, as it is another illustration of the tendency to Government to yield to well directed clamour for aid, is to be deprecated.

It would be a more dignified proceeding for the memorialists to show an earnest of their zeal for engineering education by following the example of others in several English towns, and found this part of the college themselves, than the appending of their signatures to what under the circumstances is a by no means creditable begging petition.

SELF-HELP.

May 4th.

THE BLACKPOOL ELECTRIC TRAMWAY.

SIR,—Referring to that part of the letter of "A Borough Surveyor" of the 30th ult., in which he raises an objection to the collector, or that portion of the apparatus which connects the motor under the car with the electric main, being dragged along by a cord, I certainly fail to see how there could possibly be a rigid attachment as he suggests. Now, if your correspondent will refer to any portion of the tramway on which there is a siding he will observe that the centre rails forming the slot deviate a little before the car enters the siding, so as to cross the switch rail as near right angles as possible. This, and the oscillation of the car, would to my mind certainly not permit of anything like a rigid attachment existing between the motor and the electric main.

Eastbourne, May 4th.

SURVEYOR.

THE HAWKESBURY BRIDGE.

SIR,—I am a foreman bridge-builder in a big shop, and perhaps not quite so much polished as some of your correspondents. Our firm paid their guinea and sent in a design, and of course I had to take the drawings in hand, to see what the work could be done for; and having done a lot of New South Wales work, I knew very well what Sir John Fowler's inspectors would want, and shaped my estimate accordingly. This week the Union Bridge Company's agent asked for another guinea, for which he is going to let our people give them a tender for the caissons, and the photograph copies of drawings have been given me to look over for a price to be made up. No wonder Americans can get work, if they can get their customers to take such light jobs. When our engineer was on with his designs he made a deal to do about collapsing pressures, in case caissons had to be pumped dry for excavation, and a deal of stuff of that kind; but it appears he did not know much. The Yankee caissons are quite a different thing, and if we get the job, my men will say we had better start on milk-cans. Except the bottom lengths, the plates are $\frac{3}{8}$in. and $\frac{1}{4}$in. thick for the outer skin and inner tubes, with a few light braces between, that, for what they are worth, might almost be dispensed with. Iron, 20 tons per square inch, as against 22 tons when English work is wanted; no planing specified for edges of plates; only one piece of each kind to be put together; holes punched instead of being drilled or rimered out. Mr. Dixon might well say it was a light bridge—cheap and nasty. We pay so many guineas for tendering that I feel myself transformed into a

GUINEA PIG.

May 6th.

THE PRESERVATION OF TIMBER.*

THE report of the Committee of the American Society of Civil Engineers on the preservation of timber was presented in June, 1885. The Committee, consisting of Mr. O. Chanute and others, was appointed early in 1880, and made a preliminary report in 1882. The present report is the outcome of long and laborious research, directed to the determination of the most successful methods of preserving timber from decay—best adapted to the needs and current practice in America; as it appeared that several of the sources of supply were being rapidly exhausted, and that it would soon become imperative to resort to artificial preservation of wood, as had been done successfully for many years in Europe. The various experiments made in the United States, on which information was collected, are classed as follows:—(1) Kyanising, or use of corrosive sublimate—chloride of mercury. (2) Burnettising, or use of chloride of zinc. (3) Creosoting, or use of creosote oil. (4) Boucherie's process, or use of sulphate of copper. (5) Miscellaneous.

From the results of various experiments, some of which lasted many years, with kyanised timber used for railway-sleepers, fortifications, bridges, and floors, it is deduced that for bridges, trestles, fences, and like exposed structures, kyanising is a useful process, and may safely be relied upon to preserve the wood for from twenty to thirty years; but that for railway-sleepers, pavements, and other works exposed to constant moisture, success is doubtful, probably in consequence of the washing out of the corrosive sublimate. The floor timbers of an engine-house at Charlestown were kyanised "because the location was very damp," and they were found, a few years afterwards, as much decayed as if they had not been so prepared.

The Committee consider Burnettising less adapted to bridge-work than to the preservation of railway-sleepers. In the Havre de Grace bridge, pine timber, Burnettised, proved to be brittle. When zinc-solutions are employed, weak enough not to impair the strength of the timber, they are likely to be washed out by the action of rain and moisture, and to leave the timber unprotected. For instance, the sleepers on the Chicago, Rock Island, and Pacific Railroad were externally decayed and exfoliated. Burnettising, thoroughly done, is recommended for the preservation of railway-sleepers.

Preservation by creosoting is the standard method of treating timber in the United Kingdom. Of twelve leading railway companies in England who were addressed in 1878, ten companies used creosoted sleepers, some of which, forwarded as samples, were still sound, after twenty-two years of exposure. As a protection against marine worms, creosote is thoroughly efficient. Although, in English harbours, a charge of from 10 lb. to 12 lb. of creosote per cubic foot of timber has proved sufficient, it appears that for the higher temperatures of sea-water on the French coast, and in the southern harbours in the States, a charge of about 19 lb. per cubic foot is required to secure immunity from attack. Though creosote is cheap and abundant in England, it is comparatively scarce and dear in America. The price of labour there, also, is higher, and longer time is required to operate upon freshly-cut timber, insomuch that in most cases it was found by calculation that it cost less to let the timber rot, and to replace it, than to incur the expense of preparing it against decay. "Nothing is more curious," say the Committee, "than the way in which all the inventors of cheap processes for preserving wood quote the ancient Egyptians." Crude petroleum, by excluding moisture in the case of railway sleepers, has proved to be preservative so long as the wood continued to be saturated with it, as on some of the sidings of the Oil Creek Railroad, used for loading oil; but, if merely injected once for all, it evaporates out of the wood, leaving it unprotected.

Dr. Boucherie's process, forcing a solution longitudinally through the timber, has been extensively applied in France for many years, with satisfactory results. But, to be successful, it must be applied to freshly-cut trees in the log only; and this treatment involves so much delay, moving about, waste, and annoyance, as to lead to its abandonment. These difficulties would be still greater in America, and in the Northern States the process could not be applied at all during the winter—the season for cutting down trees—as the solution would freeze. Mr. H. Fladd, of St. Louis, introduced, in 1882, a method which is the inverse of the Boucherie process. To the cap fastened to the end of a freshly-cut log he applies a suction-pump, and, placing the other end into a vat, filled with the desired solution, he sucks up the preserving fluid through the pores or sap-cells of the wood. Many railway sleepers have been treated in this way with various chemical solutions, the chief of which was sulphate of copper; and it is probable that the life of the wood was thereby increased.

Several experiments have been made with other substances. The Earle process, by which timber is immersed in a hot solution of sulphate of copper and sulphate of iron, was tried at the Watervliet Arsenal. The life of the wood was lengthened, but the strength was impaired, and the wood warped so badly that the process was abandoned in 1844. The lime process, consisting of soaking timber in lime-water, was applied in 1840, by Mr. W. R. Huffnagle, to white-pine sills laid in the permanent way of the Columbia Railroad, and in 1850 on the Baltimore and Ohio Railroad. The results were not satisfactory. Salt has been experimented with numberless times, with but limited success. The charring of timber is uncertain, and disappointing in its results. In 1865, Mr. B. S. Foreman introduced the application of a dry powder for preserving wood, composed of salt, arsenic, and corrosive sublimate. It proved to be fatal to men and animals. Railway sleepers so prepared were licked by cattle for the sake of the salt. The cattle died, and the line was strewed with dead cattle for ten miles. The farmers rose in arms, and forced the company to take up and burn the sleepers. Many other processes are noticed by the reporters.

The report comprises much tabular matter; and it concludes with a consideration of the decay of timber, the selection of preserving-processes, the conditions of success, and the question, Will it pay? There are, in addition, twenty appendices on the various processes, contributed by various authorities. In these appendices are given three different methods of estimating the economy to be derived by using some process for preserving ties. Mr. Andrews gives the money-saving at the end of the term of life of the preserved tie; Mr. Harrod gives the life that the preserved tie must have in order to make the cost of using preserved or unpreserved ties equal; and Mr. Welch gives the money-value of any tie in use when compared with the white-oak unpreserved tie taken as a standard; the difference between the money-value and the cost showing the economy or the loss in use. In the first and last of these investigations, as Mr. F. Collingwood points out, the authors have compounded the interest on the several costs; in the second case, simple interest only has been taken. This is a point that must be settled before any close agreement can be reached, and Mr. Collingwood contributes some elaborate calculations with tables, towards a solution.

In the course of the discussion which followed the reading of the paper, particular attention was given to the comparative cost of iron sleepers and wood sleepers, including interest on outlay.

Mr. Collingwood contributes an elaborate appendix on "The Preservation of Forests." From a consideration of statistical data, it is estimated that the supply of first-growth white pine will be practically exhausted in the course of eleven years. The lumber

* Abstract from Minutes of "Proceedings" Inst. C.E., vol. lxxviii.,

cut in a single year from the district of Michigan, Wisconsin, and Minnesota, would load a train of cars nearly 7000 miles in length. Vast quantities of hemlock in the north have been destroyed for nothing but the bark; and in newly settled regions great quantities of wood of various kinds are burned for the purpose of clearing the land. Years ago, the elms in the province of Quebec were burned for the manufacture of potash from the ashes. But the greatest enemy is a forest-fire. It is estimated that, in Ottawa, ten times as much timber is burned as is cut. The great unknown factor, Mr. Collingwood concludes, is waste. If this be done away with, and reasonable care be taken to re-plant forests, an abundance of timber may be secured for generations to come.

THE TEMPERATURE OF THE MOON.

IN an interesting letter in *Science* on this subject, Mr. W. Ferrel writes as follows:—

"Now that the temperature of the moon has become a subject of investigation, with the aid of recent refinements in the methods of observing very small intensities of heat radiation, it may be well to also look at the matter from another stand-point.

"The condition which determines the static mean temperature of the whole mass of the moon is, that its rate of losing heat by radiation from its surface shall be exactly equal to the rate with which it receives and absorbs the heat radiated from the sun, in comparison with which the heat coming from the stars, and that radiated and reflected by the earth, may be neglected without any sensible error. But by the generally recognised principle that the relative radiating and absorbing powers of bodies are equal, the ratio between radiation and absorption is the same for all bodies at a given temperature; so that it is not necessary to consider the radiating power of the moon, but to simply satisfy the condition that the moon, with a surface of maximum radiating power—such as a lampblack surface—shall radiate heat as fast as it is received from the sun.

"All bodies are so constituted that their absolute radiating power is a function of the temperature, the former increasing with the latter, but by no means in proportion. If, therefore, we know the relation between the temperature of a body and its rate of radiating heat, and also know the rate with which it is receiving heat from its surroundings, we can, by means of the preceding condition, form an equation of condition which determines the temperature.

"According to Pouillet's determination from the experiments of Dulong and Petit, a square centimetre of surface of maximum radiating power, and at the temperature of 0 deg. Cent., radiates 1·146 calories of heat per minute; and hence, by the law of Dulong and Petit, the rate of radiating heat for any other temperature θ, is $1{\cdot}146\,\mu^{\theta}$, in which $\mu = 1{\cdot}0077$. The rate with which a square centimetre of surface normal to the direction of the sun's rays receives heat from the sun is what is usually denoted by A. Putting, therefore, s for the area of the moon's surface in square centimetres, and a for that of a great circle, the rate with which heat is radiated from the moon's surface is expressed by $1{\cdot}146\,\mu^{\theta} s$, and the rate with which it is received from the sun by A a. Hence, by the conditions above, since $s = 4\,a$, we get in the case of the moon in space, in which it loses heat by radiation only, and receives it from the sun only, the equation

$$\mu^{\theta} = \frac{A}{4{\cdot}584}$$

for determining θ where A is unknown. Since log. μ is exactly equal to 1-300, this may be put into the following convenient and practical form:—

$$\theta = 300 \log. \frac{A}{4{\cdot}584} = 300\,(\log. A - 0{\cdot}6612).$$

"From this equation, deduced as a simple case from a more general and mathematical treatment of the subject in the 'Temperature of the Atmosphere and Earth's Surface,'* the writer, with the assumed value of A = 2·2, deduced the value of $\theta = -96$ deg. Cent. But as there is some uncertainty with regard to the value of this constant, since some of the solar rays may be entirely absorbed before reaching the earth's surface, and it is thought by some to be considerably greater than this, we shall put it here equal to 2·5. With this value we get $\theta = -79$ deg. This must be understood to be the mean surface temperature of the moon, or, more accurately, the temperature of a surface uniformly heated which would radiate as much heat as the surface of the moon—which, of course, has very different temperatures on opposite sides at any given time.

