THE WIDENING OF THE METROPOLITAN RAILWAY.

MR. JOHN FOWLER, ENGINEER.

FIG. 10

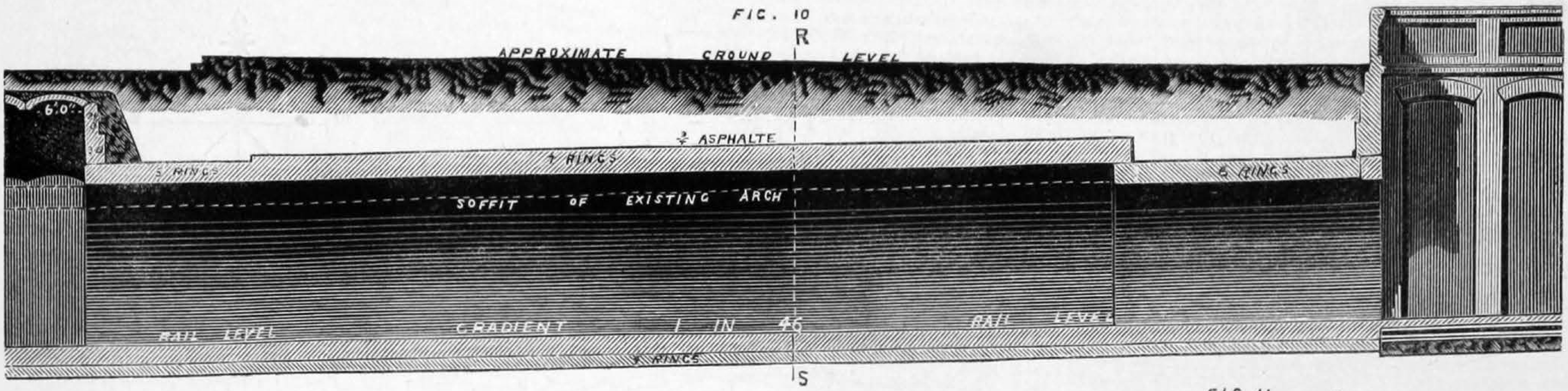


FIG. 11.

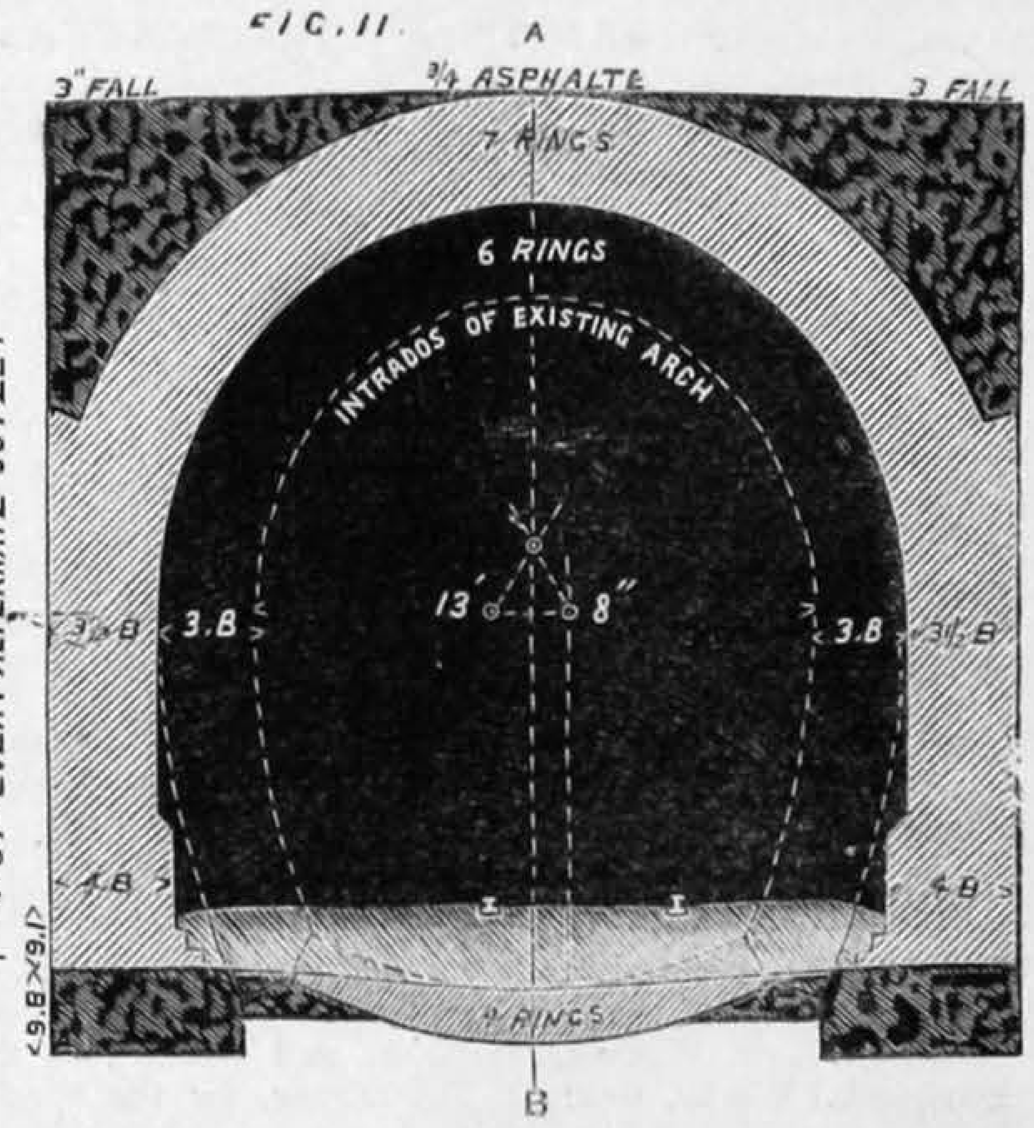


FIG. 12.

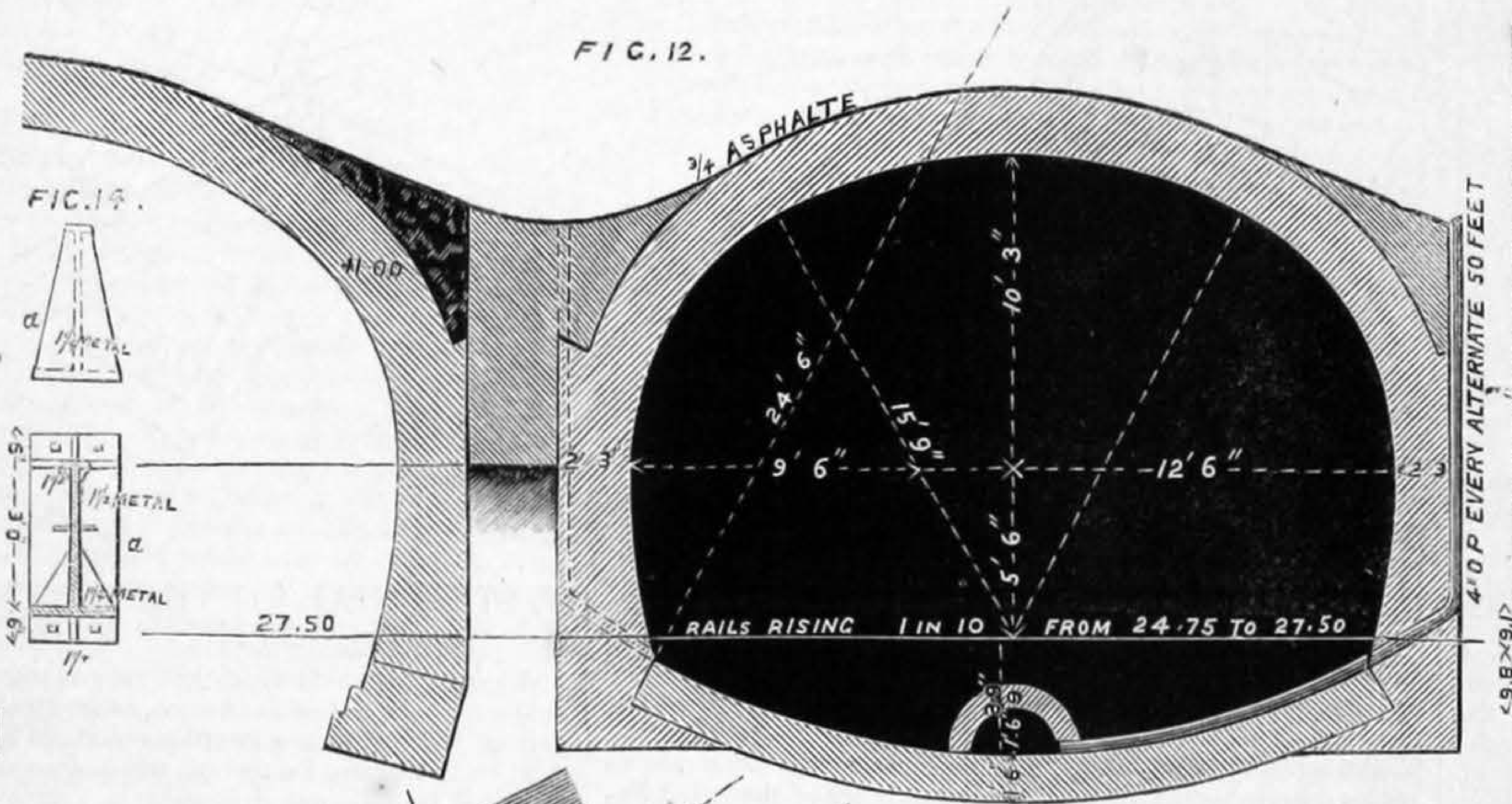


FIG. 14.

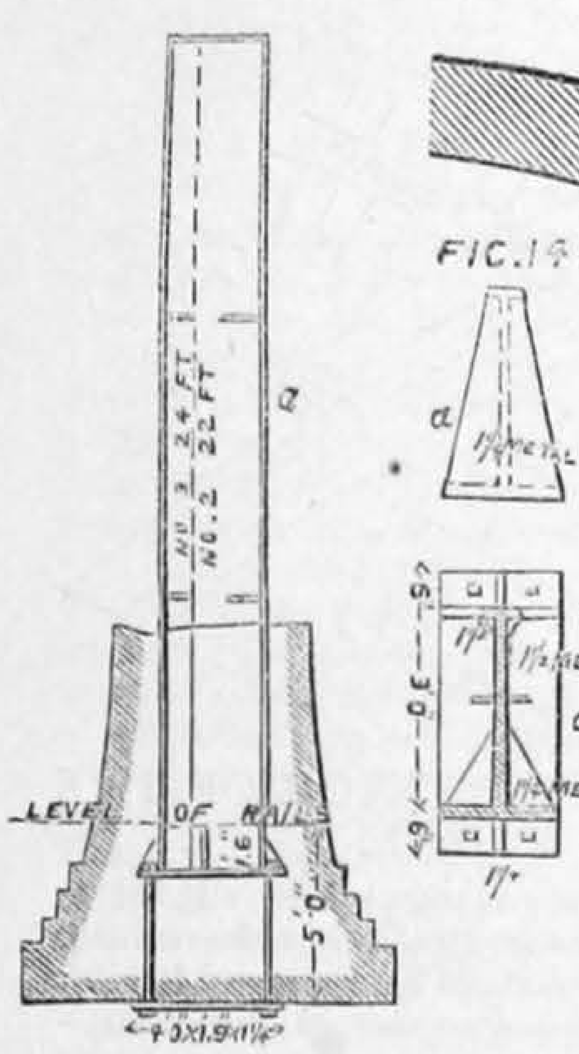
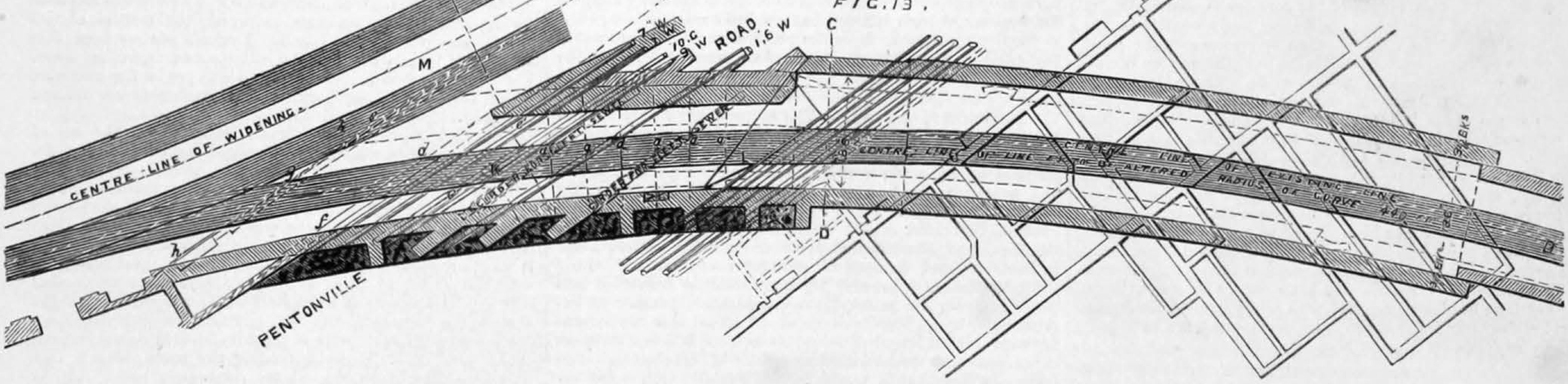


FIG. 13.



THE widening of the Metropolitan Railway between King's-cross and Farringdon-street stations, with the deviations of the branches to the Great Northern Railway, has been practically completed, and on the 15th of January was formally inspected by Captain Tyler on behalf of the Board of Trade.