"The law of Dulong and Petit being an empirical one, which satisfied the experiments from 0 deg. to 300 deg. only, there is some uncertainty in extending it down to − 79 deg.; but this is very small in comparison with what it is in extending it in the other direction, up to the temperature of the sun, as has been done by Pouillet and others, in forming an equation for determining its temperature. The uncertainty in the true value of A, together with that in the extension of the law down to so low a temperature, causes some uncertainty in the mean temperature of the moon as thus determined; but this is not very great in a matter of this sort, for it amounts to only 17 deg. in an uncertainty of one-eighth part in the value of A.

"But when we attempt to determine the temperature of the side of the full moon exposed to the sun and earth, the uncertainty becomes very much greater. In this case the heat is not only radiated from the surface, but it is also conducted inward from the surface, heated far above the mean temperature of the moon, and stored away for the time. The rate with which it is conducted in depends upon the conductivity and capacity of the lunar soil for heat, which are unknown to us; and the problem would be extremely complex if they were known. The temperature of the moon's surface, in this case, can only be determined for the two extreme hypotheses of infinitely great and infinitely small conductivities for heat. Upon the first hypothesis, the heat received and absorbed by the moon would be instantly distributed through the whole mass, and radiated equally by all parts of the moon's surface, and the temperature of the part exposed to the sun's rays would be the mean temperature of the moon as obtained above. Upon the other hypothesis, it would not be conducted away at all from the surface receiving it, but, in case of a static temperature, it would all have to be radiated away by the same surface receiving it. Hence, in this case, instead of the radiating surface being four times as great as the surface, or normal sectional area receiving it, it is only equal to it for the part of the moon's surface upon which the sun's rays fall perpendicularly, and we must therefore have $1{\cdot}146\,\mu^{\theta} = A$, or

$$\theta = 300 \log. \frac{A}{1{\cdot}146} = 300\,(\log. A - 0{\cdot}0592),$$

instead of the preceding similar expression.

"With the assumed value of A = 2·5, this gives $\theta = 101$ deg. for the temperature of the central part of the moon's disc as viewed from the sun and from the earth at full moon. For other parts the value of A in the preceding expression must be multiplied into the cosine of the angle of incidence of the sun's rays upon the moon's surface, and thus this expression will give the temperature down as low as it is safe to extend Dulong and Petit's law. The same results would be obtained sensibly with any ordinary conductivity for heat if the same side of the moon were permanently exposed to the sun, for the temperature gradient by which the heat would be conducted inward would soon become so small in this case that the rate by which heat would be conducted inward would be insensible, as in the case in which heat is conducted outward from the interior of the earth.

"The result above of 101 deg., which is a little above the temperature of boiling water, must be regarded simply as a limit beyond which, in a large range of uncertainty, the temperature cannot go. The other limit is — 79 deg. If we suppose the temperature of the warmest part of the moon's disc to fall half-way between these extremes, it would be a very little above a freezing temperature."

* "Professional Papers of the Signal Service," No. xiii.

LAUNCHES AND TRIAL TRIPS.

ON the 24th ult., Messrs. Harland and Wolff launched a fine steel screw steamer, the Inishowen Head, built for the Ulster Steamship Company, Belfast. The steamer is of the following dimensions:—Length, 340ft.; breadth, 40ft.; depth, 28ft.; about 3100 tons gross register; built to class 100 A1 at Lloyd's, but in scantlings and strengthenings generally is much in excess of their requirements. She has two steel decks, extra outside butt straps on two upper strakes of plaiting and bilge strake. All the plating is also increased in thickness throughout above Lloyd's rules. The upper deck is fitted with very substantial iron rails and stanchions, with topgallant forecastle forward, and a bridge-house 90ft. long amidships extending from side to side of the vessel, forming a complete protection for engine and boiler casings; iron wheel house and solid bulwarks aft. There are four steam winches, and powerful steam windlass and capstan, also steam steering gear, by Muir and Caldwell, of Glasgow. The Inishowen Head is built on the cellular double bottom principle, to contain about 700 tons water ballast, with trimming tank aft, fitted for cargo; is schooner rigged, with two steel pole masts, and will have a total carrying capacity of about 4700 tons dead weight. Accommodation for captain, officers, and engineers, is amidships, and crew forward. The engines are also by Messrs. Harland and Wolff, of the triple expansion type, with all the latest improvements—three cylinders, 24½ by 37 by 64in. diameter, with 48in. stroke, to work at a pressure of 160 lb. The crank and propeller shafting is of Siemens-Martin steel, and the pistons are supplied with MacLaine's patent perfect rings and springs. There are two double-ended steel boilers, hydraulic rivetted, fitted with Fox's corrugated furnaces, and tested to a pressure of 320 lb. to the square inch. The Inishowen Head will be commanded by Captain Thomas M'Calmont, commodore of the line, and is the fifth steamer built by Messrs. Harland and Wolff for the Ulster Company. She will receive her complete outfit at Belfast.

On Wednesday, April 21st, the s.s. Pera, built by Messrs. Earle's Shipbuilding and Engineering Company, Hull, for Messrs. Bailey and Leetham, of the same town, was taken on her trial trip. The vessel is 310ft. long by 37ft. broad by 20ft. depth of hold, and is built to Lloyd's highest class, with additional strengthening by the use of steel for the upper works. The main deck is of iron, and amidships she has a low bridge, in which are the engine and boiler-room casings, the whole being strongly protected with iron coverings, turtle back forecastle, and turtle back aft. She is schooner rigged, with yards on her foremast. Provision is made for water ballast in double bottom, all fore and aft framed on the longitudinal system. The rudder is of steel, by Messrs. Jessop and Sons, Sheffield, and is connected to a combined hand and steam steering gear, by Messrs. Amos and Smith, fitted in a wheel-house at forward part of bridge. With a view to the rapid loading and discharging of cargo, powerful steam winches have been provided to facilitate this. She is fitted by the builders with engines of 200 nominal horse-power supplied by the owners, and during a run of several hours' duration in very rough weather proved herself an admirable sea boat.

On Tuesday last Messrs. Raylton, Dixon, and Co. launched a steel screw steamer, named the Scholar, which has been built for Messrs. Thomas and James Harrison, Liverpool. Her leading dimensions are 260ft. length over all; breadth, 34ft.; depth, moulded, 23ft. 8½in.; and she has a dead-weight carrying capacity of about 2150 tons. She is built on spar-deck rule, has deck-house aft for cabin accommodation, and will in every way be fitted as a first-class merchant steamer. The engines, which are on the triple expansion principle, by Messrs. Blair and Co., of Stockton, are of 140 nominal horse-power, having cylinders 20in., 33in., and 54in. diameter, and 36in. stroke.

A steam yacht, named the Rosalind, was launched from Messrs. Cochran and Co.'s Bidston Wharf yard on Wednesday, the 5th inst. The yacht has graceful lines and very spacious cabins. The tonnage, yacht measurement, is 75 tons, and her principal dimensions are: Length, 91ft.; beam, 14ft.; depth, 9ft. 6in. The engines are inverted, direct-acting, compound, surface condensing, having cylinders, 13in. and 26in., and 18in. stroke, with one of Cochran's patent horizontal furnace boilers. A good speed is anticipated.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, April 24th.

IMPORTERS are quietly negotiating for the shipment of large quantities of billets and slabs for interior shipment. The imports of foreign iron and steel for the past thirty days have been rather below expectations. Brokers have been quite busy during the past week or so in soliciting business, but without much success. The bulk of the business likely to be done, will be done by two or three of the larger consumers of iron and steel at Pittsburgh and points near by. It is rumoured that heavy shipments will be made to steel consumers at Cleveland and Chicago. A genuine boom has set in in the building of natural gas pipe lines in Pennsylvania. The Manufacturers' Natural Gas Company has determined to lay a double line of 8in. pipes, from Cannonsburg to Pittsburgh, by way of Beck's Run. At an interval of four miles the pipes will be connected by cross sections. From thirty to thirty-two miles of pipe will be required to lay the two lines. The Continental Tube Works of Pittsburgh has contracted to lay the pipes, and next week delivery will begin. The Manufacturers' Company yesterday brought in an excellent gas well on the Edgar Farm near Cannonsburg, at a depth of 1000ft. The People's Company is laying pipes within the limits of Pittsburgh. The National Tube Works of McKeesport, Pa., has large contracts to furnish pipe for conveying gas from Wheeling, West Virginia. A great deal of interest is taken in the improvement of blast furnaces throughout the country. One leading blast furnace firm has contracted for the erection of thirteen furnaces, two to be built at Birmingham, Alabama, and one at St. Louis. A Bill was defeated in Congress looking to the purchase of the Monongahela Navigation Company's franchises, which controls the transportation of the bulk of the coal moved by river in the neighbourhood of Pittsburgh.

THE ROYAL AGRICULTURAL SOCIETY.—The following table, in which the respective departments are given, shows how the implement department is falling off at the Society's Shows, and deservedly so. The Society has abdicated its honourable position, and given itself up to a clique, some of whom profess very Free Trade and act the narrowest Conservatism:—

Description of shedding.	Norwich, 1886.	Preston, 1885.	Shrewsbury 1884.	York, 1883.	Reading, 1882.
Ordinary	7,155	8,417	9,315	9,569	9,326
Machinery in motion	2,017	2,063	2,035	1,949	2,289
Side sheds, including seeds, models, &c.	1,640	1,520	1,554	1,618	1,402
Total..	10,812	12,000	12,904	13,136	13,017

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

(*From our own Correspondent.*)

THE most important feature this week is the strong tendency which the sheet iron makers are showing to make some stand against the continued fall in prices. Several firms located especially about Bilston and the near-lying districts have not reopened their works since the holidays, and they state that they will not resume until either better prices or lower wages are within their reach.

Whether the ironworkers will recognise the wisdom of meeting the masters in a liberal spirit time will prove. Some masters who have now stopped state that the lowest price which they have accepted for galvanising doubles has been £6 10s. per ton. Other makers this week decline to accept less than £6 5s. to £6 7s. 6d. for reliable qualities. Yet some buyers assert that they can secure deliveries at not much over £6. Lattens are selling at £7 to £7 2s. 6d. and on to £7 5s. per ton.

All the best ironmakers have now formally notified the reduction in bars of 10s. per ton. The firms who, in addition to those previously noted have issued circulars, are Messrs. John Bradley and Co., the New British Iron Company, Messrs. John Bagnall and Sons, Messrs. Phillip Williams and Sons, Messrs. Brown and Freer, and others. Hoops, angles, tees, sheets, and plates, the products of the list houses, are also subject to the 10s. reduction.

The Earl of Dudley's prices now become: bars, lowest quality, £7 12s. 6d.; single best, £9; double best, £10 10s.; and treble best, £12 10s. Strips and hoops and angle iron become: lowest quality, £8 2s. 6d.; single best, £9 10s.; double best, £11; and treble best, £13. His lordship's rivet and tee iron becomes: single best, £10; double best, £11 10s.; and treble best, £13 10s. Strips and hoops of ⅞in. and 20 gauge become £9 2s. 6d. lowest quality; £10 10s. single best; £12 double best; and £14 treble best; while ¾in. become £10 2s. 6d., £11 10s., £13, and £15 respectively.

Messrs. John Bradley occupy a unique position in the trade for quality, and their prices for all bars above ⅝in. are, even with the reduction, £2 10s. above those of the other list houses. Their bars now become £9 10s. Their hoops are £1 per ton above other firms, namely, £8 10s., and their sheets and plates £1 10s. above other firms, namely, £10. For rounds and squares up to ⅝in., the firm will accept £8, which is £1 per ton in advance of the other houses.

The new list of William Barrows and Sons shows: Bars, £7; angle iron, £7 10s.; best tee and rivet iron, £9; plates, £8 10s.; best boiler ditto, £9 10s.; and double best boiler ditto, £10 10s.; sheets, £8 10s., £10, and £11 10s. according to gauge; and hoops, £7 10s.

The New British Iron Company now quote:—Bars, Lion brand, £7; Best Corngreaves, £6; steel ditto, £7; Corngreaves Patent Composite, £8 10s.; slit rods, Lion, £7; C.G.C., £6 10s.; Best Corngreaves, £5 15s. Plates are quoted: Lion, £8 10s.; Best Corngreaves, £7 10s.; and tank, £6 10s. Angles are: Lion £7 15s. and Best Corngreaves £6 10s.; Tees, Lion £8 and Best Corngreaves £6 10s.; hoops, Lion £7 10s. and Best Corngreaves £6 10s.

Phillip Williams and Sons continue the exceptional position which they have occupied for some time in being 5s. below the other houses. This firm's mitre bars now become £6 15s.; strips, £7 5s.; sheets, singles, £7 15s.; doubles, £8 10s.; and lattens, £9 10s.; angles and plating bars, £7 5s.; Wednesbury Oak branded qualities are £1 per ton below the foregoing.

Messrs. Brown and Freer quote H.B. Crown bars, ordinary sizes, £7; hoops, £7 10s.; and sheets—singles—and plates, £8 10s.

The marked bars which are now selling at £7 per ton are in every way equal to the bars which commanded £16 per ton in 1873.

The demand for best iron is likely to be somewhat increased by the reductions. In the week immediately following their announcement, Messrs. Hingley and Sons' works turned out over 1000 tons—almost a full week's work, and considerably more than has been made in any one week during the previous twelve months. Lord Dudley's iron is in better request just now for dockyard and engineering purposes.

Merchants and other consumers of second and third qualities are also attempting to obtain some concessions. The maximum amount of success with which they are meeting is 2s. 6d. to 5s. upon some descriptions of second-class iron, but upon common qualities there is absolutely no room for any giving way. Common bars may be had at from £4 17s. 6d. to £5 5s. per ton, and a fair medium quality at something under £6.

The pig iron trade is a little brisker this week than last, but the business is still confined to small lots. Vendors are standing off the market as much as possible. Derbyshire pigs are down at 36s. delivered at works, and Northamptons at 35s. Some Derbyshire makers are, however, declining to sell at less than 39s. Native pigs are 52s. 6d. to 55s. for hot blast sorts; occasionally, 57s. 6d. to 60s. being quoted. Part-mines are exceedingly varied, and common pigs are 27s. 6d. to 31s. 3d.

The concession in the railway rates for the conveyance of iron from Staffordshire to Hull has now been extended to the Shropshire ironmasters. In future the charges for undamageable iron from Shropshire to Hull will be 12s. 6d. per ton, and upon damageable iron 15s. per ton in lots of 10 tons and upwards.

A monthly meeting of the South Staffordshire Mines Drainage Commissioners was held at Wolverhampton on Wednesday. The chairman remarked that the canal companies had at length consented to have tests made in order to ascertain the extent of the leakage from the canals, and he had no doubt that some good would result.

That Continental, and especially German, competition in the colonies, in India, and elsewhere is no myth, is evidenced with increasing clearness every month. Local merchants are now constantly receiving orders indented for Continental hardwares, which consumers can get at a cheaper price than native goods, and which answer their purpose in every sense equally well.

The Contract Department of the Admiralty is just now making known an attempt at imposition upon manufacturers. A London firm, whose name is withheld for obvious reasons, has been circulating among manufacturers likely to tender for the Admiralty hardware orders a letter professing that they could use considerable influence in favour of any firms desiring to secure contracts for the payment of a 5 per cent. commission. The Admiralty authorities announce that the firm who have been attempting this imposition is entirely unknown to them, and that it is beyond the power of any persons to influence the decisions upon Admiralty tenders.

The annual meeting of the Birmingham gun trade was held on Tuesday. The chairman of the Proof House Guardians, in referring to the falling-off in the business, attributed it to the general depression, to hostile foreign tariffs, competition with cheap Belgian labour, and the disinclination to use labour-saving machinery. Of these combined causes the most potential was the competition with cheap foreign labour. The Belgian workmen were now, however, beginning to be more fully sensible to the value of their labour.

The West Bromwich Corporation Gasworks has made a net profit on the year of £752, as against a profit on the previous year of £2179. The difference is chiefly owing to the reduced value of residuals. In consequence of a good balance from the year 1884-5, there is still a favourable balance to go forward of £2070.

The Corporation Gas Works at Stafford have made a net profit on the year of £1844. The amount has been applied towards the reduction of the rates, and this payment makes a total of £12,000, which the funds of the borough have received from the business.

The twenty-sixth quarterly meeting of the Midland Association of Gas Managers was held on Friday at the offices of the Wolverhampton Gas Company, when the following gentlemen were elected new members:—Mr. W. S. McGregor, Hednesford; Mr. F. L. Ramsden, Burton-on-Trent; Mr. P. Thomas, Buckingham; and Mr. J. Lewis, Wellingborough. After the meeting the members visited some of the principal works in the town.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is still little or no change to report in the condition of trade in this district. "Nothing doing" is the almost unvarying reply to any question as to business, and although this, of course, is not to be taken in its absolutely literal sense, it is a relatively accurate statement of the present general condition of trade. The chief matter of surprise seems to be that the protracted depression has not resulted in some serious collapse amongst makers and manufacturers of iron; and that they have been able to keep going through so long a period of unprecedentedly bad times may be taken as an evidence of the soundness of the trade that has been done, and of the extraordinary stability of this branch of industry. There is, however, little doubt that the resources of many concerns are being very severely tried, and the excessively low prices at which business for cash is in some instances being sought after is taken as a sign that some of the weakest are gradually going to the wall.

The Manchester iron markets have only brought together small attendances since the holidays, and on Tuesday there was again less than the average number present on 'Change, with only a very small weight of business doing. For pig iron the demand was of the most limited character possible, and although prices were no lower than last week, this was due rather to the fact that buyers were not offering anything to really test whether makers would be prepared to give way, even upon the present low basis, if anything like favourable orders for quantities were to be got, than that there is any general firmness in adhering to late rates. For Lancashire pig iron, prices, if anything, are a trifle easier as compared with the rates which have recently been quoted, local makers being now prepared to accept about 37s. and 37s. 6d., less 2½, for forge and foundry qualities delivered equal to Manchester, but they are still so completely undersold that in the open market they have no chance of competing. For some of the district brands prices about the same as the above are also asked, but both Lincolnshire and Derbyshire iron is to be got as low as 35s. 6d. to 36s. 6d., less 2½, delivered here. In outside brands very low prices are being quoted to effect sales in this market. For the best named brands of Middlesbrough, sellers endeavour to hold out for 39s. 4d., net cash, for foundry qualities delivered equal to Manchester, and 6d. per ton under this figure represents about the full extent of the concession that can be obtained on special named brands; but ordinary g.m.b.'s are to be got without difficulty at more than 1s. per ton below this figure, and for Scotch iron extremely low prices are also being taken.

In hematites there is still only the smallest possible business doing, and although quoted prices are maintained at late rates, it is difficult to get more than about 50s. 6d. to 51s., less 2½, for ordinary No. 3 foundry qualities delivered here.

If anything, there seems to have been rather more inquiry stirring in the manufactured iron trade, but in the weight of actual business doing there does not appear to be any very appreciable increase. The forges throughout this district are still only partially employed, and prices show no improvement whatever. Bars delivered into the Manchester district can still be got at about £4 17s. 6d. to £5 per ton, hoops at £5 7s. 6d. to £5 10s., and sheets at about £6 10s. per ton. Nut and bolt makers report that trade never was so bad or prices so low as at present. The condition of the iron foundry trades remains much the same as last reported. In nearly all cases founders are so short of work that what little there is giving out is competed for at prices which scarcely, under the most favourable conditions, can leave any appreciable margin of profit.

With regard to the condition of the engineering trades, I may state that the results of a special journey embracing the whole of Lancashire, Yorkshire, and the East Coast, have tended to show that everywhere the depression, rather than diminishing, is intensifying itself, and the hopes which had been entertained that a revival might come with the spring have completely collapsed. There is a general expression of opinion that at no previous period in the industrial history of the engineering and iron trades of this country has the outlook been so disheartening or so critical as at the present time. The competition of prices in the general engineering trade has become so excessive that any legitimate margin of profit has long since disappeared, and in many instances the sole aim in securing orders seems to be simply to keep works going. Tested by the labour market and the reports issued by the workmen's trades' unions, the outlook is perhaps even more discouraging than from the employers' point of view. In the thirty-fifth annual report just issued by the Amalgamated Society of Engineers, the general secretary expresses his regret that the Society cannot be congratulated on having passed through a prosperous year; both home and foreign trade had been terribly depressed, and the relations of labour and capital had been of a very uneasy and disturbed character. What the actual experience of the year had been to the Society was to be gathered from the results. The Society has, indeed, been able to make some small advance as regards its membership, which from 50,681 at the close of 1884, had been increased to 51,689 at the end of 1885, but on the financial side of the question the result of the year's operations has been to leave the Society in a most unsatisfactory position. The total income for 1885 was £144,639, as compared with £157,484 in the previous year, whilst on the other hand the expenditure, which, with the exception of 1879, has been the heaviest of any year in the history of the Society, had amounted to £188,277. The chief item of this expenditure had been in the support of unemployed members, which had absorbed £79,949, an increase on the previous year of £14,638; sick benefit had cost £27,775, an increase of £1798 on the previous year; whilst on superannuation the expenditure had risen from £30,519 in 1884, to £32,608 in 1885. The excess of expenditure over income during the year has amounted to the large sum of £43,638, and this has reduced the accumulated funds of the Society to the sum of £119,130, or £2 6s. 1d. per member, which is the lowest value per member the funds have touched since the year 1869. Other important trades union organisations, are, however, in a worse position than the Amalgamated Society of Engineers. In the report issued for last month by the Boiler-makers' and Iron Shipbuilders' Society, some idea of the present expenditure of the Society may be formed when it is stated that, during the first quarter of the year, in addition to the ordinary income, they had not only drawn all the money from those branches that had any to spare, but since the commencement of the year they had been compelled to sell bonds to the amount of £11,000. Altogether the Society has been compelled to sell bonds to the total value of £21,500 to meet the requirements of branches in want, and "a worse feature of the case," the report adds, "is that up to the present time the demand for money has gone on increasing week by week." The cry is "send money! money! money! and their wants have been so regularly supplied during the past two years that we are beginning to fear they have lost very much the feeling of self-independence." In the face of this it is not surprising the ominous warning is given that "if the expenditure of the Society is not reduced immediately they would be under the painful necessity of considerably reducing the benefits and further increasing the contributions."

In the coal trade there is considerable continued falling off in the demand for all descriptions of fuel for house fire consumption, whilst the steam and forge requirements for the commoner classes of round coal remain quite as depressed as ever. The result is that very few of the pits are working more than from four to five days a week, and prices are extremely low, a very general giving way upon late rates having taken place this month. At the pit mouth best coals average about 8s. 6d.; seconds, 7s.; common house fire coal, 5s. 6d.; and steam and forge coal, 4s. 9d. to 5s. 3d. per ton. For engine classes of fuel there is a moderate demand, and with the lessened quantity of house coal now being screened the supplies of best slack are getting rather scarce at some collieries. Generally, however, supplies of engine fuel are still plentiful in the market, and at the pit mouth prices average 4s. up to 4s. 6d. and 4s. 9d. for burgy, according to quality, 3s. to 3s. 6d. for good ordinary slack, and 3s. 9d. to 4s. per ton for the best sorts.

The shipping trade is only dull, and the extremely low prices at which coal is being put on board vessels at Whitehaven and some of the Scotch ports is driving Lancashire coal out of the Irish market; delivered at the high level, Liverpool, or the Garston Docks, Lancashire steam coal averages 6s. 9d. to 7s. 3d. per ton.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

WORK has now been resumed after the Easter holidays, and there is a little more animation observable in several departments. Iron and coal could not well have been more depressed than during the last month, and May promises to be even worse for these great industries. Staffordshire prices continue to decline, owing to the severity of Cleveland and Scotch competition; and the fall in values reacts on Derbyshire and Yorkshire. It is said that several Staffordshire ironmasters have determined not to recommence work except at an advance, and this drastic measure, if carried out, may have a favourable influence in retarding a further drop in quotations; but it is doubtful if it will be concurred in by a sufficient number to make it successful.

The improvement already noted in the United States markets continues. In the States, the iron, steel, and kindred industries, even including rails, are stated to be unusually active, many houses having orders which will keep them running for six months. It is still the rule that the favourable condition of American trade reacts on Sheffield, and it may therefore be anticipated that our business with the markets of the United States will continue to improve during the year. The other improving markets are India and Australia, as well as British East Indies. The Continental and foreign markets generally are much depressed, with no immediate prospect of a change. At home, the Government orders in the leading industries are being completed, and as yet there are no signs of further orders being placed to follow them.