A constantly increasing traffic has rendered this extension necessary, and the new lines are intended for the service of the Great Western, Great Northern, and the Midland trains (the former line being turned into the widening by a cross-over road, the points of which are at the east end of the King's-cross station platform), so that the Metropolitan Railway proper will be relieved of the extra traffic which has hitherto imposed upon a limited rail accommodation. The widening commences in King's-cross station, and for some distance it runs parallel with the old line towards Farringdon-street; then dipping, it crosses beneath the Metropolitan, and rising on the other side, again runs parallel with it, the rails being laid with such a gradient as to overtake those of the Metropolitan at a point a little westward of the new station at Farringdon-street. Under the same contract is included the erection of the substructure, and the extensive system of sidings, platforms, and hoists for the new Smithfield Dead-meat Market. The works on the widening have presented unusual difficulties, in consequence of the necessary deviation of two existing branches, through one of which the traffic has been unceasingly maintained, the extent of driven tunnel work, and the tedious process of underpinning a portion of the Metropolitan Railway retaining walls and the foundations of Vine-street and Ray-street bridges; indeed, but for the excellent quality of the old brickwork, a different and more costly plan of construction, involving a stoppage in the traffic, would have been necessary, especially in those places where the sides of the tunnel were cut away at the bell-mouthed junctions. In all these cases the new work was carried out in short lengths, with the greatest care, and with the best materials, cement-set brickwork being used throughout.

The plan on the next page shows the general arrangement of the new works at King's-cross, the lines representing the Metropolitan Railway and the Great Northern branches as they were originally constructed, and the centre lines of the deviations and new works. From A to B, a length of 1 furlong 5 chains, is that branch of the widening to the St. Pancras station of the Midland Railway; the length, C D, is the diversion of the Great Northern and Metropolitan Junction Railway (single line), known as the Hotel curve; from E to F is the diversion of the eastern curve, or up line, from the Great Northern to King's-cross (also a single line).

Fig. 1, page 90, is a sectional plan from the bell-mouth, formed by the junction of the former curve with the widening to the bell-mouthed tunnel, where the Midland branch turns to St. Pancras station, diverging from that part of the widening, which it is intended ultimately to extend to Paddington. Fig. 2 is a transverse section of the Hotel curve taken on the line A B; and Fig. 3, a section on C D. At this place the tunnel of the original line of this curve intersected the side walls of the Metropolitan main line, thus making a bell-mouth, which has been cut away by the widening, and another has been formed by the junction of the diverted Hotel curve and the new line. The width of the Metropolitan railway arch has therefore been reduced to 28 ft. 6 in., and the arch of the old bell-mouth has been cut away on one side, and is supported on a brick abutment, which, on section C D, is strengthened with cast-iron standards, shown at *a a*, Fig. 1, and in detail, Fig. 14. Figs. 5, 6, 7, and 8 are different cross sections taken on the respective lines lettered on the plan, and they show the various constructions employed, as the new work gradually leaves the old, until at Fig. 8—a section on line, N O—the bell-mouth of the widening is completed; and the Metropolitan Railway arch is left untouched, except that one abutment is partially cut away, and the space between the two tunnels is filled in with concrete. This part of the work is strengthened by brick spandrils, which are shown in dotted lines in plan, Fig. 1, and in Figs. 3, 6, and 7. Fig. 9 is a section on the widest bell-mouth on the work, spanning, as it does, the two 25 ft. tunnels and a 4 ft. 6 in. intermediate pier. It is constructed with an arch of 6 rings in thickness, springing from abutments 4 bricks thick, strengthened with counterforts placed at short intervals apart, and filled with concrete, as shown in the plan. Fig. 13, above, is a sectional plan of the eastern curve.

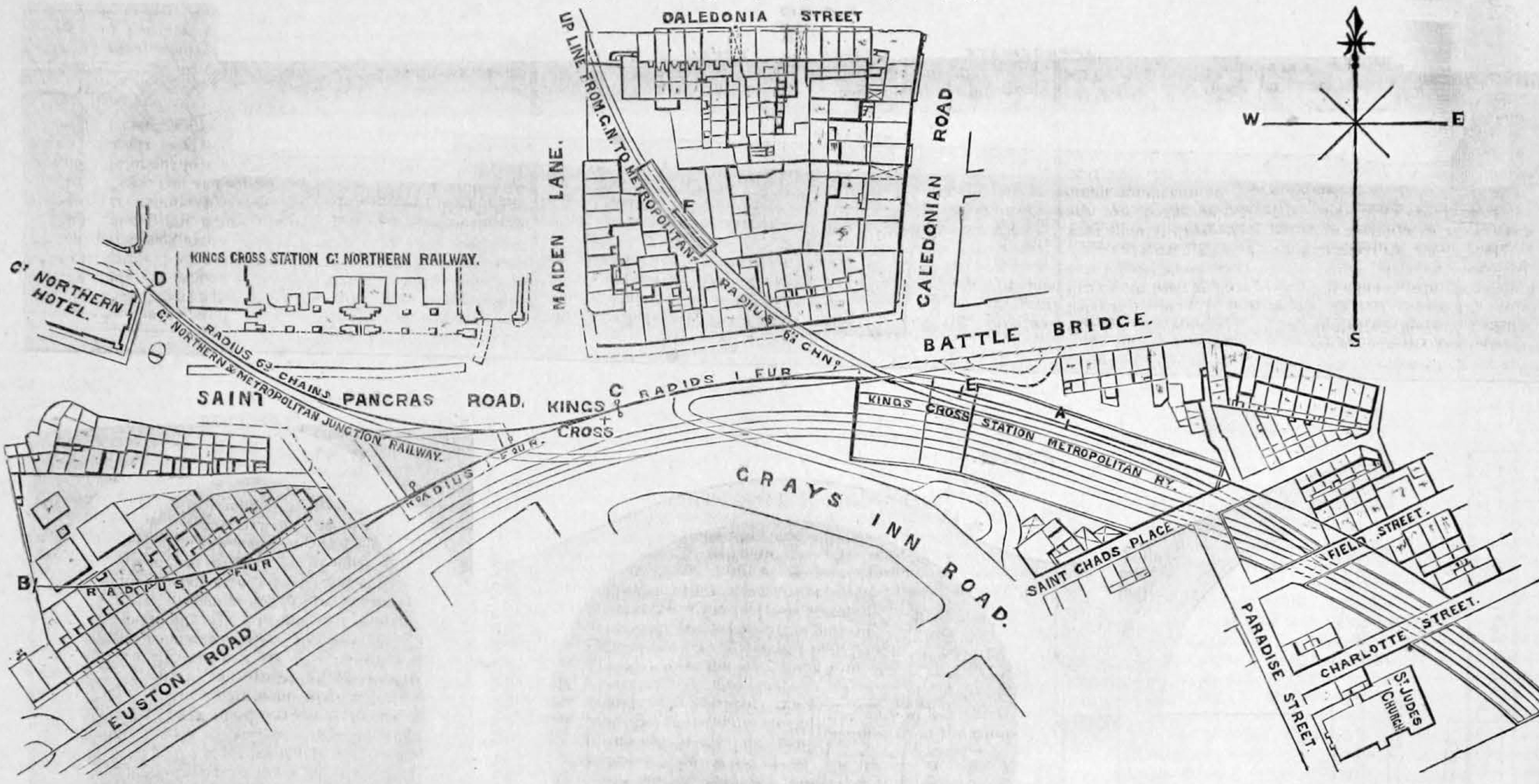
The Hotel curve, during its diversion, was stopped up, and another line to the Great Northern, known as the Maiden-lane curve, which was constructed at the same time as the Metropolitan, has been closed permanently, as shown in plan, Fig. 1, at the point where the Hotel curve joins the widening, as now constructed; the deviation in this case is extended only so far as is shown, terminating at the point where the new walls overlap the old. The arch in this length was constructed over the old tunnel (Fig. 11), which was entirely uncovered, and employed as a centering for the diversion, it being pulled down afterwards, and the invert extended to the side walls. The arch here is consequently so much wider than is necessary by the thickness of the tunnel over which it was erected. The arch finishes just beyond the crossing of the Fleet sewer (drawings of which are in preparation), and is exchanged for girder covered way, as seen in Fig. 10, which is a longitudinal section of the diversion, and which shows the point where the covered way commences. This figure also shows the junction of the original and the new tunnel.

(*To be continued.*)

THE WIDENING OF THE METROPOLITAN RAILWAY.

MR. JOHN FOWLER, ENGINEER,

(*For Description, see preceding Page.*)



RUSSIAN IMPERIAL SALOON-CARRIAGE.

WE give, as a supplement to the present number, a chromo-lithograph of the fine imperial saloon-carriage constructed by Messrs. Winans, Harrison, and Winans, at the Alexandroffski Works, near St. Petersburg, for the Nicolai Railway. Our illustration, which is printed in ten colours, represents the whole of the arrangements and the details of the decorations so fully, that but little description will be necessary. The total length of the carriage is about 85 ft., of which length 25 ft. is taken up by the main central saloon. The remainder of the space is taken up by the emperor's and empress's cabinets, each 12 ft. 6 in. in length, and by the attendants' apartments, end galleries, &c. The width of the carriage outside is 9 ft. 9 in., and the height of the compartments at the centre is 8 ft. The carriage is carried on a pair of eight-wheeled bogies, placed as shown in the longitudinal section. Each bogie has a wheel-base of 12 ft. As will be seen from our engraving—in which all the details of colouring, &c., are faithfully given—the fittings and decorations of the carriage are of the most sumptuous character throughout, and no expense has been spared to render the vehicle as luxurious as possible. This carriage, we should state, forms the principal vehicle in a train devoted to the accommodation of the Emperor of Russia and his suite. Our engraving of the carriage has been prepared with the greatest care from a most elaborately finished drawing, with which we have been kindly supplied by Messrs. Winans.

NITRO-GLYCERINE AND GREEK FIRE.

WE have received the following memorandum relative to the treatment of nitro-glycerine and the extinction of Greek fire. The memorandum has been prepared under authority, and has been issued by Lieutenant-Colonel C. B. Ewart, R.E., by order of the Secretary of State for the Home Department:

"Nitro-glycerine is not applied as an incendiary agent, and, if used as an explosive, it will not be scattered loosely about, but will be employed in cans or other closed vessels. If such should be discovered, they should be carefully removed, some heavy body should be attached to them, and they should be thrown into deep water, without any attempt being made to open them.

"True Greek fire is simply a solid highly combustible composition, very similar to 'Carcass Composition.' What is now commonly called Greek fire consists of a solution of phosphorus or of sulphur and phosphorus in a very volatile liquid, the bi-sulphide of carbon, to which occasionally some mineral oil is added with the view of increasing its incendiary powers. When this liquid is thrown on to any surface exposed to the air, the solvent evaporates, leaving a film of the phosphorus or sulphide of phosphorus, which will then inflame spontaneously, but will not very readily set fire to wood or combustible materials.

"The proper mode of extinguishing the flame produced by such an incendiary agent is to throw upon the burning surface a quantity of wet or damp sand, ashes, sawdust, lime, or any other powder, or wet sacking or carpeting, any material, in short, by which the flame can be stifled by exclusion of air. No attempt should be made to remove the covering for some time after the flame has been extinguished. The place should afterwards be thoroughly scoured by playing upon it for some time with a powerful jet of water.

"Should any scattered liquid be discovered which has not become inflamed, it should be washed away, as above directed, as quickly as possible; and if a jet of water is not immediately at hand, it should in the mean time be covered in from the air by application of any of the materials named above."

THE ALLEN ENGINE.

WE give, this week, two two-page engravings, showing fully the arrangements and details of the well-known "Allen" engine, our engravings having been prepared from working drawings with which we have been supplied by Mr. Charles T. Porter. We had intended to accompany our illustrations with a description of the various peculiarities of the Allen engine, and of the numerous mechanical refinements which have been adopted in its construction in order to specially adapt it for working at high speeds; but we find ourselves compelled at the last moment to defer the publication of our account of the engine until next week, when we shall enter into the matter fully.

"IMPORTANT, IF TRUE."—The occurrence of sulphur and phosphorus in Cleveland pig iron has hitherto prevented its being used for conversion into Bessemer steel. For the latter purpose only the pig iron obtained from the purest spathic and hematite ores has been employed; and the increasing demand for steel has led to some apprehension lest the iron trade of Cleveland should eventually suffer from the competition of the Bessemer steel manufacturers, unless some practicable and economical method could be discovered whereby the north country pig iron could be converted into steel. During the past year a considerable number of experiments have been attempted to solve this important problem, and at length it would seem there is a fair prospect of success. At the last meeting of the Middlesborough iron trade samples of steel made from Cleveland iron were exhibited by Messrs. Fox, Head, and Co. These appeared of superior quality, and excited great interest, as it was stated that by the new process steel rails could be manufactured at from 9*l*. to 10*l*. per ton, or about 3*l*. per ton under the price of Bessemer steel rails. Should these anticipations be well founded, it is certain that a great impetus will be given to the iron trade of that district.

THE STONEWALL JACKSON.—This armour-plated ram has been sold by the United States government to the Tycoon of Japan for 450,000 dollars. The Stonewall Jackson was built at Bordeaux in 1864 for the Danish government, and was subsequently sold to the Confederate States. She carries 300-pounder Armstrong guns, and is more than 1000 tons burthen. She has two screws, and steams as fast as 14 knots per hour. Her armour-plating, which is altogether 3 ft. 2 in. thick, consists of two plates with oak between.

LIVERPOOL SCAVENGING.—The scavenging of Liverpool—even after allowing for manure, &c., sold—cost that town, last year, no less than 54,271*l*., as compared with 40,247*l*. in 1866. The nett estimated cost for 1868 is set down at 53,000*l*.

HULL WESTERN DOCK.—Mr. Hawkshaw reports that since January, 1867, about 350,000 cubic yards of earthwork and 24,000 cubic yards of masonry and brickwork have been executed at this dock. He thinks, however, that a greater result might have been achieved with "more energy on the part of the contractor." If due diligence is shown, Mr. Hawkshaw thinks that the dock may be completed this year. The lock-gates and the hydraulic machinery have been let to Sir W. Armstrong and Co., and ample time has been given to them to finish this portion of the work. The payments made by the Hull Dock Company to Mr. Hawkshaw in 1867 amounted to 3350*l*.