Coal is now at very low figures, one firm is offering best Silkstone house as low as 7s. per ton at the pit, though the price generally averages 8s. per ton and upwards at pit. Steam coal is about 6s. per ton at the pit; gas coal is again dull. Messrs. Newton, Chambers, and Co., of Thorncliffe, are now quoting at Sheffield: Mortomley coal, 14s. per ton; nuts, 10s. 10d.; thin, 12s. 6d.; brazils, 11s. 3d.; Tankersley house, 10s. 5d.; kitchen coal, 8s. 4d.; best hard steam, 9s.; gas coke, 8s. 6d. These prices, with the exception of brazils, which are 1s. 3d. per ton lower, are the same as in October. The coalowners of Yorkshire held another meeting at Sheffield on Tuesday to consider sliding scale for the regulation of wages.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE was a good attendance at the Cleveland iron market held at Middlesbrough on Tuesday last, but no improvement in the amount of business actually done. Prices were slightly lower than they were a week previously. Being full of uncertainty as to the future, buyers order only in small quantities to meet immediate requirements, and sellers are reluctant to commit themselves largely at the present unremunerative prices. In the course of Tuesday's market, small parcels of No. 3 g.m.b. were sold by merchants at £29 9s. per ton for delivery this month, and 30s. per ton was quoted for delivery to the end of June. The leading makers, however, will not take these prices, but usually quote 30s. 6d. per ton, and where particular brands are specified, that figure must needs be paid. Such transactions are, however, few and far between, and meanwhile, unless a change for the better speedily ensues, both as regards volume of trade and value of products, more furnaces will, without doubt, have to be blown out.

Warrants have changed hands in a few instances during the last few days at 30s. per ton, but as a rule buyers are unwilling to operate.

The accumulation of pig iron in Messrs. Connal and Co.'s Middlesbrough store was on Monday last 222,282 tons, which represents an increase of 4509 tons during the week.

The finished iron trade is as bad as ever, and there are no signs of improvement either as to demand or price.

The shipments of pig iron made last month exceeded those made in March, but they were far below those for April. Of the total, 62,700 tons, which left the river, 26,547 tons went to Scotland, 8838 tons to Germany, 5610 tons to France, 5515 tons to Holland, 2490 tons to Wales, and 2870 tons to Spain and Portugal. The principal falling-off is from foreign exports, and especially from the deliveries to Germany. Only 28,990 tons in all were sent to foreign ports, as against 33,150 tons during April last year, and 48,235 tons during April, 1884.

The certificate of the official accountants to the Durham coal trade has been issued, and sets forth that the average net realised price of coal during the first three months of the present year was 4s. 5·49d. per ton. According to the provisions of the sliding scale arrangement, wages will be reduced 1¼ per cent.

Messrs. Doxford and Son's shipbuilding yard, situated at Pallion, near Sunderland, which has been closed since last autumn, was re-opened last week. The keel of a large four-masted sailing vessel has been laid down, and the further operations will be proceeded with forthwith. This will be welcome news to Sunderland workmen.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE is a lack of animation in the iron trade generally, although some of the smelters state that they are busy on contracts that have been some time in hand. The past week's shipments of pigs are larger than for a considerable time past, amounting to 10,282 tons, as compared with 8483 in the preceding week and 11,491 in the corresponding week of 1885. The speculative department of the pig iron trade has been very quiet during the week, with quotations on the whole somewhat lower. Current values of makers' iron do not show much change. The export demand has shown some improvement, but is still below what might be expected at this time of the year. One furnace was lately blown in at Calder Ironworks, but two have since been thrown idle there by the breakdown of an engine, and the total number now blowing is 95 as against 90 at this date last year. Stocks continue to increase at an unusually rapid rate, the addition for the past week in Messrs. Connal and Co.'s Glasgow stores being upwards of 6000 tons.

The warrant market was closed on Monday, which was a Scotch bank holiday. On Tuesday transactions occurred in the forenoon at 38s. 6d. to 38s. 5d. and 38s. 5½d. cash, the afternoon quotations being 38s. 5½d. to 38s. 4½d. cash. On Wednesday the market was flat, at 38s. 5d. to 38s. 4d. cash. To-day—Thursday—transactions were few, at 38s. 3½d. to 38s. 3d. cash.

The market values of makers' pig iron are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 43s.; No. 3, 41s.; Coltness, 47s. and 43s.; Langloan, 44s. and 41s. 6d.; Summerlee, 46s. and 41s. 6d.; Calder, 46s. 6d. and 41s.; Carnbroe, 43s. and 40s.; Clyde, 43s. and 40s.; Monkland, 39s. and 36s.; Quarter, 38s. 6d. and 35s. 6d.; Govan, at Broomielaw, 39s. and 36s.; Shotts, at Leith, 45s. and 44s.; Carron, at Grangemouth, 48s. 6d. and 45s. 6d.; Kinneil, at Bo'ness, 43s. and 42s.; Glengarnock, at Ardrossan, 43s. and 40s.; Eglinton, 39s. and 36s.; Dalmellington, 41s. and 38s.

To date the total shipments of Scotch pigs are 119,954 tons, as compared with 153,470 in the same period of last year, 189,210 in 1884, and 203,982 in 1883. The arrivals of Middlesbrough pigs at Grangemouth show a comparative reduction of 27,278 tons.

There is a good export business in iron and steel manufactured goods from the Clyde, the past week's shipments embracing four locomotives for tramways valued at £3000, for Singapore; £10,646 machinery, the greater part of which was sugar crushing plant for Honohulu, Penang, and Manilla; £4052 steel goods, and £24,000 worth of general iron manufactures.

In the steel trade there is considerable activity, most of the works being well employed.

The coal trade is backward, and in none of its departments is there so much business as might have been expected at this advanced date of the spring. In the shipping branch a marked improvement has been expected week by week; but while at some ports the shipments have certainly been large, at others they are considerably below the average. Only nominal quotations are in most cases obtainable, as it has been found impossible to maintain the current figures.

The miners, who threatened a formidable agitation a week ago on behalf of restricted output and higher wages, have made scarcely any progress in that direction. They are without an organisation, and the efforts now being made to reconstruct the union have hitherto been attended with little progress.

The ceremony of cutting the first sod of the works for the duplication of the Loch Katrine water supply was performed on Saturday by the Lord Provost in the presence of the magistrates and members of the Town Council. On the 14th October, 1859, the Queen turned on the water of the present Loch Katrine works, which up to this date have cost £1,100,000, exclusive of the outlay on piping, &c., in the city. The tunnel aqueducts are 11¾ miles in length, open channels 10¼ miles, and the pipes in the valleys 3¾ miles, giving a total length from Loch Katrine to Mugdock Reservoir of 25¾ miles, there being an additional 8¼ miles to Glasgow, making the entire distance thirty-four miles. The total amount spent on the works up till now is £1,547,000, of which £331,000 has been paid off by the action of the sinking fund. By the first Act permission was given to draw 7ft. off the surface of the Loch, and this gave a storage of 5,600,000,000 gallons, or 110 days' supply of 50,000,000 gallons a day. The Act which was passed last year authorises the raising of the Loch 5ft., giving 12ft. depth of water to be drawn off, and increasing the storage to 9,850,000,000 gallons, or nearly 200 days' supply at the above rate. The first contract for tunnel construction in connection with the new works has been entrusted to Messrs. Morrison and Mason, who are at present erecting the new municipal buildings of Glasgow, and other contracts will be fixed shortly.

During April nineteen vessels were launched from Clyde shipyards, with a total tonnage of 22,754, against thirty-one vessels of 21,101 tons in the same month of last year. In the four months the tonnage launched has been 51,312, against 59,513 in the corresponding period of last year.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

NOTICE was issued lately, at the important colliery of Middle Duffryn, Aberdare Valley, that at the end of April all contracts would cease. I am glad to see that this has been rescinded. This week, however, notices of a similar character were issued at various collieries, Abercwmboy, Cwmpennar, Aberaman Drift, and others, and as it is understood that some collieries will be closed permanently things look gloomy. Most of the collieries under notice are in the Aberdare Valley, but I see that the same course has been followed at Ynysyfeio in the Rhondda valley.

Unless we have a speedy change in Wales, there can be but one result—a train of disasters. Fortunately there has been a little change for the better. I was at most of the Dowlais collieries this week, from Bargoed to Bedlinog, and was glad to find that for the last week the work had been more regular. At Vochriw, where one of Mr. Cory's agents is stationed—the largest buyer and shipper of coals in Wales—a spurt was admitted, but no permanency in it. In other districts I find the same state of things, and for the small coalowners things look serious. That a turning-point will come is tolerably certain; the only question is whether many can survive until then.

Rhondda house coal is depressed this week; quotations are as low as 8s. 3d. Steam coal quotations vary according to quality, from 7s. 6d. to 9s. 6d. The public, however, would be surprised to hear at what price even the best coal has been put on board at Cardiff.

A fine seam of coal has been struck at Trinsaran Colliery.

Swansea coal trade is, like the rest, slow. Exports last week only slightly exceeded 20,000 tons. Cardiff showed a slight increase, but Newport trade, which is largely house coal, was not so good, the summer weather telling as usual. I am glad, however, to report favourably of Newport industries and prospects. Sir Geo. Elliot is to the front, literally, in that quarter. He calculates with tolerable certainty on the new line being a commercial success—the Pontypridd, Caerphilly, and Newport—and is taking the requisite steps for making it a passenger line as well.

The Ocean Collieries have declared a reduction of 2½ per cent. in colliers' wages, and it is expected that this will be the case with the Associated Coalowners.

I must note that a very useful work is to be issued periodically by Dowen and Co., Cardiff, in connection with the great Welsh coal industry in the form of a "Coalowners' and Colliery Managers' Guide and Directory."

Steel sleepers are fairly occupying the works at Dowlais and Tredegar, and steel bar at Blaenavon, Dowlais, and Cyfarthfa. I fancy that Dowlais has the lion's share. The only drawback, so say the agents at each works, is the quotation. Prices are too low for any good to men or masters. In the matter of steel rails the discharge of 8000 platelayers by the Great Western Railway shows how much more economical these rails are than the iron, which scaled off and needed great supervision. Surely this should prompt more to go in for steel sleepers as well.

Iron ore is dull. Quotations for best Spanish are as low as 10s. 6d., ex ship Cardiff. I have known it at double the price.

Notice has just been issued at Dowlais Works for the conclusion of all contracts at the end of the present month. This is reefing the sails, and making all taut for probable storms. I do not imagine that stoppage is meant, only reverting to a day-to-day contract.

There is a dispute waging at Navigation Collieries, and though principally affecting pitchers, banksmen, and roadmen, it has had the effect of temporarily stopping the colliery.

The tone of the tin-plate trade is good, and though a falling off in shipments occurred last week at Swansea, makers say that they hold large orders, and that even if prices have slightly drooped—about 3d. per box—prospects are good. Cokes are quoted at 13s. 3d.; Bessemer steels, as low as 13s. 6d. For Siemens' demand is improving, and prices have a tendency upwards. Some makers have sold well at 14s. 3d. Ternes are also firm, with upward tendency.

A mass meeting of colliers was held at Aberdare on Monday, when clauses in the Regulation Act, affecting "croppings" and "check weighings," were discussed. It was also decided to move for a new election of representatives. The formal beginning of the Taff Vaur Waterworks of the Cardiff Corporation was made on Tuesday, when the sod was cut by the Mayor in presence of a large gathering. It is a great enterprise, and will cost at least £360,000.

A SUNKEN steamer, the Cuxhaven, belonging to the Yorkshire Coal and Steam Shipping Company, Goole, was floated and beached at Goole on Sunday last. The contract for raising and getting out the cargo was settled with the Dundee Salvage Company for £1450.

NEW COMPANIES.

The following companies have just been registered:—

Costa Rica Railway Company, Limited.

This company proposes to acquire, extend, improve, equip, and work the railways in Costa Rica, between the port of Limon and the town of Carrillo, and between Cartago and Alajuela, with the pier at Limon; also to construct and work a railway between a point on the said Limon and Carrillo Railway, near the River Reventazon, and the Cartago and Alajuela Railway at or near the city of Cartago. The company proposes to acquire the rights and privileges of a concession, dated 21st April, 1884, made between the Republic of Costa Rica, of the one part, and Minor Cooper Keith y Meiggs, the concessionaire, of the other part. It was registered on the 22nd ult. with a capital of £1,800,000, in £10 shares, with the following as first subscribers:—

	Shares.
William Doherty, 6, Great Newport-street, W.C., printer	1
J. A. Holliday, Asylum-road, Peckham, clerk	1
A. Vansittart, 1, Langham-street, W.	1
A. Von Der Sabel, 89, Finsbury Park-road, clerk	1
H. E. Meiggs, 146, Cromwell road, contractor	1
W. H. Adams, 30, Peckham grove, accountant	1
L. Clow, 11, Upper Hamilton-terrace, stockbroker	1

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £1000 in shares, stock, or debentures. The subscribers appoint the first directors and act *ad interim*; remuneration, £2000 per annum, or such other amount as the company in general meeting may determine.

Hampshire Steam Thrashing Company, Limited.

This is the conversion to a company of the business of corn thrasher carried on by Mr. Alfred William Wilkinson, of Winchester. It was registered on the 28th ult. with a capital of £10,000, in £1 shares. The subscribers are:—

	Shares.
A. Haslett, St. John's, Kent, agent	1
E. Jumpserjee, 57, Cadogan-street, S.W., merchant	1
J. H. Polak, 4, Derwent-road, Anerley, merchant	1
G. A. Clements, Hampton, accountant	1
A. W. Wilkinson, Winchester, corn thrasher	1
W. W. Harrison, 23, Falkland-road, clockmaker	1
C. Noyce, Bishopstoke, corn thrasher	1

The number of directors is not to be less than three nor more than seven; qualification, ten shares; the company in general meeting will determine remuneration.

Marling and Co., Limited.

This company proposes to acquire the businesses carried on under the style of Marling and Co., at Ebley Mills, near Stroud, and elsewhere, and under the name of Woolright and Co., at Stanley Mills, Stonehouse, and to trade as cloth and linen manufacturers, and flax, hemp, jute, and wool merchants. It was registered on the 21st ult. with a capital of £200,000, in £100 shares. The subscribers are:—

	Shares.
*Sir W. H. Marling, Bart., Stanley House, Stonehouse, Gloucester	1
*S. Stephens, Ebley Mills, Stroud, manufacturer	1
*G. R. Garner, Stroud, accountant	1
*J. R. Hooker, 24, Sibella-road, Clapham, salesman	1
*S. C. Hooper, Rodborough, Stroud, manufacturer	1
J. Smith, Ebley, Stroud, manufacturer	1
A. H. Cox, Stonehouse, manufacturer	1

The number of directors is not to exceed five; qualification, £1000 of share capital; the first are the subscribers denoted by an asterisk; the company in general meeting will determine remuneration.

Scarborough Pure Ice Manufacturing Company, Limited.

Registered on the 28th ult. with a capital of £8000, in £5 shares, to carry on in Scarborough the business of ice manufacturers, smackowners, shipowners, fish merchants, and salesmen. The subscribers are:—

	Shares.
*J. Dale, Scarborough	20
*W. Holroyd, Scarborough	100
*E. Middleton, Scarborough	100
*S. Davis, Scarborough, fish merchant	20
*H. L. Woodger, Scarborough, smackowner	20
*J. H. Holroyd, Leeds, dyer	20
W. Ascough, Scarborough, clerk to School Board	20

The first six subscribers are appointed directors; the company in general meeting will determine remuneration.

Home Calico Manufacturing Company, Limited.

This company was registered on the 22nd ult. with a capital of £20,000, in £10 shares, to manufacture and deal in textile fabrics of all descriptions and other similar articles. The subscribers are:—

	Shares.
James Boyd, 7, Nicholas-street, Manchester, merchant	1
J. D. McLenner Chambers, 35, Back George-street, Manchester, buyer	1
C. W. Teltey, 7, Nicholas-street, Manchester, cashier	1
H. Hartley, Nelson, manufacturer	1
R. Dutton, Lymm, Warrington, estate agent	1
S. Thomson, Knutsford, accountant	1
G. Newnes, 83, Farringdon-street, journal proprietor	1

The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first and act *ad interim*; qualification for subsequent directors, five shares. The company in general meeting will determine the remuneration of the board.

New Emma Silver Mining Company (1886), Limited.

This is a reconstruction of the New Emma Silver Mining Company, Limited, in accordance with the resolution passed at a general meeting of shareholders held on the 2nd, and confirmed at a meeting held on the 19th ult. The old company was incorporated on the 17th January, 1882, with a capital of £700,000, in £10 shares, to take over the Emma Mine from the Emma Silver Mining Company, Limited. The last return, made up to the 6th of August, 1885, was filed on the 14th August, 1885. This return shows that the capital had been increased to £785,000, in £10 shares, the whole of which had been issued and fully-paid. The new company was registered on the 28th ult. with a capital of £350,000, in £1 shares. Shares in the new company credited with 15s. paid up will be issued to shareholders in the old company in the proportion of four new shares to each share held in the old company. Debentures in the new company will be issued to the debenture-holders of the old company for the amount of principal and interest expressed to be payable on such debentures, the principal sums to be repaid at the expiration of five years from the date of issue. The subscribers are:—

	Shares.
F. W. Snell, 1 and 2, George-street, solicitor	1
C. W. C. Hutton, 6 and 7, Newgate-street, warehouseman	1
J. B. Snell, The Chesnuts, Chislehurst, articled clerk	1
R. L. Hobbs, 8, Great Winchester-street	1
S. L'Amy, Junior United Service Club	1
J. A. Snell, 1 and 2, George-street, solicitor	1
S. H. Newman, Devonshire-road, South Lambeth, clerk	1

The number of directors is not to be less than three nor more than seven; the first directors need not be members of the company. The remuneration of the board will be determined by the company in general meeting.

Tauranga (New Zealand) Railway Company, Limited.

This company proposes to acquire the whole or part of the property and rights of the Tauranga, East Coast, and Hot Lakes District Railway Company, Limited, of New Zealand, and particularly the benefit and interest of a contract dated the 21st August, 1882, between her Majesty the Queen and the said company. It is also proposed to enter into an agreement with Mr. William McCandlish for the construction of a railway in New Zealand from the Port of Tauranga to Rotorua. The company was registered on the 22nd ult. with a capital of £250,000, in £10 shares, with the following as first subscribers:—

	Shares.
Hy. Cecil Raikes, Mold, Flint, Privy Councillor	1
J. Brunlees, C.E., 5, Victoria-street, S.W.	1
G. B. Bruce, C.E., 2, Westminster-chambers, S.W.	1
Granville R. Ryder, 60, Ennismore-gardens, barrister	1
Robert White, C.E., 43, Belsize-square, N.W.	1
E. M. Nelson, 15, Dowgate-hill, chairman Nelson Brothers, Limited	1
J. Barker, Grove Park, Chiswick, merchant	1

The number of directors is not to be less than three nor more than ten; qualification, 25 shares. The subscribers are to nominate the first directors; remuneration, £1300 per annum.

Mead Lodge Terra Cotta and Brick Works Company, Limited.

This company was registered on the 28th ult. with a capital of £3000, in £1 shares, to acquire premises at Acton, and the business of brick-making carried on in connection therewith. The subscribers are:—

	Shares.
C. Wilson, 22, Station-road, Finchley	1
H. Wilson, Southfield-road, Chiswick, brickworks manager	1
R. E. Arnold, Kensington-court-place, artist	1
S. Innes, 91, Manor-street, Clapham	1
C. Luff, Chertsey, clerk	1
A. J. Barker, St. Alban's-road, Kensington	1
P. R. Stamper, 49, Shardloes road, New-cross	1

Registered without special articles.

Coal in Transylvania.—The *Montan und metallindustrie Zeitung* announces the discovery of an important coal field in Transylvania, near Petrosseny. Its extent, as far as has yet been ascertained, is about 78 square kilometres, and the average thickness of the coal seam is 10 metres (33ft.) The quality appears to be good for gas making and coke. It is anticipated that when coal mining is carried on in this district, the price of fuel at Petrosseny will be 16 frs. only per ton. instead of 36 frs. as at present.

M. Galland.—We regret to learn from the *Brewers' Guardian* that the well-known French engineer, Nicolas Galland, is dead. The sad event took place at Berlin, where he was engaged in the erection of some large maltings on his pneumatic system. It is now some twelve years since M. Galland attempted to introduce his pneumatic system of malting into this country, but it has never been extensively adopted, although he could point to the successful working of his large maltings erected on this principle at Maxéville, in France. After endeavouring to convince French and English maltsters, he at length succeeded in getting his system introduced into Germany, and at the time of his death was erecting some very large maltings on the pneumatic system at the Schultheiss Brewery in Berlin.

Reclamation of Land in Russia. — Large works for the reclamation of land have been carried out for some years on a large scale in Russia—viz., the drainage of marshes of Pinsk, on the frontier of Russian Poland, a tract of country larger than Ireland. This undertaking was commenced by the Government in 1870, and now 1,620,000 hectares (4,003,246 acres) of land have been reclaimed by the construction of embankments and navigable canals. Of this area, 240,000 hectares (593,074 acres) are excellent meadow lands; 365,000 hectares (901,966 acres) of woods which by a rational system of cultivation are now productive; 202,000 hectares (499,179 acres) of forests, which previously were inaccessible, but are now, thanks to a system of navigable canals, in communication with large towns; finally 813,000 hectares (2,009,036 acres) of good arable land, of which as yet only 50,000 hectares (123,577 acres) are under cultivation. In addition to a large number of miles of canal, and drains, and embankments, it was necessary to construct 179 bridges, and to sink 572 wells, varying in depth from 6 to 25 metres.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

27th April, 1886.