WARMING RAILWAY CARRIAGES.—It is stated that, since the occurrence of the lamentable accident at Angola, plans for heating railway carriages without incurring the danger of fire, have been the general topics of discussion amongst railway men in America. The employment of the foot-warmers used in England has been advocated in some quarters.

TESTIMONIAL TO THE INVENTOR OF THE REAPING-MACHINE.

A CIRCUMSTANCE which has several times been alluded to in the columns of ENGINEERING, as prospectively to be realised, has at last become a veritable fact. The Reverend Patrick Bell, of Carmyllie, Perthshire, has been presented with a testimonial of One Thousand Pounds, in token of the pre-eminent services which he has rendered to agriculture and necessarily to the human race. Who Patrick Bell is, and what he has done for agriculture, are subjects on which the readers of this journal can scarcely afford to be ignorant, and we hope that very few of them are in a state of ignorance regarding them. For such as are so it may be desirable to pen a few remarks, which, it is hoped, may not be uninteresting to our readers generally.

Some forty years ago, last autumn, Patrick Bell, the son of a farmer, and then simply an alumnus of the University of St. Andrews, was smitten with a desire to invent some machine for lessening the manual labour of harvest operations, labour that he regarded as doubly oppressive sometimes by the heat of the weather, and always by the very awkward position in which the reapers were obliged to stoop when engaged at their work. It was in the year 1826 that he commenced his inventive efforts with this object in view, and after applying his mechanical ingenuity in a variety of ways, he had the unspeakable delight of seeing his invention—the first practical reaping-machine—doing good serviceable work in the harvest-field in the autumn of the year 1827. Notwithstanding the many patents that have since then been taken out for reaping-machines, both in this country and in America, and notwithstanding the great fame of the Hornsby, the Eclipse, the Buckeye, the McCormick, and other well-known reapers, there does not seem to have been any really practical improvement made upon the reaping-machine since it left Mr. Bell's hands in its most finished state forty years ago. As in many other instances, the original inventor has not derived the benefit, or at least his due share of the benefit, accruing from the invention. He was so poor at the time, that the late Lord Panmure deemed it his duty to offer him the amount of money requisite to secure a patent for his machine. This he respectfully declined, and ever since he has been in that humble worldly state for which country clergyman of the Church of Scotland are almost proverbial. The American patentee, Mr. McCormick, has made money largely from his machines—as much even as 40,000*l*. in the year 1866, in America alone—and other persons whose names are identified with reaping-machines have also reaped some pecuniary benefits from the sale of the same; but poor Mr. Bell has all the while been poor, and poor he seems destined to be for the rest of his days.

As a benefactor to his race Mr. Bell is undoubtedly entitled to a high rank. Entertaining this opinion, a number of his countrymen, landed proprietors and farmers, belonging chiefly, if not entirely, to the Highland and Agricultural Society of Scotland, resolved, now many months ago, that they would raise a testimonial to present to Mr. Bell as a simple acknowledgment of the incalculable benefits conferred on mankind by his reaping-machine. To reward him they justly deemed to be beyond their power: that is only possible now by a vote from the national exchequer by the House of Commons. A committee was formed, and appeals were duly made to the agricultural interest; but, if the truth must be told, we are compelled, although with regret, to say that the agricultural interest generally turned but a deaf ear to the frequent eloquent appeals which were made for funds from time to time by Mr. Scott Skirving, the convener of the committee. What sum the committee aimed at securing we know not; but this we know, that an extraordinary amount of labour, up-hill exertion, and appeals in season and out of season have only brought in a paltry thousand pounds. The farmers and landowners of Scotland have no room to congratulate themselves upon the character of the testimonial which, in their name, the Marquis of Tweeddale presented to Mr. Bell the other day in Edinburgh. The largest amount subscribed by any single individual was 50*l.*, and even it was not given by a person identified with, or one of, the "agricultural interest." The donor in question was a certain James Young, a chemical manufacturer, of whom our readers have heard before now, a gentleman who has also made a name for himself as an inventor, and whose monument—erected by himself during his lifetime—may be seen in the gigantic paraffine and paraffine-oil works at Bathgate, and at Addiewell, near West Calder. But, even with this handsome subscription from an "outsider," the paltry thousand pounds was not fully subscribed till the day of the presentation. The sum of 30*l.* was still wanted to complete the 1000*l.*; and it was left for the noble marquis, who presided, to announce, in the presence and hearing of Mr. Bell, his intention to make up the required amount.

As one of the most thorough-going agriculturists in Scotland during the last forty or fifty years, the Marquis of Tweeddale—himself an inventor—was perhaps the fittest person in Scotland to preside, and he performed the duties devolving on him in an admirable manner. In the course of his reply, the reverend gentleman who was the recipient of the testimonial uttered the following interesting remarks:

"My feelings to-day are very different from what they were on that day forty years ago when I left my father's house on a cold winter's day—a day similar to this—and made my bow before the Highland Society. I came with a small wooden model under my arm, and as my friends had advised me to call upon the secretary of the society, and let him know what I was about, I waited on Mr. Gordon (latterly Sir Charles Gordon), who was secretary, with fear and trembling—with feelings very different from those of to-day. Sir Charles looked over the wooden model, and after a while he said he was no mechanic himself, and could not give an opinion on the subject; but that there was a celebrated mechanic in Edinburgh, and he would be very glad to give me an introduction to him, if I would take it. That was Sir John Graham Dalziell. I went to Sir John with my wooden model—it was more like a piece of a rotten tram than anything else. Having examined it, he said it was a very difficult thing to say what would be necessary to put it in proper form; but, so far as he was able to judge, it was very like the thing. He recommended me to get one constructed on a large scale, which I did next year, and it was then tried among corn, and succeeded very well. I need not say anything further to you about the history of the reaping-machine, as it is as well known to yourselves as to me. I can only assure you that this will be a high day with me during my lifetime, and with those with whom I am connected."

Will no member of Parliament, from his place in the House of Commons, do as was done in the case of Arkwright—move that a national testimonial from the funds of the state be presented to the inventor of the reaping-machine, the Reverend Patrick Bell? Failing that, will no Scotch nobleman or commoner who has the ear of the present prime minister, himself also a great agriculturist, see that Mr. Bell is placed on the Literary Pension List? We shall not rest satisfied until something is done upon which we can more heartily congratulate both Mr. Bell and ourselves as a nation, than we feel it desirable to do with reference to the testimonial just presented to him. We bestow peerages and great wealth on such of our soldiers as successfully command our armies in foreign wars. But "peace hath her victories as well as war." Patrick Bell long ago acquitted himself well as one of the victors; let us make sure that he reaps some reward ere it be too late, as in the case of poor Henry Cort. As his invention was a practical one forty years ago, he cannot now be regarded as young or even in his prime.

THE SEACOMBE AND EGREMONT FERRIES.

ON the 9th of January, at an adjourned general meeting of the Wallasey Local Board, held at the public offices, Egremont, the premiums were awarded for the best schemes for the improvement of the above ferries. J. C. Boyd, Esq., occupied the chair, and the other members present were Messrs. Pooley, Percival, Dixon, M'Innes, and Chadburn, and Captains Williams and Smith.

Two prizes of 100*l.* each were offered for the best plans for improving Seacombe and Egremont ferries, and two prizes of 50*l.* each for the second best plans; in response to which there were twenty-six competitors, who submitted about forty sets of plans. The plans were publicly exhibited for some weeks in the Water Tower, at Liscard; and a sub-committee of the Local Board, together with Mr. Carson, the ferry manager, was appointed to select two plans such as were considered worthy of the premiums which had been offered for the best schemes for improving Seacombe, and the same for Egremont. They, however, selected seven designs which were considered the most suitable, all displaying great ingenuity, which were marked as follows:

For Seacombe:—"Justitia" 1 and 2, "Red Wafer," "Archimedes," and "Crux."

For Egremont:—"Crux" and "Old Stager."

These designs were submitted at the meeting of the Board on the 9th inst, and, after some discussion, the prizes were unanimously awarded as follows, viz.:

For Seacombe:— First prize, "Archimedes."
Second ditto, "Crux."
For Egremont:— First ditto, "Old Stager."
Second ditto, "Crux."

The letters of the successful competitors were then opened by Mr. Ewer, the law clerk, when it was found that the plans marked "Archimedes" were those of Mr. Benjamin Haughton, C.E., and Mr. G. J. Crosbie Dawson, Assoc. Inst. C.E., Engineers' Office, London and North-Western Railway, Euston Station; those plans marked "Old Stager" were by Mr. Charles Cubitt, Assoc. Inst. C.E., of 3, Great George-street, Westminster (nephew of the late Sir William Cubitt); those plans marked "Crux" were by Messrs. A. C. Andros, M. Inst. C.E., and James Young, Assoc. Inst. C.E., of 140, Culford-road, De Beauvoir Town, London.

The cost of the improvement, as estimated by the several plans sent to the Board, varied, for Seacombe ferry, from 61,000*l.* to 7000*l.*, and for Egremont from 36,000*l.* to 4048*l.*

The average of all the estimates were, for Seacombe, 36,000*l.*, and for Egremont, 16,800*l.* Messrs. Benjamin Haughton and G. J. Crosbie Dawson sent in two designs for Seacombe; the estimate of the one adopted was 45,418*l.*, and of the alternative design 54,736*l.* Messrs. A. C. Andros and James Young's estimate for Seacombe was 34,040*l.*; Mr. Charles Cubitt's estimate for Egremont was 16,186*l.*; and Messrs. Andros and Young's estimate for Egremont was 8625*l.*

Of course the proposed improvements cannot be carried out until the Board have obtained an Act of Parliament to enable them to raise the necessary funds, and have power to complete the works.

NOTES FROM THE NORTH.

GLASGOW, Wednesday.

State of the Pig-Iron Market.—A week ago the price of pig iron in the Glasgow market was bidding fair to come down to the lowest ebb reached during the whole of last year. Since then, however, there has been a very decided manifestation of an upward tendency. On Wednesay last 51s. 9d. cash was accepted; but almost every day since the market has become firmer, prices mounting upwards, until now they have risen to 52s. 7½d. one month and 52s. 6d. cash. These prices prevailed yesterday, when a large cash business was done in warrants. No. 1 Gartsherrie and No. 1 Coltness have both improved 1s. per ton; yesterday they were quoted at 58s. The following are the pig iron shipments from all Scotch ports for the week ending January 25, 1868:

	tons.
This year	5,733
Last year	6,039
Decrease...	301
Total since December 25, 1867 ...	32,226
For corresponding period in 1866-67 ...	33,870
Decrease...	1,644

The Caledonian Railway.—This seems almost destined for some time yet to come to be a standing title for one of my "Notes." The proposal to effect a joint-purse arrangement with the North British Railway Company has been published in full detail, and has restored confidence considerably in the minds of the shareholders, evidence of which seems to show itself in the improvement in the price of the shares. Other official documents have also appeared in the newspaper during the last few days, and to-day there has been held a large meeting of the shareholders, in the City Hall, for the consideration of them. No ulterior measures were resolved upon; but a large committee was appointed to confer with the directors, and to report to a special meeting. A strong desire is expressed that there should be a change in the *personnel* of the board of directors; in the mean time, however, it is deemed imprudent to insist on it until the arrangement with the North British Company is finally brought into operation. Edinburgh insists that ultimately there must be a reconstructed board, in which that city shall at least have three representatives, Glasgow having five, Dundee, Aberdeen, and Carlisle having one each, and the other four places in the board being filled by representatives from other districts.

Royal Scottish Society of Arts.—On Monday night the usual meeting of this society was held in Edinburgh, when Mr. Thomas Stevenson, of the celebrated firm of lighthouse engineers, gave a description of "Some Arrangements for Lighthouse Illumination." He specially described the apparatus recently erected at Buddonness lighthouse, at the mouth of the Firth of Tay. This apparatus is remarkable from its employing in one instrument every kind of dioptric apparatus now in use. Mr. Stevenson stated that a reproduction of the Tay light would shortly be seen in the Industrial Museum. Professor Swan, St. Andrews, read part second of a paper on "New Forms of Lighthouse Apparatus," describing an apparatus for utilising all the rays of light from a flame for lighthouse illumination, and stating that the problem of transmitting any ray in any direction whatever, by means of a single dioptric agent, had now been solved for the first time. Mr. Stevenson's and Professor Swan's papers were remitted to a committee, consisting of Professor Piazzi Smyth, Mr. Sang, and Dr. Ferguson. Discussion on a paper on trades' societies, strikes, and lock-outs, by Mr. David Smith, Belfast, was deferred till the next meeting of the society.

Chair of Engineering in Edinburgh University.—Some time ago I mentioned that Sir David Baxter, of Dundee, had offered to endow a chair of Engineering in the Universiy of Edinburgh, providing the Government would supplement his endowment. A letter from the Treasury has been received by one of the deputation whom the senators appointed to urge the claim on the Government, and from it we are informed that the sum of 200*l.* annually will be asked from Parliament to supplement the 200*l.* resulting from the interest of Sir David Baxter's benefaction of 5000*l.* Dr. Lyon Playfair made some mention of this matter last week at the Society of Arts conference on technical education, but it is also proper that I should take some notice of it in these "Notes" for the benefit of such of your readers as have not seen the full report of the proceedings of that conference.

State of Trade in the Coatbridge District.—The various malleable iron works in the district are fully employed—some of them being exceedingly busy. In the tube works and foundries full time is given. In the tinplate works there are plenty of orders. The machinery and entire plant of the Dundyvan Malleable Works have been disposed of, and are to be removed at once; so that the hopes indulged in as to operations being resumed there are entirely cast down in the mean time, and the stoppage of the work will be a loss to the town. They have been sold privately to Messrs. Martion and Sons, ironmasters, Marryton, Coatbridge. As an offset to this, however, the steel works of the Messrs. Smith, at Gartcosh, which have been idle for some months, are expected to be in full operation in a day or two. At Gartsherrie and the other ironworks activity prevails, and the men are working peaceably at the reduced wages. Amongst the colliers and miners some dissatisfaction prevails as to wages; but the high price of provisions, &c., deters them from striking. During the early part of last week a large number of the blast-furnace men employed at Calderbank by the Monkland Iron and Steel Company were out on strike rather than accept a reduction on their wages to the amount of 10 per cent. In consequence of the "turn out," all the furnaces but one were put out, and the village at night presented a cheerless picture. The strike extended over a week or so, but it has now been brought to a termination by the men accepting the terms offered by the managers when the strike commenced. The "damped" furnaces have again been put in blast, and nearly all the old hands have resumed work at the reduced wages. The miners attached to the Calderbank Works have had their wages reduced as much as 6d. and 7½d. per day.

Depression of Trade at Bathgate Paraffine Works.—For some time past trade in general in Bathgate and neighbourhood has been in a somewhat depressed condition. Lately between thirty and forty hands have been discharged from the works of Young's Paraffine Light and Mineral Oil Company. Amongst them there were retort-men labourers, masons, and coopers. The retort-men still employed, as well as the engineers and fitters, have had their wages reduced one shilling per week. It is said that this reduction will become general throughout the works.

The Iron Trade at Motherwell.—This branch of industry appears to be improving at the Malleable Ironworks at Motherwell, and although orders are said to be not very abundant, indications are better. The prospects of a good spring trade on the Clyde are hopeful, and it is everywhere considered that the worst times have been seen in the Scotch iron trade, and that next month will witness a great revival of commercial prosperity. At Calder an additional blast-furnace has just been "fired up." This last-mentioned act is a consequence of the total "blowing out" at the Govan Ironworks, the property of the same owner, Mr. W. S. Dixon, and to which reference was made last week.

Miners' Affairs.—In the Kilmarnock district, the reduction in the miners' wages from 4s. to 3s. 6d. per day has taken effect after a short attempt at a strike in the case of one of the largest collieries, that of Woodhill, in which there are about 300 miners employed. These men have returned to work on the employer's terms, after having worked out their fourteen days' warning, and withdrawn their tools from the pit. In other collieries in the same district the workmen are going on at the reduced rate. In the Wishaw district a number of collieries have commenced on the short "darg;" a large number of the men have resolved to restrict their labour to eight hours per day, so as to keep the stock of coal down.

Iron-moulders' Affairs—The unfortunate strike and lock-out of the moulders at Aberdeen is now at an end. After a good deal of discussion between the workmen and their employers, the following decision was come to by the latter: "The terms on which we will receive back the men—as many of them as we require—into our shops are just that the notice printed and exhibited on the shop doors is a distinct statement of a principle which shall guide us in the management of our shops. All the shops in town must be opened at the same time; and all the men now employed in the shops are to remain and work at such work as the employers think proper. Other shops in the south or elsewhere, where union men have refused to work, must be opened; otherwise, should the employers associated for mutual protection find it necessary to order a lock-out until these shops are opened, the ironfounders in Aberdeen will agree with their brethren to do the same." The return of the moulders to work has consequently been sanctioned, and the condition referred to is that the masters shall be judges of all kinds of hands, the number and age of apprentices, and of all kinds of work at which labourers or other hands shall be employed.

In Glasgow things are in a very unsatisfactory state in the moulding trade. A general meeting of the members of the Scottish Ironfounders' Association was held a few days ago, when it was intimated that the lock-out and strike at Aberdeen had come to an end; but as the Moulders' Union had still shut a number of shops, both in Glasgow and elsewhere, the difficulty was not overcome. The meeting, therefore, adopted the following resolution: "That notice be given to the union moulders that on and after the 1st February next their services will be dispensed with until the directors of this association can intimate to the trade that all the workshops in the trade that are still struck or shut by the Moulders' Union have been opened free of all restrictions." This decision is expected to cause a general cessation of work in the trade throughout the whole of Scotland at the end of the present week.

Shipbuilding and Shipping Items.—Messrs. Scott and Company, shipbuilders, Greenock, are recommencing work this week, and besides the extensive repair on those vessels lately mentioned, they have contracted to build a screw steamer of 560 tons, the keel of which will be laid immediately. Two other keels are expected to be laid shortly. This will be a relief to a number of men who have been hanging on for some time expecting a commencement. On Monday it is said that not a single ship-carpenter was idle in Greenock. This is surely a great contrast to the state of affairs prevailing in the east end of London.

I have learned this afternoon that Messrs. Randolph, Elder and Co. concluded a contract at Liverpool yesterday to build two screw steamers, each of 2500 tons and 500 horse power, for the direct Pacific trade from Liverpool to Valparaiso. It is satisfactory to know that Messrs. Randolph, Elder and Co. are almost as busy as they could possibly be.

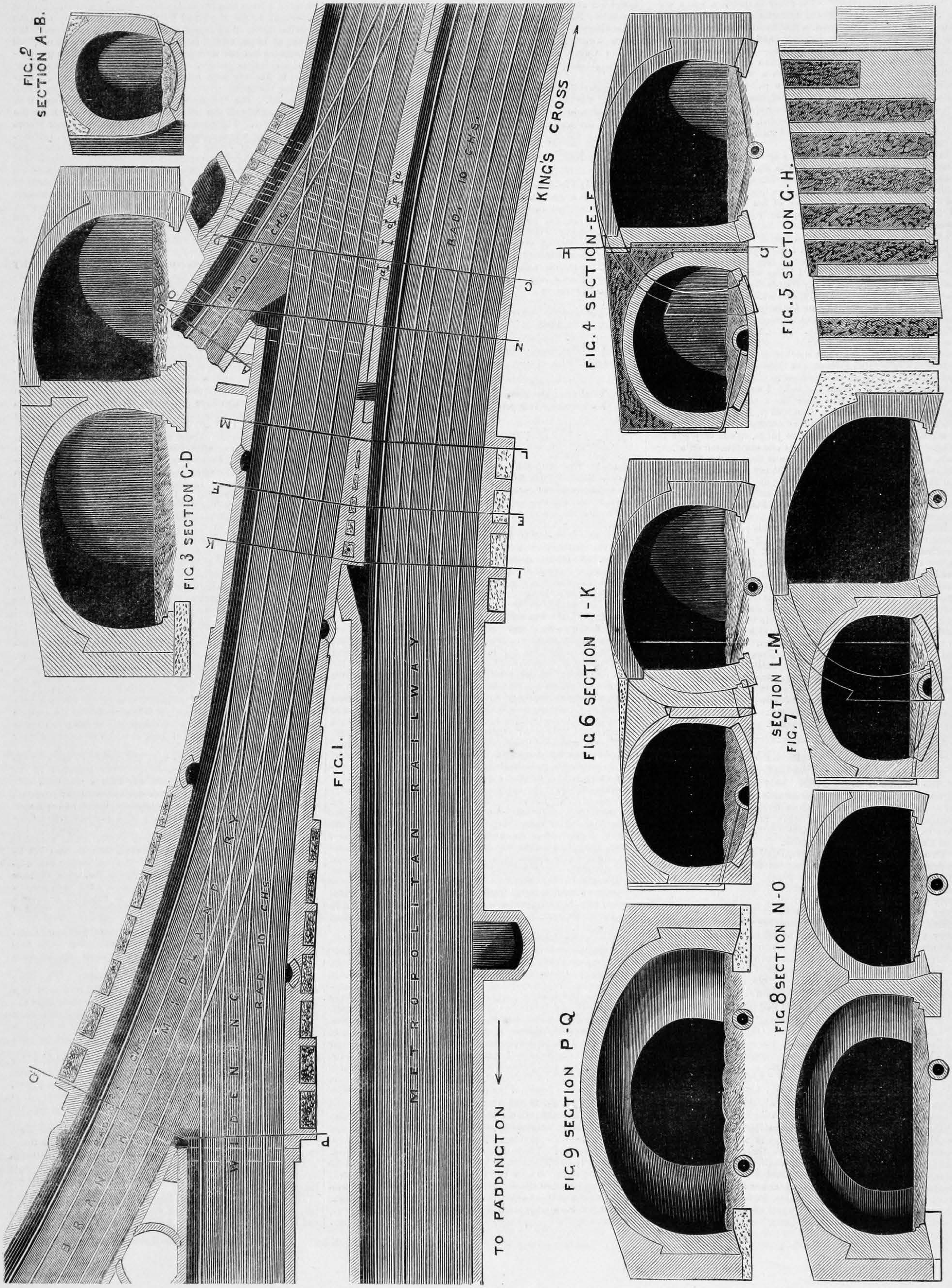
There was launched, on Saturday afternoon, from the West Shipbuilding Yard of Messrs. Charles Connell and Co., a finely modelled composite sailing ship, named the County of Stirling, of 1174 tons, to class fourteen years A 1 at Lloyd's. She is owned by Messrs. R. and J. Craig, Glasgow, and is intended for their Java line of packets.

The City of Edinburgh, a beautiful iron sailing ship of 1200 tons register, was launched last week by Messrs. Barclay, Curle and Co., from their Stobcross building-yard.

THE WIDENING OF THE METROPOLITAN RAILWAY.

MR. JOHN FOWLER, ENGINEER.

(*For Description, see Page 87.*)



METHOD FOR THE DETERMINATION OF SILICON IN IRON AND STEEL.

By V. EGGERTZ, PROFESSOR AT THE SCHOOL OF MINES, FAHLEIN, SWEDEN.

(*Concluded from page 71.*)

THE oxide of iron is easily dissolved in the heat of a water bath. The silica is again thrown on a filter, washed, dried, ignited, and weighed. 0.016 gramme of silica answers to each 0.001 gramme of silica when 3 grammes of iron have been used in the analysis. To ensure the purity of the silica, it may be mixed in a platinum crucible with ten times its weight of pure fluoride of ammonium, diluted with water to the thickness of syrup. The water must be evaporated on a water bath, and the crucible heated, with a cover on it, by a gradually increasing heat over a spirit-lamp to a full red. If nothing is left in the crucible, the silica was pure, and has passed off as silicon fluoride; but, if anything remains, the operation with fluoride of ammonium must be repeated until a constant weight is obtained. When iron contains tungsten, for instance, some tungstic acid is formed, and this accompanies the silica for the most part, being dissolved by the soda solution, but not volatilised by the use of fluoride of ammonium. Vanadic acid also accompanies the silica, behaving as tungstic acid. Instead of using fluoride of ammonium, it is preferable to use hydrofluoric acid, with which the silica is moistened, and the evaporation is conducted on a water bath. 0.1 gramme of pure silica obtained from analysis is easily dissolved by 2 c.c. of hydrofluoric acid (of the strength that 2 c.c. of it are neutralised by 1.5 c.c. of a saturated solution of ammonia 0.95 sp. gr.). When using hydrofluoric acid, getting it on the hands or exposure to the evaporating gas must be carefully avoided. The mass left on the filter from the soda solution may be composed of—besides graphite—slag, oxide of iron, oxide of titanium, &c. (but not copper, at least, when the iron does not contain more than 1 per cent.); this is dried, ignited, and weighed. The method of separating oxide of iron and slag, when the iron or steel contains both these, is not yet known. If the composition of slag were always alike (which it is not), it would be easy to calculate its amount from either the silica or oxide of iron obtained in the analysis. In a piece of Bessemer iron very red short (that is, it could not be bent at a white or yellow heat without being broken), which contained no sulphur, by several experiments 0.3 per cent. of oxide of iron has been obtained, and only traces of silicon. After ignition, the oxide of iron may possibly be found as sesquioxide. The amount of oxygen, in case that the red shortness is due to this, as it probably is, amounts to less than 0.1 per cent.

When the iron or steel for analysis contains titanium, a part of this substance follows the slag in the form of titanic acid. If such is the case, this must be melted with ten times its weight of acid sulphate of potash, by which it is dissolved; the mass is dissolved in cold water, and the solution precipitated by boiling; the weight is determined, and subtracted from that of the slag. This ingredient has not, however, been found in bar iron or steel in such a quantity as to merit special attention.

Regarding the determination of silicon in cast steel where only a trace of slag is found, the method given below for cast iron may be employed; but 3 grammes at least ought to be taken for each experiment, and the acids for solution in proportion.

In experiments conducted at the Mining Institution for the determination of silicon and slag in bar iron and steel, the amount of silicon has generally varied between 0.01 per cent. and 0.1 per cent.; but in two sorts of good cast steel from Krupp's it has amounted to about 0.3 per cent. Slag in cast steel has been found only in traces, but in another case it amounted to 0.2 per cent.; in good iron wire, prepared from bar iron, converted in a refinery hearth from charcoal pig iron, 0.33 per cent.; in puddled iron (armour plate), from 0.75 to 3 per cent.; and in an English iron rail, to 4 or 5 per cent.

For the determination of silicon in cast iron, in which no finery slag is found, and only exceptionally blast-furnace slag, the following method has proved suitable: 2 grammes of iron, which has passed a sieve with holes of a diameter of $\frac{1}{50}$ in. at the most, is put into a beaker of 100 c.c. capacity, containing 30 c.c. of hydro-chloric acid, sp. gr. 1.12. The beaker is covered with a close-fitting watch-glass, heated without delay, and the liquid kept at a gentle boiling for half an hour.

All the carbon chemically combined with the iron is separated from the liquid in the form of an ill-smelling hydrocarbon gas, by which operation a disadvantageous formation of humus and oxide of iron is prevented (in case that the solution should be required for further researches).