5670. Decorating Pipes, Cigar and Cigarette Holders, S. Turnbull, Theydon Bois.
5671. Speeding the Cylinder and Doffer of Carding Engines, E. and S. Tweedale and C. Mills, Halifax.
5672. Ball Hydrants, I. Ross, Edinburgh.
5673. Obtaining Chlorine from Hydrochloric Acid, &c., J. Hargreaves, T. Robinson, and J. Hargreaves, Liverpool.
5674. Flower-pots, H. W. Godfrey, Staines.
5675. Camera Stand, A. Birnie, Dundee.
5676. Sink Troughs and Tanks, B. R. Phillipson, Dublin.
5677. Electro Galvanic Hair Brush, T. W. Lawson, Manchester.
5678. Water Regulating Apparatus, J. Mitchell, Glasgow.
5679. Boot Last Holder, J. E. Gill, Farsley.
5680. Flushing Cisterns for Water-closets, J. Jackson, Newcastle.
5681. Treating Pyrites, J. Hargreaves, T. Robinson, and J. Hargreaves, Liverpool.
5682. Sulphates of Soda and Potassa, J. Hargreaves, T. Robinson, and J. Hargreaves, Liverpool.
5683. Obtaining Carbonate of Soda and Sulphur from Sulphate of Soda, J. Hargreaves, T. Robinson, and J. Hargreaves, Liverpool.
5684. Rail Clasps or Fastenings, W. Dickie and W. Motherwell, Glasgow.
5685. End Irons for Fire-grates, J. Corry and S. White, Bradford.
5686. Fertilising Compounds, H. J. Allison.—(*W. S. Pierce, United States.*)
5687. Horseshoes, J. Cole, Coventry.
5688. Splayed Hoop Iron for Coopers, J. H. Bullock, Birmingham.
5689. Self-locking Bolts for Doors, N. B. Locke, Glasgow.
5690. Filling Bottles, H. M. Whitefield and S. Washington, Manchester.
5691. Wringing and Mangling Machines, S. Washington and R. Lowe, Manchester.
5692. Coupling and Uncoupling Apparatus, J. B. Meeson, Sheffield.
5693. Propelling, Exhausting, and Moving Air, &c., F. J. Crossley, London.
5694. Lock Cover for China, &c., W. H. J. Edwards and E. R. Boulton, Burslem.
5695. Feeding Boilers with Water and Air, F. H. Moldenhauer, London.
5696. Wire Rope or Cable, W. E. Gedge.—(*A. S. Hallidie, United States.*)
5697. Ground Brushes, H. Weinreich, London.
5698. Marbling Earthenware and China in Enamels, H. Forrester, Stoke-on-Trent.
5699. Protecting Stand Pipes in Public Streets, E. Geall, Bury.
5700. Raising and Lowering Cables, A. Jamieson, Glasgow.
5701. Ship's Gangway, A. Lessels, New Brighton.
5702. Regulating the Speed of Machinery, J. Griffiths, Wrexham.
5703. Bottles, S. Laycock, Halifax.
5704. Dispensing with Metallic Springs in Washing Machines, T. Ramsbottom and T. Park, Halifax.
5705. Discharging Coal Cargoes from Ships, G. Jenkins, Newcastle-on-Tyne.
5706. Water Fittings for Baths, J. Macleish, Glasgow.
5707. Plough for Spreading and Ballast on Railways, T. Rodger, T. Black, and R. Crawford, London.
5708. Hopper Wagon, T. Rodger, T. Black, and R. Crawford, London.
5709. Automatic Railway Couplings, F. H. Addis, London.
5710. Dust and other Bins, G. Porter, London.
5711. Dispensing with the Publicity on Post Cards of the Names and Addresses of the Senders, W. Evans, Stafford.
5712. Paper Bags, W. Dickie and W. Inglis, Glasgow.
5713. Indicators for Steam Engines, J. Buchanan, Glasgow.
5714. Marine Steam Engines, C. Henderson, Glasgow.
5715. Burning of Oils for the Production of Heat, J. Lyle, Glasgow.
5716. Vaccination Shield, R. E. McGowan, London.
5717. Security Appliances for Watches, A. J. Boult.—(*C. Mouche, Belgium.*)
5718. Cut-off for Gas-burners, A. J. Boult.—(*E. A. Jukes and A. J. Johnson, Canada.*)
5719. Joints for Watch Cases, R. J. Quigley and O. Young, London.
5720. Mats, A. J. Boult.—(*H. T. Windt, Canada.*)
5721. Steam Engines, E. Easton, M. W. B. Ffolkes, and A. Mackie, Westminster.
5722. Piano Chairs, C. Luckat, London.
5723. Governor Mechanism of Steam Engines, J. G. Howard, London.
5724. Metallic Tubes, &c., S. Walker, London.
5725. Electric Arc Lamps, E. G. Brewer.—(*D. B. Macdonald and H. W. Woodman, Canada.*)
5726. Ploughs, J. Howard and H. W. Gibbs, London.
5727. Obtaining, &c., Gas from Coal, T. Nicholson, Abergele.
5728. Square Hole-boring Machines, J. C. and A. E. Lake, London.
5729. Teipel Arm for Throwing the Tongueless Ligowsky Clay Pigeons, C. J. Barrett.—(*B. Teipel, United States.*)
5730. Valve Gear for Gas Motor Engines, F. W. Crossley and H. P. Holt, London.
5731. Galvanic Batteries, A. Dun and F. Hasslacher, London.
5732. Musical Instruments, J. B. Hamilton, London.
5733. Spinning, &c., Machines, D. Ross, W. Armstrong, T. Watson, and G. Kirk, Belfast.
5734. Triturating Machines, J. R. Alsing, London.
5735. Evaporating Apparatus for Juices, J. Guardiola, London.
5736. Varying the Velocities of Rotating Mechanism, W. W. Beaumont, London.
5737. Buckle or Fastener, A. M. Clark.—(*C. Menger, United States.*)
5738. Velocipedes, M. D. Rücker and P. L. C. F. Renouf, London.
5739. Designs for Jacquard Cards, J. Y. Johnson.—(*T. J. Sloan, France.*)
5740. Reception and Removal of Dust, &c., J. H. Harvey, London.
5741. Clip Support for Books on Book-shelves, J. Allen, London.
5742. Spindles and Bobbins, H. H. Lake.—(*C. H. Chapman, United States.*)
5743. Cleaning Knives, &c., J. Marshall, London.
5744. Magazine or Repeating Fire-arms, J. Mark, London.
5745. Electric Conductors, H. H. Lake.—(*W. P., H. B., and J. Tatham and D. Brooks, jun., United States.*)
5746. Hydraulic, &c., Lifts, S. Pitt.—(*L. Gonin, Switzerland.*)

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5747. Raising the Globes, &c., of Lamps, J. Jackson, Birmingham.
5748. Casting Plate Glass, W. W. Pilkington, Liverpool.
5749. Ventilators for Exhausting, &c., Air or Gases, J. Howorth, Manchester.
5750. Backbones and Forks of Bicycles, &c., G. T. Warwick, Birmingham.
5751. Suspending and Securing Boots, &c., E. Webb, Birmingham.
5752. Compound Sanitary Pipe, J. Parsons, Nottingham.
5753. Combined Closets and Cinder Sifters, J. Heap, Manchester.
5754. Speed Governors, W. D. Ferguson, Glasgow.
5755. Windlasses, D. D. Napier, W. D. Napier, A. Kelly, and C. D. B. Hansen, Glasgow.
5756. Advertising Post Card, W. Pope, London.
5757. Shuttles for Weaving Fabrics, J. Royston, Accrington.
5758. Admission of Air to Bottles, C. Fielden, Norton-in-the-Moors.
5759. Circular Looms, W. Brierley.—(*R. Santer and E. Naef, Switzerland.*)
5760. Distance Registering Apparatus, J. E. Hayward, Birmingham.
5761. Trimming the Soles of Boots and Shoes, R. H. Southall, Leeds.
5762. Treatment of Copper Precipitate, &c., H. B. Fulton, near Glasgow.
5763. Springs for Railway and other Vehicles, H. R. Haigh, Derby.
5764. Rolling Cylinders and Tubes, E. Maitland, London.
5765. Hanging Rowing Boat Rudders, &c., R. Poore, London.
5766. Standard for Wire Fencing, F. B. W. Malet, London.
5767. Stay for Iron Fencing Standards or Posts, F. B. W. Malet, London.
5768. Revolving Fittings for Wardrobes, F. Cawley and W. H. Taplin, London.
5769. Soap Making, &c., Machinery, T. Rockliffe and G. J. Bowes, London.
5770. Check Back Action Index for Meters, &c., W. Partridge and J. W. Lawford, London.
5771. Book-markers, W. Hardy, jun., London.
5772. Treating Brewers' Wort, F. Faulkner and W. Adlam, London.
5773. Self-acting Feeding Apparatus for Thrashing Machines, A. C. Henderson.—(*J. A. Demoncy, France.*)
5774. Presses for Pressing Hay, &c., J. S. Warburton, Preston.
5775. Gas Motor Engines, J. Hodgkinson and J. H. Dewhurst, London.
5776. Trouser Supports, P. Wolfsohn, London.
5777. Open hearth Furnaces, R. Miller and N. E. Maccallum, Glasgow.
5778. Lubricating Hutch and Wagon Axles, M. B. Baird and J. T. Pitcairn, Glasgow.
5779. Lamps, J. Gilchrist and D. Ballardie, Glasgow.
5780. Curtain Hooks, H. C. Harrison, Edgbaston.
5781. Shaft Couplings, G. A. Page.—(*H. Enich, Germany.*)
5782. Coupling Railway Wagons, &c., T. A. Brockelbank, London.
5783. Reversing Gear for Engines, C. Henderson, Glasgow.
5784. Singing Woven Fabrics, A. D. Singer and D. Hunter, Glasgow.
5785. Mechanism for Propelling Boats, A. McRae, Glasgow.
5786. Driving Gear for Velocipedes, Major Offord, London.
5787. Rendering Buildings Fireproof, S. Stott, Manchester.
5788. Explosive Compounds, H. E. Newton.—(*A. Nobel, France.*)
5789. Motors for Wheeled Vehicles, &c., C. Benz, London.
5790. Steeping Flax, &c., P. Parsy, London.
5791. Ore-crushing, &c., Machines, A. J. Boult.—(*J. B. Low, United States.*)
5792. Extracting Oils, A. J. Boult.—(*E. Oppelt, Spain.*)
5793. Plates for Photographic Purposes, J. B. J. Journoud, London.
5794. Instruments for Forming Parallel Lines, W. F. B. Massey-Mainwaring, London.
5795. Ventilator, C. Gannaway, Glasgow.
5796. "Maltina," J. Painter, Malmesbury.
5797. Fire-escapes, G. Bray, London.
5798. Baby-jumper, L. N. Loeb.—(*C. Loeb, United States.*)
5799. See-saw, L. N. Loeb.—(*C. Loeb, United States.*)
5800. Making Cigarettes, W. H. Beck.—(*A. E. Decouflé, France.*)
5801. Petroleum Oils, E. Phillips, London.
5802. Flushing Tanks, C. W. Farquhar, Moseley.
5803. Fire-grates, G. S. Hardy, London.
5804. Gas Motor Engines, C. D. Abel.—(*The Gas Motoren-Fabric-Deutz, Germany.*)
5805. Harness, &c., Pads, H. H. Lake.—(*J. P. Miller, F. F. Driscoll, and T. Curley, United States.*)
5806. Jacquard Mechanism of Looms, I. Preissler, London.

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5807. Wedging Hammers, &c., to their Handles, C. Price, Leicester.
5808. Book File, C. H. Cole, London.
5809. Holding Scythes, F. Seary, Newport.
5810. Flats of Carding Engines, J. A. Dyson, Manchester.
5811. Winding, &c., Yarn, J. Boyd, Glasgow.
5812. Securing Knobs for Door-locks, J. Hill, London.
5813. Automatic Weighing Machines, H. Pooley and J. Parkinson, Liverpool.
5814. Thrust Apparatus for Screw Propeller Shafts, J. B. Fyfe, Glasgow.
5815. Jointings on Fishing-rods, &c., Redpath and Co., Kelso-on-Tweed.
5816. Tuning Trichord Pianofortes, J. H. Papps, Yeovil.
5817. Galvanic Batteries, S. F. Walker, Cardiff.
5818. Metal Sleepers and Chairs for Railways, S. Leadbeater, New Brighton.
5819. Holding Closed the Ribs of Umbrellas, &c., R. C. Langton, Manchester.
5820. White Lead, J. Warwick, Newcastle-upon-Tyne.
5821. Ferrules for Umbrellas, &c., C. H. Parkin, London.
5822. A Bridle Buckle, B. J. Teeling, Reigate.
5823. Telephone Receivers, J. L. Corbett, Glasgow.
5824. Telephone Transmitters, J. L. Corbett, Glasgow.
5825. Telephonic Apparatus, J. L. Corbett, Glasgow.
5826. Facilitating the Dividing of Hard Waste Materials, J. Schofield and J. Hitchon, Rochdale.
5827. Gearing for Driving Velocipedes, R. Caswell and J. C. Goslin, London.
5828. Automatic Fire-extinguishing Sprinklers, R. Dowson and J. Taylor, London.
5829. Water Motors, J. Langton, London.
5830. Accurate Sighting of Fire-arms, R. Gaskin, Canada.
5831. Removing Bobbins from Carriages of Lace Machines, &c., J. H. Johnson.—(*The Wilcox and Gibbs Sewing Machine Company, United States.*)
5832. Making Nickel, &c., J. Y. Johnson.—(*La Société Anonyme Le Ferro Nickel, France.*)
5833. Preserving Milk, &c., J. C. Benit, Peckham.
5834. Making Beverages, J. C. Mewburn.—(*Emilio Bourcoud, Spain.*)
5835. Horseshoes, J. B. Molas, London.
5836. Application of Fuel to Engines, &c., J. Holden, London.
5837. Window-blinds, W. Parks, London.
5838. Controlling Rakes of Reaping Machines, W. McI. Cranston.—(*The Walter A. Wood Mowing and Reaping Machine Company, United States.*)
5839. Transforming, &c., Electrical Energy, E. Conry, Hammersmith.
5840. Tweezers, &c., H. C. Pennell, Middlesex.
5841. Heating, &c., L. W. Leeds, Middlesex.
4842. Compasses, &c., B. Russ, London.
5843. Cement, &c., C. J. Howe London.
5844. Cement, &c., C. J. Howe London.
5845. Gas-engines, J. Y. Johnson.—(*H. C. Powell, France.*)
5846. Producing Sulpho-acid, &c., J. Y. Johnson.—(*The Farbenfabriken vormals Friedrich Bayer and Co. Germany.*)
5847. Vapour Baths, R. J. Lee, London.