If the carbon formed in the solution is left in contact with the air some minutes before the boiling is begun, it undergoes such a change that it cannot afterwards be decomposed into gas and evaporated; if necessary, some hydrochloric acid is added, and the solution evaporated on a water bath, until the smell from hydrocarbon gas has ceased. If the graphite in the iron is to be determined at the same time, it is placed, as well as the silica, on a filter previously dried at 95° or 100°, and weighed; well washed with hot water containing 5 per cent. nitric acid, again dried, weighed, and ignited in a porcelain crucible. By deduction of the weight of silica and of the filter ash, the amount of graphite is determined. (It must be observed that the silica dried on a filter contains 6 per cent. water, or only 94 per cent. silica.) If, for instance, the filter weighs 0.125 gramme, and its ash 0.001 (the combustible substance being 0.124 gramme) and the filter+graphite+silica 0.182 gramme, and the residue after ignition 0.025 gramme (0.001 gramme of this is filter ash), the weight of the silica (0.024 gramme) is, after the drying, 0.0255 gramme, and thus the weight of the graphite becomes $0.182 - (0.124 + 0.001 + 0.0255) = 0.0315$ gramme. To the solution, after the separation of graphite and insoluble silica, is added 4 c. c. nitric acid, 1.2 sp. gr., and evaporated to dryness. The further proceedings are the same as previously described for the determination of silicon. If it is intended to determine only the silica, the whole solution is evaporated to dryness immediately after boiling. When the silica is red, strong hydrochloric acid is added, as previously described. If the silica is contaminated with titanic acid, vanadic acid, or tungstic acid, it is operated upon with fluoride of ammonium or hydrofluoric acid, as previously mentioned, whereby the silica is evaporated and calculated by loss. By the above method of dissolving iron in hydrochloric acid, the silicon changes, without evaporation, for the most part, to insoluble silica, which may be filtered and determined. Sometimes a very unimportant part is dissolved, especially if the boiling has been short.

When iron is dissolved in hydrochloric acid without heating (white cast iron is very difficult to dissolve in this way), a still less portion is dissolved, and generally so little that it may be neglected for practical purposes. The washing is performed with hot water containing nitric acid, as previously described.

When the iron is dissolved in nitric acid, a great deal of silica enters into solution.

The different sorts of cast iron appear to be slightly different in this respect. In dissolving cast iron with heat, in very diluted sulphuric acid, a great deal of silica is dissolved, but very little when the water is the least possible; as the water evaporates, the silica settles and becomes insoluble. The method given below rests upon these circumstances, and has proved very satisfactory, and by this the taking away of the acid is avoided, which is both necessary and troublesome when using hydrochloric acid with heat. The amount of silicon has, according to both methods, turned out alike. Traces of silica are always found left in the solution and wash-water. Regarding the determination of silicon in iron, it should be observed that only such vessels may be employed as are unacted upon by the reagents used in the analysis, as otherwise an undue proportion of silicon may be obtained.

Two grammes of cast iron which have passed a sieve of 0.2 of a line, are shaken by small portions at a time into a beaker of 100 c.c. capacity. In this beaker has been previously put 18 c.c. of water with 3 c.c. pure sulphuric acid of 1.83, or 15 c.c. sulphuric acid of 1.23 sp. gr. with 6 c.c. of water.

The beaker is covered with a watch-glass, and placed on a water bath; if the graphite rises on the sides of the beaker, it is pushed down into the liquid by a glass rod. When the iron is dissolved, the watch-glass is changed, after being washed, for a paper cover, and the solution evaporated on a water-bath until no condensation occurs on a watch-glass held over the beaker; 30 c.c. of water are then added, and it is frequently stirred with a glass rod, whilst on the water bath, until the white iron salt has completely dissolved. The insoluble mass is thrown on a filter, washed with hot water containing 5 per cent. nitric acid, 1.2 sp. gr. (in order to dissolve all compounds of iron) as long as an iron reaction is given with ferrocyanide of potassium. The filter, with its contents, is placed in a carefully tarred porcelain crucible; it is then cautiously dried, ignited, and weighed. The silica contains 48 per cent. of silicon, and its purity is examined by the method previously mentioned, when such is considered necessary. If the cast iron contains vanadium, this is obtained for the most part as a yellow-brown vanadic acid with the silica, from which it may be extracted by warm hydrocoloric acid or ammonia.

When intending to determine at the same time the amount of graphite in the cast iron, the solution is treated, after the separation of the chemically combined carbon, by boiling, as is previously described when dissolving the iron in hydrychloric acid. In determination of graphite the use of hydrochloric acid is preferable.

The greatest amount of silicon which has been found here in grey charcoal pig iron was 2.7 per cent., and in white (spiegeleisen) 0.8 per cent. The amount of silicon in pig from coke blast-furnaces is rarely more than 4 per cent. The least quantity of silicon in grey cast iron has been 0.2 per cent., and in white (spiegeleisen) it has not been less than 0.01 per cent. The amount has usually been from 1 to 2 per cent. in cast iron suitable for the Bessemer process, about 1 per cent. in good Franche Comté, and in pig iron for puddling about 0.5 per cent.

From many ironworks have been obtained pig iron suitable for refining on the charcoal hearth, which contained about 0.2 per cent. silicon; but from others a greater amount of silicon has been found in the same sort of pig iron, and it is generally presumed that different quantities of silicon require a different construction of the furnace, and a different method of working the refinery. It has been clearly proved by numerous experiments what a great influence the amount of silicon has upon the nature of cast iron, in being more or less easily refined, &c., and at the same time the great importance of paying more attention to its manufacture than has hitherto been done, in order to obtain cast iron, which, with regard to its silicon, may be suitable to the purposes for which it is to be employed.

The amount of silicon in iron of different degrees of hardness from the same charge of the blast furnace ought to be pretty well valued by the fracture, after some determinations have been made by analysis.

CANADIAN ENGINEERING.

TO THE EDITOR OF ENGINEERING.

SIR,—There is a description of work, called crib-work, extensively used in the United States and Canada which is little known in this country. It is used chiefly in piers, wharves, docks, abutments of bridges, weirs, mill-dams, &c. It is composed of timber framing, with dovetailed angle-joints, with diagonal and cross bracing well tenoned or dovetailed into the front, back, and end timbers, built layer upon layer horizontally, the courses, angles, and bracing being all secured by good sound oak trenails, and it is formed with a floor of rough timber at or near the lowest course.

In lake or river works the ground or bed is usually prepared by dredging; the timbers are prepared on shore, floated to the intended site, and put together and secured while afloat, rough stones being continually laid upon the floor above alluded to, and added so as to keep the framing at, or a very little above, the water surface, the work being so continued until the bottom of the crib is fairly grounded, when the frame is carried to its full intended height, and the interior completely filled up with rough stone to give weight and solidity to the structure; the surface is then finished in accordance with its peculiar requirements, sometimes being covered with timber bearers and planking, and sometimes with gravel or macadamised metalling.

In wharves, &c., these cribs are usually made of a somewhat greater width than they are high, and they are constructed in lengths of 25 ft. or 30 ft., according to the facility of procuring the necessary timbers. In bridges piers or abutments they are at once constructed of the size required.

In making weirs or dams across running streams, a much greater proportion of width is adopted at the bottom; but scarcements are made as the work increases in height, so as to leave the work immediately below the crest of the weir equal in width to about half or three-quarters of the depth. The framing is thoroughly filled with rough stone, and a few feet of each side of the apex is carefully planked and well spiked down. The up-stream side has then a large mass of earth, clay, and gravel applied as puddle behind it, which is again secured by a further portion of rough stone or boulders, running out the slope to about $2\frac{1}{2}$ or 3 to 1.

One of the best examples of these weirs is that across the river Schuylkill for the Philadelphia Waterworks, which weir is about half a mile in length, and a great portion of it in 24 ft. of water, built in or about the year 1826, and has often withstood floods pouring over it the full width of the river, with a height of fully 8 ft. over the crest of the weir.

The examination of such works as these often surprises English engineers, who are apt in the first instance to think that there is a great waste and extravagance in such a liberal use of timber; but, upon a closer examination of the prices of the material and labour available in the country, they find that these works are both cheap and efficient. Experience has shown that, in all the region of the great lakes and other timbered districts, this description of works can be executed at from two and a half dollars to three dollars per cubic yard equal to, say, from 10s. 6d. to 13s. sterling—a rate that would in many cases be insufficient to provide coffer-dams and pumping, if the system in use in this country were adopted.

Here, then, we see an adaptation of the materials with which the country abounds to a very useful class of works, which, although they may be deemed to some extent of a temporary character, are exceedingly efficient; and the cheap rate at which they can be executed not only *warrants* their use, but the dearness of money very generally *compels* their adoption, the choice being only between this class of work or no provision at all for the emergency.

On this subject, also, it appears to me that American engineers might, with benefit, adopt some of the English practices. In particular, it may be suggested that much greater care should be given to the perfect seasoning of the timber, and also to the subjecting it to some chemical action which would materially extend the period of its duration. Perhaps you, Sir, or some of your numerous correspondents may be able to give some information which could be made available for this purpose at a cheap rate. If such a result should follow these brief notes, it would greatly gratify the writer, and be productive of much benefit in the United States and Canada. More especially would it be beneficial if such chemical action had the effect of rendering the timber uninflammable, as well as of increasing its durability.

I have an impression (although I am writing from memory only) that about eighteen or twenty years ago a Mr. Payne took out a patent for a system of preserving timber, which he called "Payneising," and which, I believe, consisted in injecting into the timber first a solution of diluted sulphuric acid, and afterwards a solution of chloride of calcium, by which means the whole of the capillary cells of the timber were filled with sulphate of lime or gypsum, the timber, if I recollect aright, being placed in iron tanks and the air exhausted therefrom before the solutions were applied. Can you, Sir, give any information on this matter?—if the patent is in existence still; if it has been to any extent a success, and if the timber would still retain its floatage power, or whether the application would render it of a greater specific gravity than water? I think there can be no doubt of its rendering timber uninflammable, and, unless it should injure it in its tensile power, or decrease its resistance to compression, although it might to some extent diminish its elasticity, it appears to me that some such application would materially tend to remove the very serious objections now entertained to timber bridges for railway purposes.

I purpose making some remarks on the timber bridges of America, with your permission, at a future time, but think the subject too important to come in at the end of the present already too lengthy communication.

I am, Sir, yours obediently,
London, January 28, 1868. S****

THE REWARDS OF SCIENCE.—We are a practical people, we English, enthusiastic for physical science, eager for wealth, desirous, above all things, of increasing the dominion of man over nature and her forces. In this generation our two representative men in that work have been Professor Wheatstone and the late Mr. Faraday. Consequently, it is stated, that the Government intend to grant Mr. Wheatstone a knighthood—to elevate him to the position of a mayor who has entertained a prince—and it is certain that it will require pressure to get Faraday's pension continued to his wife, who is in need of it. It is all their own fault, of course. Faraday ought to have wasted his life in a futile endeavour to protect patents, as poor Henry Cort did, and then his heirs would have been rich; and Mr. Wheatstone ought to have devoted his genius for subtle observation to electioneering, and then he would have been made a baronet or a peer; but still the country does not seem quite content with the perfection of its arrangements. Suppose Mr. Disraeli, who is suspected of a suspicion that brain-work is useful, improves them just a little—say, by establishing a Knight Companionship of the Brain, with a pension attached to the decoration? —*Spectator.*

TEMPORARY APPOINTMENTS IN INDIAN PUBLIC WORKS DEPARTMENT.

GREAT interest has recently been felt throughout the profession, regarding the selection of men to fill the thirty temporary appointments in the Indian Public Works Department, for which candidates were invited by an advertisement from the India Office, dated 30th November last. It will not surprise any of our readers to learn that no less than 360 persons sent in applications for those appointments. Of these a considerable number applied too late, and were not therefore admitted; but 324 names were actually registered as qualified applicants.

Two engineers were appointed to conduct the examination, and to recommend thirty names for appointment; these were Major G. Chesney, R.E., and Mr. George Preston White, C.E. It must have been a work of no small amount of delicacy, and requiring great perception and discrimination, to decide upon the relative merits of so many candidates; but the plan adopted by the examiners has, we believe, met with the general approval and commendation of all disinterested persons; and we have no doubt that the selections made by the examiners will in every case justify the correctness of their judgment. With engineers required to fill some of the higher grades in the department, a competitive examination of an elementary character, such as candidates for the junior grades are subjected to, would obviously have been impracticable and unsuited for the occasion; and a *vivâ voce* examination of a very different character was therefore very wisely determined on by the examiners. As each candidate was received separately, it would obviously have occupied some weeks had all the applicants been asked to appear in person; and, upon this ground, a selection was first made from the testimonials sent in by each applicant. Those who had evidently had insufficient experience in the profession to fit them for the appointments, and those who, from their age, it was considered would be placed in a somewhat false position, by being placed under men considerably their juniors in age and experience, were in the first place eliminated from the list of candidates, and were not requested to appear before the examiners. This was a very proper preliminary measure, and saved many from the expense and inconvenience of a journey to London, from which they would doubtless have derived no benefit. The number of candidates was thus reduced to 139. To each of these a printed form was sent, which they were required to fill up, showing their age, the engineers to whom they had been articled, and detailing the several works on which they had been employed, the period of their employment on each work, and the total length of their experience in the profession. They were also required to give the names of engineers in London and elsewhere to whom they could give references. They were then required to appear personally before the examiners, with specimens of their drawings, &c. With great consideration and forethought, the candidates, being assembled in a waiting-room, were received one at a time by the examiners, and the examination of each occupied from a quarter to half an hour; and, subsequently, confidential communications were addressed to the engineers in London to whom each likely candidate had referred in his printed form. All this naturally occupied the examiners for many days; but, we think, no one can conscientiously complain of the delay necessary to the completion of such investigations, when it is considered that these selections had to be made for the public service of India—a country in which every engineer should be capable of turning his attention to any branch of his profession, where gentlemanly bearing is of no small importance, a knowledge of the language of the country is desirous, and experience in the management of workmen is of the highest consideration.

The present stagnation in works at home rendered this a most favourable opportunity for obtaining the services of first-class men; and if many of superior attainments have been passed over, it must not be considered that they were not thought qualified for the appointments, but that others of still greater experience have been selected, and we fully believe that the recommendations of the examiners will prove the soundness of the principles by which they have been actuated. Out of so large a number of applicants, of course many will have been disappointed; but we hope that this will not be the last occasion on which such appointments will be thrown open to the profession. The selected candidates have yet to pass the Indian Medical Board before receiving their appointments, and, after these have finally been confirmed, we hope to be in a position to publish the names of those who may finally prove successful.

RECENT PATENTS.

THE following specifications of completed patents are all dated within the year 1867; and that year should be given in ordering them, at the annexed prices, from the Great Seal Patent Office, Chancery-lane.

(No. 936, 8d.) Edwin William Ball, of Birmingham, patents arrangements of gas-stoves, in which a series of Bunsen's or other burners, consuming a mixture of gas and common air, are employed for the purpose of heating to bright redness layers of broken pumice-stone, asbestos, fireclay, plumbago, or other substances not injuriously affected by heat.

No. 950, 8d.) Simeon Lilley, of Birmingham, patents a method of making railway fog-signals, and also an apparatus for depositing them on the rails. The object of this latter contrivance is stated to be to enable the signals to be laid down from the interior of any van, without its being necessary to alight for the purpose; but we must confess that we do not see the utility of the arrangement. The patentee says they could be deposited from *any* vehicle; but obviously, unless deposited behind the hind wheels of the last vehicle of a train, they would be instantaneously exploded by the succeeding wheels passing over them. Moreover, the circumstances under which any advantage could be gained by depositing signals from a train in motion are of exceedingly rare occurrence.

(No. 951, 6d.) James Jennings McComb, of Liverpool, patents, as a communication from David McComb, of Memphis, U.S., a simple method of coupling the ends of telegraph fencing and other wires. According to this plan, a hook is formed by bending the end of the wire, and a short distance from this hook an eye is formed by lapping the wire once round a round pin. The two ends to be connected are coupled by placing the hook of each in the loop of the other, when any tensional strain brought upon the wires serves only to tighten the connexion.

(No. 954, 1s. 10d.) William Clark, of 53, Chancery-lane, patents, as the agent of Frederich Hertel, of 29, Boulevard St. Martin, Paris, apparatus for preparing clay, and for moulding solid or hollow bricks, drain-pipes, tiles, &c. The various machines included in this patent could not be described without the aid of drawings.

(No. 956, 10d.) Henri Adrien Bonneville, of 38 Porchester-terrace, Bayswater, patents, as the agent of Henry Harris Pember and Uriah Furman Rogers, of New York, a method of hanging ships' rudders so that they can be shipped or unshipped from the deck of the vessel. In order that this may be done, the rudder, instead of being hinged to the stern-post, is hinged to a plate which can be slid down in a kind of dovetail groove formed at the back of the stern-post, this plate and the rudder with it being capable of being raised or lowered through an opening formed for the purpose in the deck of the vessel.

(No. 964, 1s. 8d.) James Grafton Jones, of the Blaina Ironworks, near Newport, patents improvements in coal-cutting machines, and in the construction of the tramways on which such machines are worked. According to these plans, instead of the pick or sliding cutter having one cutting edge only as usual, it is furnished with a series of cutting edges arranged so as to act in succession, the first making a narrow groove in the coal, the second a wider groove, and so on. The cutting edges are also arranged so that they cut to different depths; and when lever-picks are used, one or more of the wider cutters are placed near the rear end of the pick, so that the front of the groove is made wider than the deeper portions. The back of the bar or pick is made with projections like ratchet teeth, which draw out the pieces of coal during the backward stroke. The patent also includes an arrangement for communicating the motion of the piston to gearing, by which a traversing motion can be given to the machine, this gearing in some cases acting on a chain laid down between the rails. The rails Mr. Jones proposes to employ are of a hollow or bridge section, and particular methods of laying and fixing them are specified.

(No. 967, 8d.) John Harker, of Great Driffield, patents arrangements for pressing oil-cake and similar substances between corrugated plates, the main feature being the peculiar section of the plates, which could not be described without the aid of drawings.

(No. 969, 10d.) John Prentice, of New York, patents machinery for making cigars, these machines including arrangements for preparing and making up the filling, squaring up and shaping the end and tip, and putting on the wrapper.

(No. 971, 8d.) Francis Curtis, of Newton, patents improvements in paper-making machinery, these including a roll for pressing, sizing, and callendering, a method of constructing the suction-box for a paper-making machine, and a screen-plate. The roll for pressing, &c., is made with a metallic body, and is coated with a layer of hard rubber, the body having a number of longitudinal grooves cut in its surface from end to end, to allow of the escape of the air from beneath the rubber during the application of the latter. The suction-box and screen-plate Mr. Curtis proposes to make of hard india rubber, instead of the materials now employed.

(No. 975, 6d.) Henri Adrien Bonneville, of 38, Porchester-terrace, Bayswater, patents, as the agent of Eugène Hippolyte Duru, of 72, Boulevart Sébastopol, Paris, a terrific railway brake. This brake consists of two pairs of gigantic pincers which hang down at one end of the guard's van, and which are made to lay hold of the rails, when required, by means of an arrangement of chains and pulleys! We should think that this brake might be relied upon for stopping any train with ease and certainty, unless, indeed, some trifling accident, such as smashing the whole apparatus, tearing up the permanent way, or pulling the end out of the guard's van, should interfere with its successful action.

(No. 977, 1s. 6d.) Jean Jacques Meyer and Adolphe Meyer, jun., of Mulhouse, patent a system of constructing tank locomotive engines. This system was fully described, and the details illustrated, in the last volume of ENGINEERING (*vide* page 500).

(No. 984, 8d.) Jean Albert Moll, of Moutier Grandval, Bern, patents an apparatus for obtaining motive power, or for pumping. This apparatus consists of a tube or cylinder, which is enlarged at one point to accommodate what the inventor calls a "motor." This "motor" is an egg-shaped or ellipsoidal body mounted on an axis, and furnished with spiral vanes on its exterior surface. The "motor" is to be driven by water conducted through the cylinder so as to act on these vanes; or it is to be driven by other power, and is to be itself employed for forcing water.

(No. 988, 2s. 10d.) William Clark, of 53, Chancery-lane, patents, as the agent of Victor Langlois, chief naval constructor at Cherbourg, methods of fixing the tubes of tubular boilers and condensers. This patent includes various plans for screwing the tubes into their places, and for otherwise securing them so that they can be removed when required; as well as appliances for preparing the tubes and holes. The various details could not be described without reference to drawings.

(No. 990, 1s. 2d.) Jonathan Pickering, of Stockton-on-Tees, patents the lifting apparatus and gearing illustrated and described on page 55 of our last number but one.

(No. 994, 1s.) Andrew Smith Hallidie, of San Francisco, and of 18, Salisbury-street, Strand, patents a peculiar method of constructing suspension-bridges. According to this plan, two pairs of cables are employed for each span, each pair of cables extending over the summit of one tower down to the opposite tower at about the level of the roadway. The two pairs of cables thus intersect each other at the centre of the span, and they are connected at various points by inclined tie rods, whilst vertical rods connect them to the flooring of the bridge. Some other peculiarities of construction are also included in the patent.

(No. 997, 4d.) Peter Spence, of Newton Heath, patents methods of treating minerals which contain blende, or sulphide of zinc, in combination with galena, or sulphide of lead. Mr. Spence grinds the mineral to powder, and treats it with hydrochloric acid, free from sulphuric acid, and of a specific gravity 1.21. The powder ore and acid are well stirred together and allowed to stand about a week, when the chloride of lead which has been formed is dissolved out by boiling water.

(No. 1000, 4d.) George Edward Van Derburgh, of New York, patents making artificial grindstones or polishing-stones, by mixing particles of emery or other gritty substances with a suitable vitrescent flux, and then subjecting the whole to the action of heat, so that it may be wholly or partially vitrified.

(No. 1012, 10d.) Stanhope Perkins, of Fairfield, patents making the point or V-rail of railway crossings by taking a rolled double-headed steel rail, planing off a portion of the flanges on one side, and then bending the rail back upon itself, so as to bring the planed surfaces in contact. The parts in contact are then drilled through, and bolted or rivetted together.

(No. 1016, 10d.) Barnard Fowler, of 71, Cornhill, and David Greig, of the Steam Plough Works, Leeds, patent arrangements of locomotive engines intended for working up steep inclines. These engines are fitted with a clip-drum taking hold of a steel rope laid between the rails, and they were fully illustrated and described on page 517 of our last volume.

(No. 1018, 4d.) Henry Buss, of 56, High-street, Shoreditch, patents constructing quays, jetties, &c., by fixing firmly to the bed of a river or other site two parallel lines of iron foot-rails, the space enclosed between these lines of rails being equal to the width of the intended structure. The rails are to be grooved on their upper sides, and iron panels kept together by top longitudinal rails and stiles are to be slid into these grooves, the space between the panels being afterwards filled in with concrete. The patentee does not state the manner in which the foot-rails are to be fixed.

(No. 1022, 8d.) Thomas Beaumont Marshall, of Queen-street, Cheapside, patents methods of insulating and laying subterranean telegraph wires. Mr. Marshall proposes to place the bare wires in a trench, in which a layer of hard insulating material has already been laid, and then to cover them with another layer of insulating material on which more wires can be placed, and so on. Let alone the other numerous and evident practical objections in such a plan, it would involve a most wasteful expenditure of insulating material.

(No. 1027, 8d.) William Adair, of Liverpool, patents a form of double-acting pump, the chief peculiarity of which is that the top cylinder cover is made to serve the purpose of a delivery-valve, it being made to close on a suitable seat, and being without a stuffing-box, so that it may slide freely on the piston-rod. We fear that there would be considerable leakage between the rod and valve after the pump had been at work some time. The leakage would, however, be a leakage of water, as the valve is submerged in the water in the delivery-chamber.

(No. 1028, 10d.) William Edward Newton, of 66, Chancery-lane, patents, as the agent of the Mitchell Safety Steam-Generator Company (Incorporated), of Albany, U.S., a form of steam-generator, consisting of a cylindrical vessel mounted on a horizontal axis, and made to revolve over a fire. The water is injected into this vessel in small quantities at a time, the injection of the water and the withdrawal of the steam generated being effected through the trunnions of the vessel.

(No. 1034, 1s. 4d.) William Parell Butchart, of Dundee, patents methods of softening jute, hemp, &c., by passing the materials between series of grooved rollers, and at the same time subjecting them to the action of a softening liquid or liquids. The machinery which it is proposed to employ for these purposes could not be clearly described without the aid of drawings.

(No. 1040, 4d.) Clinton Edgcumbe Brooman, of 166, Fleet-street, patents, as the agent of Cyprien Marie Tessié du Motay and Charles Raphael Maréchal, of Metz, a method of obtaining oxygen indirectly from atmospheric air by the decomposition and recomposition of sulphuric acid. According to this process, the sulphuric acid is decomposed into sulphurous acid and oxygen by the action of the oxides of aluminium or zinc; next, the sulphurous acid is absorbed by oxide of magnesium, setting the oxygen free; and, finally, the sulphide of magnesium thus formed is heated in a retort and made to evolve the sulphurous acid, which is reconverted into sulphuric acid by contact with air, steam, and nitrous gases in the usual way.

(No. 1045, 8d.) William Robert Lake, of 8, Southampton-buildings, patents, as the agent of Elihu Spencer and Thomas Stephens, of New York, a combined water-meter and force-pump. In this apparatus the water is admitted by suitable slide-valves to a pair of cylinders, and the pistons working in these cylinders are connected by rods with the pistons of a pair of smaller cylinders, which are used for pumping water to a higher level than that from which the water for working the apparatus is supplied. The piston-rods have slotted crossheads, in which the crank-pins of a crank-shaft placed between the two pairs of cylinders work, and from this shaft the slide-valves and the indicating mechanism are driven.

(No. 1047, 10d.) George Frederick James, of Salford, patents machinery for twisting two or more yarns round a central woollen or other soft yarn, for the purpose of ornamenting or consolidating the latter.

(No. 1048, 1s. 8d.) William Thomas Henley, of St. John-street-road, patents methods of constructing telegraph-posts of iron plates, which are tapered from the foot of the post upwards, and connected by angle irons and gusset pieces so as to form posts of cruciform, three-webbed, and other sections.

(No. 1049, 4s. 4d.) William Thomas Henley, of St. John-street-road, patents various improvements in wire-making machinery. This patent includes a machine for pointing the wire previous to drawing; several arrangements for welding wire; and machines for stretching and straightening wire. A description of these various machines would require more space than we can give to them here.

(No. 1051, 1s. 4d.) William Clark, of 53, Chancery-lane, patents, as the agent of John Kinney Mayo, of New York, a machine for cutting scale-boards, match-splints, &c., and also methods of applying scale-boards to various purposes. In this machine, which we could not fully describe without the aid of drawings, the boards are cut by a stationary knife, over which the timber is made to slide, arrangements being provided for holding the timber firmly, and for straightening the boards after they have been cut.

(No. 1058, 8d.) John Lacey Davies, of 4, St. Ann's-square, Manchester, patents, as the agent of Wolf Maurice, of Faubourg Poissonière, Paris, a method of purifying smoke by passing it through a flue, where it is subjected to the action of a liquid shower, this shower falling or being injected in the same direction as that in which the smoke is being led, so that it does not obstruct the draught.

(No. 1059, 8d.) Hugh Forbes, of 184, Euston-road, patents a wonderful machine "for maintaining and augmenting motive power." This may be described as a kind of overshot water-wheel, which is worked by water raised by a rotary pump, the kindness of the latter in raising water for this purpose being reciprocated by the wheel in its turn working the pump! With regard to his marvellous pump, which is the chief feature in the concern, the inventor says: "As comparatively little physical effort is required to rotate the drums of the pump having my improvements above referred to, a column of water raised to a considerable height by the apparatus can turn a large wheel, so as to acquire a power superior to that employed to rotate the drums of the said pump, and all or a portion of that power can be devoted to the movement of machinery"! We should think that only machinery of the most massive character could stand the application of such a power.

(No. 1066, 8d.) James Robert Napier and William John Macquorn Rankine, of Glasgow, patent an arrangement of slide-valves and seats. According to this plan, the valve-seat is made in such a manner that whilst the bars, or those parts of it which lie between the exhaust and steam ports, are fixed as usual, the parts of the face outside the steam-ports are movable, and are capable of being shifted by suitable gear, so as to enlarge and contract the steam-ports alternately. The idea is, we believe, not a new one.