5848. Lubricating Apparatus, H. Schaffstädt and A. Bergen, London.

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5849. Appliances for the Optical Lantern, G. Davenport, London.
5850. Increasing the Speed of Vehicles, F. A. Ruther, France.
5851. Connectings for Cuff, &c., Links, C. Meredith, Birmingham.
5852. Fastening Rails to Sleepers, W. T. Stewart, Cork.
5853. Artificial Bait for Fishing, A. W. Warner, Harborne.
5854. Non-conducting Composition, J. Roberts, Lancashire.
5855. Galvanic Battery, F. W. Branson, Leeds.
5856. Hook for Suspending Pictures, &c., T. and D. Lister, Huddersfield.
5857. Fitting of Artificial Teeth, T. Robertshaw, Halifax.
5858. Removal of Ammonia from Coal Gas, J. Hepworth and E. Marriott, Manchester.
5859. Self-delivery Apparatus for Printing Machinery, A. H. Seggie, Edinburgh.
5860. Distributing Oil or other Liquids, T. H. Wharton, Bradford.
5861. Repairing Sheet Music, &c., J. W. Lomas, Yeovil.
5862. Globe Holders for Chandeliers, J. Everard, Birmingham.
5863. Bobbins, J. Whalley and J. Pickup, Halifax.
5864. Destroying Insects in Gardens, W. H. Keys, West Bromwich.
5865. Braces for Trousers, &c., R. Longdon, Manchester.
5866. Printing Machine for Fabrics, J. H. McFerran, Belfast.
5867. Sifting Cinders or Ashes, S. Woody, Cleverton.
5868. Potters' Batting Machine, W. Evans, Tunstall.
5869. Belting for Driving Machinery, D. Jackson, Ashton-under-Lyne.
5870. Projectiles for Ordnance, J. C. Sawer, London.
5871. Lathes, W. P. Thompson.—(*C. E. D. Winssinger, Belgium.*)
5872. Thread of Screws, &c., W. P. Thompson.—(*C. E. D. Winssinger, Belgium.*)
5873. Belts for Pulleys, &c., W. P. Thompson.—(*G. Schwab, fils, France.*)
5874. Steam Boilers, J. Millington and H. Jones, Liverpool.
5875. Face Plate for Lathes, &c., E. P. Baville, Liverpool.
5876. Teaching, &c., Code of Signals, H. Shedden, Liverpool.
5877. Roller Mill Machinery, Messrs. Diener and Boldt, Liverpool.
5878. Automatic Electric Switch, J. Radcliffe, East Retford.
5879. Box Cabinet for Holding Books, D. Bryce, Glasgow.
5880. Valve Gear, C. H. Benton, London.
5881. Tool-holders for Lathes, J. Y. Johnson.—(*G. Armstrong, United States.*)
5882. Fog Signalling, E. H. White, London.
5883. Swimming Machine for Torpedo Warfare, R. W. Rundle and T. Allen, London.
5884. Thermopiles, H. W. Cook, London.
5885. Injector, H. Long, London.
5886. Automatic Gas Heating Apparatus, J. Humphrys, London.
5887. Manifold or Header for Sectional Steam Generators, &c., W. Fairweather.—(*The Babcock and Wilcox Company, United States.*)
5888. Wrest Pins for Musical Instruments, J. Semple, Glasgow.
5889. Oil, &c., Lamps, S. P. and W. P. Catterson, London.
5890. Latch Mechanism of Locks, J. Bates and R. Hughes, London.
5891. Dead Weight Latch, E. and J. M. Verity, and B. Banks, Leeds.
5892. Steering Gear for Vessels, H. E. Newton.—(*C. H. D. Sincennes, Canada.*)
5893. Couplings for Railway Wagons, W. Anderson and D. Laughland, Glasgow.
5894. Cutting Paste-boards for Boxes, H. Gardner.—(*J. Scherbel and T. Remus, Saxony.*)
5895. Projectiles, B. J. Capell and D. G. Ginn, London.
5896. Frog-pad for Horses, J. Y. Johnson.—(*A. C. C. Robert, France.*)
5897. Boilers Heated by Gas, L. W. Leeds, London.
5898. Gas Kitchen Ranges, H. C. Turner, London.
5899. Press for Moulding Feed Cake, &c., R. Sizer, London.
5900. Ascertaining the Strength of Balance Springs, G. Cornioley and E. H. Law, London.
5901. Washing Machines, W. H. Nevill, London.
5902. Fire Extincteur, C. Wells, London.
5903. Conveying a Safety Line in Cases of Fire, C. Wells, London.
5904. Fire Grenade, C. Wells, London.
5905. Fire Grenade, C. Wells, London.
5906. Fire Extinguishing Lamp, C. Wells, London.
5907. Combination Fire Grenade, C. Wells, London.
5908. Tilting Beer Barrels, &c., J. C. Walker, London.
5909. Road Vehicle, D. Albone, London.

1st May, 1886.

5910. Materials for Respirators, J. G. Lorrain, London.
5911. Felt Hats, F. W. Ashton, Manchester.
5912. Pencil Sharpener, W. Appleby and T. Wood, Manchester.
5913. Vice, G. H. Wells, London.
5914. Furnace Bars, R. A. Wilson, Manchester.
5915. Producing Heating and Illuminating Gas, W. S. Sutherland, Liverpool.
5916. Door Knobs or Handles, S. Bott and C. Homer, Birmingham.
5917. Guiding, &c., Dobby Horses, J. Broxup, London.
5918. Wringing Machine, J. and J. Scott, London.
5919. Candleholders, &c., C. Wood, Birmingham.
5920. Locks for Securing Velocipedes, H. G. Kelly, London.
5921. Sanitary Dustbin, R. T. Macan, London.
5922. Open-work Border in Towels, R. H. Reade, W. Kennedy, and T. F. Bell, Belfast.
5923. Making Clog Blocks and Soles, R. J. and C. Jones, Lancashire.
5924. Steel and Ingot Iron, F. J. R. Carulla, London.
5925. Couplings for Railway, &c., Carriages, W. B. Brough, London.
5926. Straw Sewing Machines, J. H. Johnson.—(*The Wilcox and Gibbs Sewing Machine Company, United States.*)
5927. Steps or Ladders, J. Strick, London.
5928. Working Machines on Board of Steamships, C. Henderson, Glasgow.
5929. Diaphanous and Air-tight Paper, J. Collins, London.
5930. Chemical Compound for Destroying Insects, T. Terrell, London.
5931. Weighing Grain, &c., W. B. Avery, London.
5932. Running and Burning Work of a Magnesium Lamp, Messrs. H. Heine and Sohn, Baden.
5933. Gaffing or Landing Salmon, &c., E. L. Berthon, London.
5934. Collapsible Boats, E. L. Berthon, London.
5935. Cutting Files and Rasps, R. Denison, London.
5936. Complete Purification of Perfumes, E. Edwards.—(*E. A. Viteau, France.*)
5937. Closing and Opening Tins, J. Rieffel, London.
5938. Blue Colouring Matters, R. and W. Barringer, and I. H. Wallis, London.
5939. Twist Lace Fabrics, J. Coxon, London.
5940. Telephones, P. Gannon, London.
5941. Preparation of Fibrous Vegetable Substances, W. Saunders.—(*R. H. Collyer, United States.*)
5942. Door Springs, F. Stent, London.
5943. Postage Stamp and Label Affixer, F. Stent, London.
5944. Distillation of Tar, J. Yates, London.
5945. Loading and Unloading Barges, W. Thomas and J. Kitto, London.
5946. Bread, S. Preston, London.
5947. Artists' Canvas Frames, J. Sims, London.
5948. Burner for Oil Lamps, G. F. Redfern.—(*F. R. Roy, France.*)
5949. Registering the Distance Travelled by a Vehicle, H. E. Vosper, London.

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5950. Grimbleby's Patent Lock Wing Tiles, T. and H. Grimbleby, Lincolnshire.
5951. Marking Kindergarten Desk Tops, G. Perry, Dublin.
5952. Adjustable Book Holder for Music Stands, T. Firth, Halifax.
5953. Implements for Washing Carriages, &c., D. Butterfield and G. A. J. Schott, Yorkshire.
5954. Constructing Windows of Carriages, W. Broadhurst and S. Washington, Manchester.
5955. Seaweed Bath Gloves, R. Galland-Mason, Douglas.
5956. Fastening Mechanism of Bag Frames, J. B. Brooks and J. Holt, Birmingham.
5957. Clothes-pegs, J. Westgarth, Manchester.
5958. Rendering Invisible Exhaust Steam, C. J. Nicholson and A. Green, Birmingham.
5959. Melting Caldrons, B. D. Healey, Liverpool.
5960. Steam Furnaces, H. C. Paterson, Glasgow.
5961. Stand and Action to Weighing Machines, J. Gardner, London.
5962. Incandescent Electric Lamps, T. J. Handford.—(*E. H. Johnson, United States.*)
5963. Purifying Water, W. Cotton, Peckham.
5964. Demijohns, &c., J. F. A. Höper, London.
5965. Preventing Knobs Getting Off Spindles of Locks, J. Kaye, London.
5966. Ships' Side Lights, W. Chadburn, Liverpool.
5967. Bowls Employed in Calendering, J. Rigby and J. E. Rigby, London.
5968. Suspending Carriages, R. C. W. Horsley, London.
5969. Extracting Foul Air, &c., from Buildings, J. Ramer, London.
5970. Steel Wire Skeleton and Spring Hinges, S. S. Bromhead, London.
5971. Electrical Batteries, &c., A. W. Armstrong, Lewisham.
5972. Reconstruction of Frames and Runners for Parasols, &c., A. A. Aldred, London.
5973. Tenoning Apparatus, J. Grant, London.
5974. Lamps, A. J. Boult.—(*C. Rakenius and Co., Germany.*)
5975. Cement, A. J. Boult.—(*A. Grasset and A. C. Mallat.*)
5976. Straw-bruising Apparatus, J. Good and R. Gamble, London.
5977. Boring-out Cylinders, C. H. Binney and R. C. Dennett, Ilford.
5978. Producing Ornaments, Lettering, &c., on Glass, &c., F. Winterhoff, Hammersmith.
5979. Incandescent Electric Lamps, B. J. B. Mills.—(*W. Holzer, United States.*)
5980. Adjustable Boring Tool, T. R. Shillito.—(*J. Uhle, Germany.*)
5981. Fold-up Bedstead, F. W. Diestelhorst, London.
5982. Registering Weighing Machines, W. B. Avery, London.
5983. Lifebuoy, A. Smith, Glasgow.
5984. Dress, H. Cholmondeley-Pennell, London.
5985. Applying Electricity to Illuminative and other Purposes, M. McMullin, London.
5986. Incandescent Gas Burners, M. Bauer.—(*J. Pintsch, Germany.*)
5987. Composition for Dressing Cotton, &c., E. Edwards.—(*C. Welté, France.*)
5988. Velocipedes, E. Edwards.—(*E. Lhoest, France.*)
5989. Fastening the Girth or Belly-band of a Saddle or Harness by a Spring, F. Loeb, London.
5990. Straps or Belts, N. Browne.—(*Messrs. Wilh., Kux, Nachfolger, Germany.*)
5991. Tiles, Bricks, &c., J. H. and J. Edge, London.
5992. Chaff-cutting Apparatus, J. Oliver, London.
5993. Electro-magnetic Retouching Pencils, H. J. Haddan.—(*L. Fried and B. Iscovits, Austria.*)
5994. Preserving Timber, G. Mancion, London.
5995. Roller for Moving Weights, J. S. E. Ellis.—(*C. H. Slatyer, Sydney.*)
5996. Instrument for Laying Down Coast Lines, &c., G. F. Redfern.—(*H. G. J. Stang, Norway.*)
5997. Fret Sawing Machine, M. D. Wischker, London.
5998. Hosiery, J. H. Cooper and G. Blunt, London.
5999. Circular Knitting Machines J. H. Cooper and G. Blunt, London.
6000. Production of Para-rosanilin, &c., H. Baum, London.
6001. Production of Chloride or Bromide of Nitrobenzyl, H. Baum, London.
6002. Lining Steel Converters, &c., W. Perrott, London.
6003. Envelope Holder of Chain of an Envelope Making Machine, T. J. Denne, London.
6004. Lids for Boxes, S. C. Allibone, London.

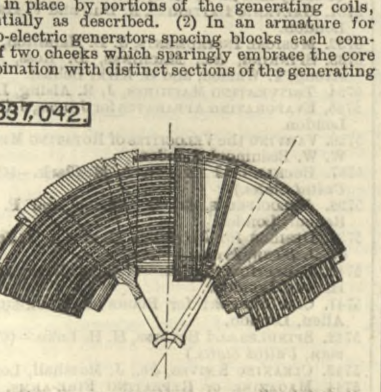
SELECTED AMERICAN PATENTS.