(No. 1070, 8d.) William Colborne Cambridge, of Bristol, patents making firebars with diagonal slots across their upper surfaces for the admission of air to the fire. This form of bar is not new. Particular mixtures of iron for casting, and methods of moulding the bars, are included in the patent.

(No. 1071, 8d.) Francis George Fleury, of Southwark, patents a reciprocating water-meter. In this meter two cylinders are employed, each cylinder being fitted with a piston which slides on its rod for the greater portion of each stroke, motion being communicated to the rod near the ends of the stroke only. The admission of the water to, and its release from, each cylinder is effected by a slide-valve, the valve of one cylinder being worked by a lever connected to the piston-rod of the other cylinder, and *vice versâ*.

(No. 1072, 8d.) Alexander Carnegie Kirk, of Glasgow, patents the arrangement of blowing-engines which we illustrated and described on page 15 of the present volume of ENGINEERING.

(No. 1076, 10d.) Samuel Barlow and Thomas Edmeston, of Stakehill, patent placing in the furnace of a steam-boiler a kind of water-tube grate, this grate being placed at a higher level than usual, and an ordinary grate of less length being placed below it. A damper is provided in the bridge of the lower grate, so that the gases from the lower fire can be made to pass to a greater or less extent through the fire on the upper grate. It is intended that the fires should be fed alternately, or that the lower grate should be supplied with red burning fuel only, raked down from the upper grate.

THE PACIFIC COAST.—We learn that a second line of steamers is to be established between Panama and San Francisco. The existing company hopes, by important reductions in its passenger and freight rates, to force the new company to abandon its enterprise.

FERRY TRAFFIC AT NEW YORK.—It appears that in 1867 no fewer than 79,925,000 passengers crossed, by means of the ferries provided, the bay which separates New York from Brooklyn, Jersey City, &c. There will, then, be plenty of traffic for Mr. Roebling's great bridge.

BLOWING OUT A BLAST-FURNACE.

BLAST-FURNACES, as a rule, are expected to remain in continuous operation from the time of their being blown in until they have become unfit for further use from the wear and tear of many years' working. In times of stagnant trade, however, and under the varied fluctuations of the commercial position of iron-smelting in different localities and ironworks, it occasionally becomes necessary to interrupt the operation of a furnace while it is in complete working order, and intended to be blown in again at a more or less remote date. The problem of blowing out a blast-furnace, under such conditions, involves a certain amount of difficulty, since it is necessary to preserve the internal fire-brick lining of the furnace, and at the same time to prevent the adherence of slags and iron to that brickwork. If the blast were interrupted while the furnace is charged in the usual way, an enormous "salamander" would be formed inside the furnace, which could not be removed without a total destruction of the internal brickwork. If, on the other hand, charges of coke were introduced without any ironstone, the temperature of the furnace would rise to such an extent as to destroy the masonry, and particularly the apparatus for taking off the furnace gases. A similar rise of temperature would take place even if the coke were mixed with broken sandstone or any other material, which would act only as a neutral filling mass between the pieces of coke. A very ingenious plan for blowing out a furnace was resorted to, about two years ago, at the Heinrichshütte, near Hamm, in Rhinish Prussia, with perfect success, and a description of this operation has appeared in our German contemporary, *Der Berggeist*. This plan consists in charging the furnace with limestone instead of ore, and absorbing the heat evolved in the lower strata by the combustion of the coke in the process of burning the limestone. The furnace at Hamm is 45 ft. high and 7 ft. wide at the mouth. It is closed, and the gases are taken off for firing boilers and stoves. Its usual make is grey or mottled iron for the Bessemer process, and occasionally spiegeleisen. After the last charge of ore had been made in the usual way in this furnace, the blowing-out process was commenced with, by first charging a quantity of coke for the purpose of dividing the iron charges from the following limestone, and thereby preventing the lime from forming a thick slag in contact with the iron ore. The charges of coke were continued for three hours, seven charges of coke, weighing about 5 tons in all, being in this manner introduced into the furnace. At this time the temperature at the furnace mouth commenced to rise to such an extent as to necessitate the immediate charging of the limestone. The limestone was charged in lumps weighing from about 6 to 12 lb. apiece, and no fuel was mixed with the charges of limestone. The temperature at the furnace-mouth commenced to sink immediately after the first charges of limestone were made. The blast was maintained at its usual pressure, and the gases drawn off at the top were combustible, same as before, and continued to fire two boilers and two blast stoves. The combustible gases consisted, of course, of the carbonic oxide formed in the lower strata of the furnace, mixed with the carbonic acid from the limestone, which latter, although not combustible itself, does not interfere with the combustion of the other gases. The reduction of temperature at the furnace-mouth was due to the absorption of heat in volatilising the carbonic acid contained in the limestone. The charging of limestone continued through sixteen hours, during which time forty-eight charges were made, and a total quantity of 113 tons of limestone was used. During this time the furnace was tapped three times, making iron of the usual quality from the ore which descended in front of the limestone. After the forty-fourth charge the limestone had arrived in front of the tuyeres, the heat decreased, and the mass in front of the tuyeres became black; the sound produced by the blast changed, and the gases drawn from the top of the furnace ceased to be combustible; an auxiliary boiler fired with coal was brought into requisition for working the blowing-engine The blast, after this, was reduced in quantity, and continued for three and a half hours. This was required for allowing the materials still remaining at the sides of the furnace, and through which the limestone had worked its way down into the hearth, to melt and run down into the hearth of the furnace. The last portion of liquid slag tapped from the furnace contained so much lime as to fall into dust after being cooled and exposed to the atmosphere. After the tapping of this last quantity of slag, the hearth and tuyeres were carefully plugged up, and the cover of the furnace-mouth, or gas-catcher, slightly raised, so as to produce a moderate ascending draught. When the whole had cooled down sufficiently, the removal of the limestone was commenced with, by breaking open the hearth at one side, and withdrawing the burnt lime through the opening thus made. During this operation the temperature at the furnace-mouth again commenced to rise, since some portions of the coke still remaining close to the sides of the furnace were re-ignited by the access of air. The charging of limestone was therefore recommenced at the top, and this reduced the temperature to the desired extent. The lumps of limestone had retained their form and consistency, and very little dust had been produced from them; but only a very small portion was completely burnt, the rest being affected only at the surface, and to a depth gradually diminishing in the upper strata. The sides of the furnace were found perfectly clear and in excellent working order, and a very moderate amount of repairs was sufficient for preparing the furnace for a new campaign. The use of limestone for blowing out furnaces is, according to the experience gained in this instance, of great value. It is possible to substitute spathic iron ore for the limestone, since the latter, being carbonate of iron, undergoes a similar process during its calcination as the limestone, viz., the volatilisation of the carbonic acid contained in it. When charged with spathic ore, the furnace virtually becomes converted into a calcining-kiln, and the ore employed in this manner can be charged into a blast-furnace for being smelted after its having undergone a calcination in this manner.

SUEZ CANAL.

THE following is an extract from an account which appeared recently in an Indian journal, of the present state of the Suez Canal and its subsidiary works, by one who had journeyed along it course from Port Saïd to Suez:

Within the last few months, the Levant steamers of the French, Russian, Austrian, and Turkish lines have made Port Saïd a station. There is generally at least one steamer a week from Alexandria, whence, after a trip of about twenty-four hours, the rising town of Port Saïd is reached. From a distance it looks quite an important place, from the smoke proceeding from dredges and steam-tugs at work in the harbour. The entrance to the port is formed by an extensive breakwater, composed of large blocks of artificial stone, running into the sea for nearly a mile and a half. Immense dredging-machines are at work deepening the channel, the soil being carried some distance out to sea by the steam barges. The population of Port Saïd, consisting of about 8000 Frenchmen, Italians, Greeks, and Levantines, inhabit about 1000 wooden houses, none of them particularly ornamental. A few of the houses on the boulevard facing the sea are of superior build, and look a good deal like Italian bungalows. The rest of the town consists of Indian rows of houses, on the barrack system, for the workpeople; any number of cafés and cabarets, a few shops, a couple of hotels, and two or three chapels. The harbour contained about a dozen English barques, laden chiefly with coal, and some dozen or fifteen smaller vessels carrying the various flags of the Mediterranean. Adjoining the harbour is a large building-yard, or rather dock, where the dredging-machines, barges, and earth-spouts are constructed. Here are also situated the workshops and foundries of the contractors for this part of the work. A small steamer is despatched every morning for Ismailia, whence Suez may be reached by the sweet-water canal. The whole transit is made in twenty-four hours, and the fare is forty francs first class.

The mail packet consists of a small screw steamer, about the size of a bunder-boat, capable of holding about thirty passengers. The width of the canal is to be about 120 yards; and for a considerable distance this width has been attained; but in many places not above 70 or 80 yards have yet been dredged. The scenery is very tame, and is often limited to the sides of the canal. Thirty-three miles from Port Saïd is the small station of Cantara, which is reached in about five hours; and here a good breakfast may be obtained for three francs. About four hours' more steaming will bring the traveller to Lake Timsah, which is now filled up to the level of the Mediterranean without the intervention of a single lock. On the western shore of the lake is the new town of Ismailia, so called in honour of the present Viceroy, as Port Saïd is after his predecessor. The situation of Ismailia is very pleasing, standing as it does on high ground, overlooking the lake. The town is better built than Port Saïd, and contains a good hotel, with accommodation for 60 to 100 visitors. The head-quarters of the company are now located here; and as the climate is said to be healthy and remarkably pleasant in winter, it will probably be a place of importance should the canal succeed. The present population is about 4000. The sweet-water canal is here joined to Lake Timsah by a lock. About ten miles from Ismailia is the small station of Serapeum, where the two canals are contiguous. The works on the maritime canal at this spot are very interesting, a cutting having to be made through a range of the finest sand, which, it was feared, would fill up rapidly, and make it necessary for dredging-machines to be constantly at work; but it is stated that such has not yet been the case. Serapeum itself consists of a few workshops, with the necessary houses for the work-people. On the fresh-water canal, the means of conveyance is a tow-boat, mules being here employed in place of steam. At Suez the work is chiefly going on in the roads, where several dredgers are employed deepening the way, and gradually creeping up in a northerly direction. Immediately in front of the Suez Hotel, there is a small colony of canal people, and the bed of the canal is traced out, and in some places partially cleared. M. Lesseps, it is stated, is sanguine that the work will be completed by the end of 1869, at a cost of 12,000,000*l*., and that the canal will be used by vessels representing three millions of tons per annum. In addition to this he anticipates large profits from the sale of land in its neighbourhood, especially near Port Saïd, Ismailia, and Suez; others, however, are not so sanguine.

After giving his account of the trip, of which the foregoing is but an abstract, our *voyageur* sums up as follows: "Passengers from India intending to visit "Syria or Palestine will find the canal route to Port "Saïd preferable, I think, to the rail by Cairo; and, "as all the steamers which leave Alexandria call at "Port Saïd, they will find the same facilities at the "latter place for proceeding to the Levant ports as "they would at Alexandria."

PETROLEUM AS STEAM FUEL.

TO THE EDITOR OF ENGINEERING.

SIR,—Will you please permit me to inform your correspondent "Scotus" that I am fully sensible of the merits of Colonel Foote's system of burning petroleum; but I affirm it is one that can only be used for short experimental trials. The boilers in our ships often have four fireplaces each, and are at work for several days and nights together, evaporating an immense amount of water to satisfy the cravings of the powerful engines to which they are attached. I was very early told that it required a very devil of a fire to keep up steam, and that no half-contrivances would do. Let "Scotus" imagine four of Colonel Foote's apparatuses placed in one of these boilers! He says they commence working at such a degree of redness as would be perceptible in the dark. In what state would they be in after six hours? The radiant heat alone would be sufficient to destroy them. Then there are the retorts, red hot, filled with an explosive mixture, to be considered. On the least split in them, the boiler would be lifted from its place. I question if the oil could be long used in such apparatus. Schele oil certainly could not, for, as a whole, it does not readily vaporise. A portion of it is like common tar; the steam would spurt this out of the burners, and there would be a pool of liquid fire in the ash-pit. The apparatus, it appears to me, is too scientific; it is not sufficiently practical or common for use.

As to "Scotus's" observation on my small-area firegrate, I can hardly explain what I meant without a drawing. My system has no burners; the grate itself is one entire wick; the tar burns in the surface, superheating and decomposing the steam, the oxygen of which takes up the spare carbon of the oil, and there is a fierce smokeless flame. If the grate is of the usual size allowed for coal, the flame is more than sufficient to fill the firebox and tubes. By reducing the size of the grate, I reduce the flame. There is no fear of the boiler-plates being injured by the impact of flame, if they have water on the other side.

I am, yours respectfully,

32, Kensington-square, W. C. J. RICHARDSON.

THE DENSITY OF SALT WATER.

TO THE EDITOR OF ENGINEERING.

SIR,—Your correspondent, "A.B.," has started an important inquiry on this subject, which I hope will be continued by more exact experiments. He has, however, mystified himself by an error of calculation, viz., 37 in a 100 is $\frac{12}{32}$ nearly, and not $\frac{8.6433}{32}$, as he says. On referring to a paper read by me on May the 7th, 1866, before the Society of Engineers (of which I shall be glad to send him a copy, if you will kindly give me his address), he will find some information on the subject which may prove useful to him. The experiments referred to are valuable, as giving the amount of salts that can be held in solution at 80°. At the specific gravities, between 1/32 and 3/32, there is an irregularity in the results he arrives at which further experiments may overcome.

I am, Sir, your obedient Servant,

Brixton, January 27, 1868. PETER JENSEN.

DETAILS OF THE ALLEN ENGINE.

CONSTRUCTED BY THE WHITWORTH COMPANY (LIMITED), MANCHESTER, FROM THE DESIGNS OF MR. CHARLES T. PORTER.

(*For Description, see Page* 98.)

DETAILS OF THE ALLEN ENGINE.

CONSTRUCTED BY THE WHITWORTH COMPANY (LIMITED), MANCHESTER, FROM THE DESIGNS OF MR. CHARLES T. PORTER.