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

337,042. Armature for Dynamo-Electric Machines, *Foree Bain, Chicago, Ill.—Filed September 25th*, 1885.

Claim.—(1) In combination with an armature for dynamo-electric generators, spacing blocks or cheeks secured in place by portions of the generating coils, substantially as described. (2) In an armature for dynamo-electric generators spacing blocks each composed of two cheeks which sparingly embrace the core in combination with distinct sections of the generating

337,042.

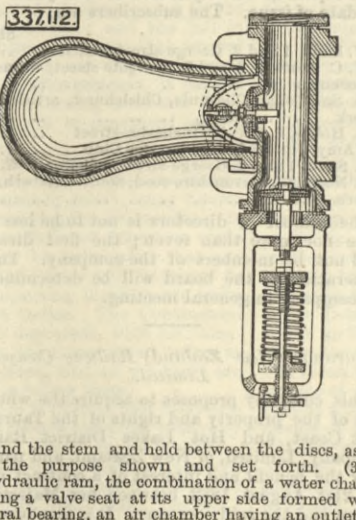


coils wound upon the cheeks, whereby the latter are held in place without additional fastening devices substantially as described. (3) An armature for dynamo-electric generators, consisting of a laminated core with fibrous material between the laminæ, in combination with spacing blocks between the generating coils held in place by portions of said coils, substantially as described.

337,112. Hydraulic Ram, *Adolphus Baer, Zurich, Switzerland.—Filed December 12th*, 1885.

Claim—(1) In a hydraulic ram the combination of a water chamber, a valve seat secured at the discharge end of the chamber and having an outwardly projecting guide frame formed with an inner smooth longitudinal bearing and an outer screw threaded longitudinal bearing, a discharge or stop valve having a stem passing through the bearings, and having a collar secured at its outer end, a screw threaded sleeve fitting in the threaded bearing and having a notched disc at its outer end, the stem sliding in the sleeve with its disc bearing against the outside of the disc, and a latch pivotted to the end of the guide frame and engaging the notched disc, as and for the purpose shown and set forth. (2) In a hydraulic ram, the combination of a water chamber, a valve seat secured at its discharge end, and having an outwardly projecting frame provided with a smooth longitudinal inner bearing at one end and a screw threaded bearing at its outer end, a screw threaded sleeve fitting in the threaded bearing and having a disc with a notched edge at its outer end, a pivotted latch engaging the notched edge of the disc, a discharge or stop valve playing upon the seat and having a stem sliding in the bearing and sleeve, and formed with a collar at its outer end and with a screw threaded inner portion, a disc upon the stem bearing against the inner end of the threaded sleeve, a disc fitting upon the inner portion of the stem, adjusting nuts bearing against the inner face of the disc and fitting upon the threaded portion of the stem, and a spiral spring wrapped

337,112.

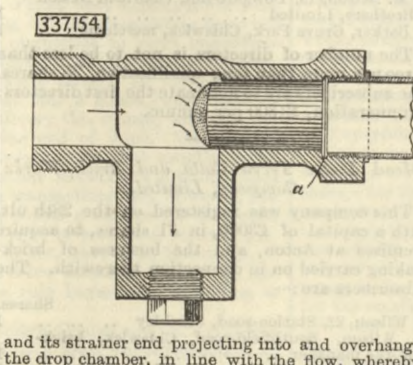


around the stem and held between the discs, as and for the purpose shown and set forth. (3) In a hydraulic ram, the combination of a water chamber having a valve seat at its upper side formed with a central bearing, an air chamber having an outlet and secured over the valve seat, a stem sliding with its enlarged lower portion in the bearing of the seat and having a threaded middle portion, a yoke having a bearing in its upper portion for the upper end of the stem, a valve upon the stem having an elastic disc clamped between a disc upon the shoulder, and a nut upon the threaded portion of the stem, and a stop nut and a jamb nut upon the threaded portion of the stem as and for the purpose shown and set forth.

337,154. Filtering Device for Feed Water Pipes, *John Heath, Janesville, Wis.—Filed September 30th*, 1885.

Claim. — The combination with the pipe section having the drop chamber and the interior shoulder *a*, of the cylindrical strainer having the seating flange

337,154.



and its strainer end projecting into and overhanging the drop chamber, in line with the flow, whereby it will constantly shed the dirt and be washed in washing out the sediment chamber.

337,199. Extension Electrolier, *James T. Robb, New York, N.Y.—Filed September 26th*, 1885.

Claim.—(1) In an electric light fixture, the combination of a stationary tube or body, a tube sliding therein and carrying the lamp conductors within said sliding tube connected with the lamp, flexible conductors attached to said sliding tube and connected with the conductors inclosed thereby, a chamber above said sliding tube for concealing said flexible conductors, and a frictional device for holding said sliding tube at any desired point in the stationary tube

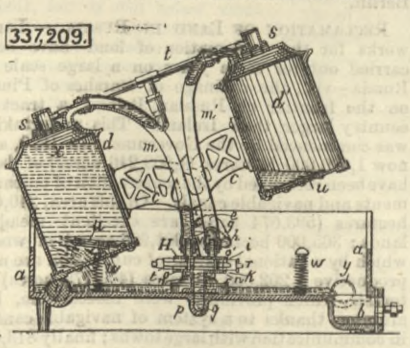
337,199.

or body, substantially as set forth. (2) In an electric light fixture, the combination of the main supporting stem, the ring at the lower end thereof, the shell surrounding said ring, the stationary tube carried by said ring, the sliding tube within said stationary tube carrying a lamp and enclosing electrical conductors, and flexible conductors connected electrically with said enclosed conductors and adapted to be placed in or withdrawn from the said shell as the sliding tube is raised or lowered substantially as set forth.

337,209. Hydraulic Air Compressor, *William Thomas, Jersey City, N.J.—Filed October 2nd*, 1885.

Claim.—(1) In a hydraulic air compressor, substantially such as described, the combination with vessels or cylinders $d\ d^1$ of a double-acting water inlet valve, substantially such as H, arranged to open one eduction port to the water under pressure and the other eduction port to the atmosphere, with eduction tubes $m\ m^1$, leading from said ports to the tops of the vessels, and water exhaust valves, u, in the bottoms of the vessels,

337,209.

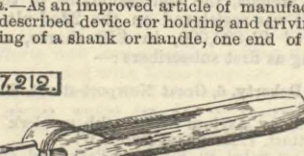


arranged and operating substantially as shown and described. (2) In a hydraulic air compressor, the combination with the alternately filling vessels $d\ d^1$, of the water valve H, having a cylinder i, open to the air at the ends, pistons $k\ k$, inlet port p, and outlet ports $o\ o^1$, arranged as shown, with eduction pipes $m\ m^1$, leading from said ports to the tops of the cylinders, air outlet valves s in the tops of the cylinders and water exhaust valve u, in the bottoms of the cylinders, with suitable means to shift the valve as the cylinders alternately fill and empty, substantially as herein set forth. (3) The combination of the vessels $d\ d^1$ and rocking beam c, a double-acting valve substantially as set forth arranged to open one eduction port to the air, and the other to the water under pressure, an operating connection between the beam and the valve, eduction pipes $m\ m^1$, extending from the eduction ports to the tops of the cylinders, air outlet valves s in the tops of the cylinders, and water exhaust valves u in the bottoms of the cylinders, arranged and operating substantially as shown and described. (4) In a hydraulic air compressor, such as set forth, the combination with the rocking or tilting vessels $d\ d^1$, and exhaust valves u in the base thereof, of the springs w, interposed between the valves and the supporting base, and on which the valves fall when the vessels tilt substantially as and for the purpose set forth.

337,212. Staple Holding Implement *Charles E. van Dusen, Oneonta, N.Y.—Filed June 15th*, 1885.

Claim.—As an improved article of manufacture, the herein described device for holding and driving staples consisting of a shank or handle, one end of which is

337,212.

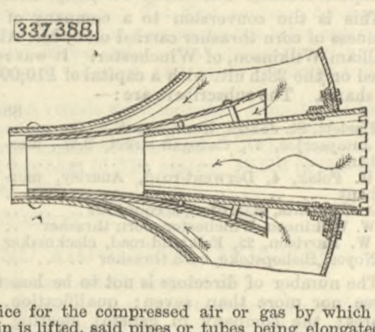


adapted to receive the blows of the driving implement, and, the opposite end is provided with a recess adapted to hold the staple, and a transverse slot or recess across said first recess and at right angles thereto, substantially as and for the purpose set forth.

337,388. Apparatus for Transferring Grain, &c., *Alexander B. Fernald and David T. Lawson, Jersey City, N.J.—Filed January 21st*, 1885.

Claim.—In a device for conveying grain or other material, the combination, with the grain inlet pipe or tube, of a surrounding pipe or tube forming a jet

337,388.



orifice for the compressed air or gas by which the grain is lifted, said pipes or tubes being elongated or oval in shape at the point of discharge, substantially as described.

337,443. Steam Ejector, *Louis Schutte, Philadelphia, Pa.—Filed December 10th*, 1885.

Claim.—(1) In an ejector or syphon pump having a steam nozzle, a combining tube, and a discharge tube, a passage forming a communication between the discharge end of the instrument and the combining tube at a point between the end of the steam nozzle and the smallest bore of the instrument. (2) In a syphon pump or ejector, the combination of the steam nozzle, the mixing tube provided with a lateral opening at an intermediate point in its length, the discharge tube, and a channel G, forming an external communication between the opening in the combining tube and the delivery side of the apparatus, and a valve for closing said passage. (3) In an ejector or jet apparatus sub-

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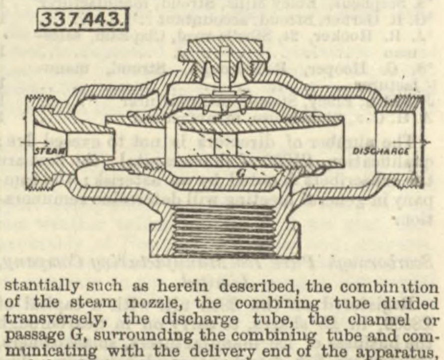
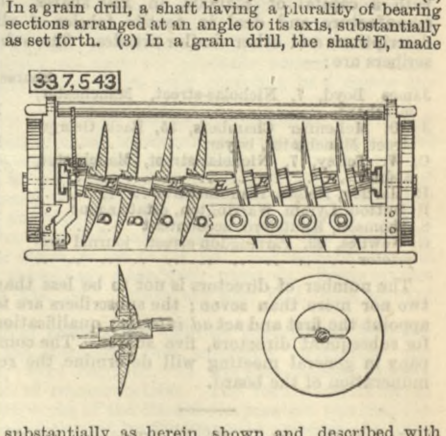


stantially such as herein described, the combination of the steam nozzle, the combining tube divided transversely, the discharge tube, the channel or passage G, surrounding the combining tube and communicating with the delivery end of the apparatus, and the check valve H. (4) In combination with the steam nozzle and the threaded regulating spindle of angular or equivalent form at the outer end, the locking washer, applied substantially as shown. (5) The threaded squared spindle, the recessed cap b, having the spindle mounted therein, the locking washer, and the supplemental cap c, covering the end of the spindle and confining the washer, substantially as described.

337,543. Grain Drill, *Mileden Wonser, Kingston, Kans.—Filed March 30th*, 1885.

Claim.—(1) In a grain drill, the combination, with the frame of the machine and a series of circular rotary cutters, of the shaft E, having inclined sections to receive the hubs of the said cutters, and a supporting and adjusting mechanism, substantially as herein shown and described, whereby the inclination of the said cutters can be readily adjusted, as set forth. (2) In a grain drill, a shaft having a plurality of bearing sections arranged at an angle to its axis, substantially as set forth. (3) In a grain drill, the shaft E, made

337,543



substantially as herein shown and described with inclined sections parallel with each other on each arm of the shaft and inclined in reverse directions upon two arms of the shaft, as set forth. (4) The combination of a rotarily adjustable shaft having bearings arranged at an incline or angle to its axis of revolution, cutters journalled on said inclined bearings, and vertically adjustable supports for said shaft, whereby the cutters may be set at any desired incline and held at a common depth with each position or inclination, substantially as set forth.