(*For Description, see Page* 88.)

CANADIAN ENGINEERING.

To the Editor of Engineering.

Sir,—Your correspondent "S.," of last week, refers to the steam excavators, as used in the United States and in Canada, in relation to the proposed earthwork of the Huron and Ontario Ship Canal. He rightly there says that the price of labour (and he might also have added, materials) in those countries is much higher than it is in England; for wherever large public works are in progress there, the price of labour mounts up to 75 per cent. in the first year of operation above its normal condition in ordinary periods. The labour, too, is of a very miscellaneous and hybrid character, and composed of such diverse nationalities, that it takes five men, skilled and unskilled, there to do the work of three here in England. This conviction has been arrived at in my mind by noting the work of 3000 men continuously for four years, grappling with about 5,000,000 cubic yards of earthwork.

About fifteen years ago I was much concerned with the working of the steam shovel (as it is called in America) at places in Upper Canada, in close proximity to the proposed ship canal. Labour became with us so scarce and so excessive in cost, and our work was so great, that we were driven to the use of the steam excavator, having four of them in use very near to each other, and sometimes two in the same cutting. They were made specially strong to order, and much improved in many of the details, as compared with the light, fragile machines which had been partially used up to that time in the United States. I have a drawing of one before me as I write, and its general movements may be described in the language of your correspondent "S." The maximum effect that I ever got out of the excavator was 26,000 cubic yards of earthwork per month, from one face or gullet, working night and day of, say, twenty hours out of the twenty-four, and averaging about twenty-two days and nights per month. But this would be in good loamy earth, and above the average of our work; 20,000 cubic yards per month was nearer our performance, even during the summer months. We considered that a machine was doing its full duty when it excavated 500 cubic yards by day and 600 cubic yards by night in summer. The night return was generally in excess of the day, as the nights were cool, and the men were more concentrated upon the work. By night wood fires were used throughout the bush, and the getting, filling, leading, and tipping all went on admirably. The cost of each steam shovel was, in 1853 to 1856, about 1200*l.* in the States and in Canada. There were in attendance upon it about eighty wagons, holding 1¼ cubic yards each, all side tips; a circular and rather rudely constructed table, to tip from, on the bank-head; and a locomotive on a 3 ft. 3 in. gauge, with two pairs of wheels coupled, costing 800*l.*, to lead away the material. There was no horse tipping, as in England, on the bank-head; all was done by hand and turntable; hence the light yard and a quarter side-tip wagons, and the possibility of tipping the stuff all right without killing horses and smashing up tip wagons, as would have been the case with 3-yard wagons (end tips), English fashion. And then such a perfect delivery of earth at the tip head, the material forming a semicircular slope in advance, composed of earth chopped up into small pieces about the size of a walnut by the steam shovel. No pushing one road in advance of the other on the tip, and leaving great trenches and cavities between, but the whole width formed at once and simultaneously. The locomotive took away each time twenty to twenty-five wagons per set easily, as nearly all the earthworks were laid out with a descending grade to the tip, and the chief duty of the locomotive was to bring back the empties. The Fairlie locomotive would, I fear, be too ponderous, complicated, and costly for earthwork and temporary roads, and her duty would have to be much greater than it has been, according to report, upon the Neath and Brecon Railway, or she would not answer the contractor's purpose. I have known those little locomotives at work in Canada, hammering away with the dirt for three months together, night and day, without cessation, so simple were they in their parts, and so easily repaired when anything went wrong.

With reference to the cost of earthwork with the steam shovel, I think your correspondent, "S.," has under-estimated the work. He thinks that 4½d. per cubic yard will get, fill, and lead for 3½ miles a cubic yard of earthwork with this apparatus. I think not; at least I never could accomplish thus much, although I narrowly watched the putting out of nearly two millions of cubic yards of earthwork with the steam shovels. Multiply these figures by four when you are in Canada, and the price then will be nearer the mark, and the material must not be unusually hard or stony. We tried the excavator in all kinds of material (short of rock)—soil, sand, gravel, clay, and *hard pan*, which means indurated blue clay in your description of the ship canal. This latter material (hard pan) can only be attacked by the steam shovel in its upper layers, say, for 10 ft. to 20 ft. in depth; for as you descend into it, it becomes so tough and intermixed with stones and boulders, that it shakes the machine from stem to stern, and often breaks it down. In some sections of this earth the average duty of the machine would be about one shovelful in from three to five minutes, and the stoppages from breakages incalculable. I have known this material, where human labour has been at work upon it, to average in cuttings only two cubic yards per man per day, taking all the men employed about the cutting into the average. I have taken boulders out of it weighing 3 tons, the teeth of the shovel picking round them most carefully to prevent the machine breaking up. Blasting does less duty upon it than upon rock, and I base this opinion on shots which I have fired in this material up to an extent of 1500 lb. of powder. So woolly, tough, and stony is the hard pan (or, as you call it, indurated blue clay) of Upper Canada—and you meet it almost everywhere at from 10 ft. to 20 ft. below the surface—that it is much better to have to deal with rock at once, and save your slopes. As to the behaviour of hard pan in embankments or on the slopes of cuttings, it is simply unmanageable; the weather, rains, and frost of Canada melt it away under exposure, and it runs about like so much liquid blue paint, filling up ditches, drains, and formations.

The great incentive to the use of the steam excavator is not so much that in America it does its work cheaper than by manual labour, but it does it more expeditiously, and this is especially the case where there is a great bulk of earthwork in one spot, which governs the completion of the works. The excavation is wholly done in gulleting, 45 ft. broad, and 20 ft. to 25 ft. deep, and according to the depth of the cutting, so there can be placed one machine at the top of the other, and slightly in advance, in galleries, with distinct roads running to each. It is thus that a cutting can be operated upon much faster than by any manual method. One has only to imagine 25,000 cubic yards of earthwork coming out of each face per month, instead of the ordinary 10,000 cubic yards, to estimate the rapidity of the work. In Canada, with men-worked cuttings, the average does not reach even 5000 cubic yards per month. Then, with the steam shovel we must remember that it is all gulleting (the heaviest work in excavation), and the slopes can be thrown down and trimmed up after the line is running; or where there is a very deep cutting being got out in galleries, the wings can be filled into back wagons by hand. I have known a section of 25 miles of railway, of very heavy work, having upon it one and a half million cubic yards of earthwork, besides other heavy works, begun and completed in five months, owing entirely to steam shovels, which, cutting under other conditions, would have taken two years to complete, and in this instance saving an interest of more than 1000*l.* per day on capital then expended upon works which awaited this piece of line to make them productive and stop the contractors paying further interest.

Yours truly,

London, January 27, 1867. Pioneer.

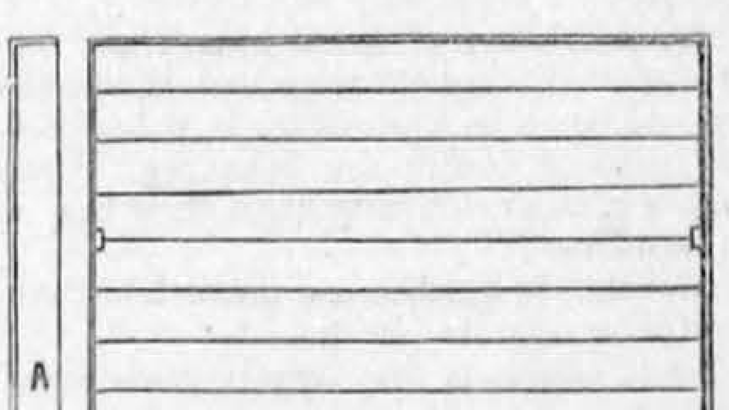
PAVED STREETS.

To the Editor of Engineering.

Sir,—No one who has watched the tedious process of paving a London street, and who is at all acquainted with the great public inconvenience occasioned by any lengthened suspension or diversion of the usual traffic, and who, moreover, has seen the subsequent too rapid destruction of the fair road-surface then presented, can conclude that the existing system is either scientific or satisfactory; and it must be allowed that any suggestions which are calculated to expedite paving operations, to preserve the surface fair and uniform, and to diminish the dust and dirt upon it, are entitled to careful consideration.

There can be little doubt that the reason why a paved street presents, after a few months' traffic over it, the unevenness of surface which is now everywhere apparent is to be found in the small bearing of each individual stone upon the surface of the road beneath, so that those stones which are the least firmly upheld by the pressure of the stones around them are driven downwards by the weight of the traffic into the under surface of the road. Hence those numerous depressions which so constantly call for the paviors' attention, and which tell with such unpleasant effect on all passing vehicles. The first object, therefore, to be sought is an extension of the bearing surface, and this it is proposed to attain by forming the paving-stones into blocks, of any required dimensions, by means of iron plates or shallow troughs. By uniting those blocks when in place, it is evident that the bearing surface might be indefinitely extended, and the whole paved surface supported.

The accompanying sketches will serve to show the plan proposed:



A A is an iron plate (buckled, if necessary), with the sides turned up square and lapped together, thus forming a shallow trough or box, say, 3 ft. square, 4 in. deep, and ⅛ of an inch in thickness, and filled with granite paving 5 in. thick, carefully laid in 3 in. courses, and well grouted. The advantages such a system presents over that now in use are:

1st. *Rapidity of execution*, and, in consequence, diminished interference with traffic. This is sufficiently manifest when it is considered that each block, or plate, will cover an area of 9 square feet. It is brought to the spot ready in every respect to be put into place, and as it would weigh only about 6 cwt., very simple tackle would be sufficient to handle it. As each block is laid, it is to be at once united to the adjacent blocks by a simple arrangement, as, for instance, by the bolt and key shown in the diagram. Looking to the ease with which the plates might be laid and fixed—and they might be laid as fast as the concrete foundation of the road could be formed—it does not seem unreasonable to expect that a street might be paved by this system in one-tenth of the time at present occupied.

2nd. *Facility of removal and reinstatement.* This is also a matter of importance, looking to the interference so frequently occasioned to paved streets by gas and water companies—an interference which does great damage, as it not only breaks up the paving immediately interfered with, but tends to loosen and destroy the bond in all the paving adjoining. With the plate system, however, the removal of any part might be readily effected, and would in no way affect the stability of that remaining.

3rd. *Permanent smoothness of road*, and therefore reduced draught and wear and tear to passing traffic. This is consequent on the distribution or enlargement of the bearing surface. In fact, the whole of the plates being securely fastened together, and resting upon, not rammed into and breaking up, the carefully formed foundation of the road beneath, present, as it were, a solid sheet of paving, which would be subject merely to the slow process of deterioration of its upper surface from the proper detrition of the stone.

4th. *Comparative freedom from dust and dirt.* This is due to the small number and extent of the joints in the plates as compared with the joints in ordinary paving (viz., as 1 to 4), and to the fact that the plates rest upon, and do not break up or penetrate, the surface of the road beneath; so that if the existing filthy and disagreeable state of the streets is (as has been asserted, and seems most probable) to be traced mainly to the working up of the road-foundation between the joints of the stones as they are being constantly driven down into it, the system here proposed presents a method whereby the nuisance may be very greatly mitigated, if not actually reduced to a minimum.

5th. *Durability and consequent economy.* The greater durability of this road over those now laid is evident from the consideration of what has been advanced under heads 3 and 4—viz., the preservation of evenness of surface, and the little interference occasioned to the under surface, or foundation, of the road. As to the first cost, little if any difference would exist between the ordinary granite paving, 9 in. thick, bedded in concrete, and granite paving, 5 in. thick, laid in iron plates or troughs, as suggested. The latter, however, would require little or no maintenance, as there would be no pot-holes to lift and make up; but the most important points attaching to the economical consideration of the question are those already advanced—viz., the diminished interference with the public convenience and traffic and the greater durability secured. It may also be added that, as all the plates are brought to the spot filled and ready for laying, the cost might be reduced to a minimum by the preparation of the blocks at those places where the union of cheap labour and storage, and facility of carriage, offer the greatest advantages.

William Dennis.

106, Cambridge-street, S.W.,
January 20, 1868.

FUTURE ENGINEERS.

To the Editor of Engineering.

Sir,—In an article entitled "Our Future Engineers," which appeared in your issue of the 10th inst., you compare the practical education of English engineers with the more theoretical one which their Continental brethren receive, and you seem to give the palm to the latter system; and no doubt to a certain extent you are right; but what I fear is, that the present movement in favour of a more theoretical and mathematical education for young engineers will be carried too far, and the practical part of the question slighted, and, in my opinion, no greater mistake could be committed.

Some years ago I resided in Hanover, where, as you are aware, there is a very large and celebrated polytechnic school for the education of engineers. With some of the students I became very intimate, and I was surprised to find that young men of twenty-two and twenty-four years of age, who intended to become mechanical engineers, were almost entirely ignorant of the construction of a steam-engine, and when I showed them a working model which was out of order they had not the least idea how to repair it; but at the same time they could perform, with greatest ease, most extraordinary gymnastics with algebraical symbols, and *talk* any amount about formula, chemistry, &c. At twenty-five these young men would leave that school, almost entirely ignorant of anything of a practical character, though they were *supposed* to spend a portion of their vacations in some foundry or manufactory. Now compare these German students with young men of the same age in an English civil or mechanical engineer's office, and how frequently will you find the latter occupying positions either as resident engineers, having practically the sole charge of most important railways or waterworks, or sent to the other side of the globe to fix and work steam-engines and other extensive machinery.

I do not for one moment deny the absolute necessity for every engineer to possess a certain amount of mathematical and other theoretical knowledge of the subjects connected with his profession; but do not let the time devoted to the acquisition of this knowledge occupy too much of that time at present devoted to acquiring that *practical* experience on the works and in the workshop, which is at present one of the greatest characteristics of an English engineer. Let a boy intended for the profession be thoroughly well grounded in the elements of mathematics while he is at school, which will enable him as he grows up to read and understand the elementary books on professional subjects, and then, if he is worth anything, he will find out how *useful* such knowledge is to him, and he will strive to improve himself in his leisure hours; for, excepting to a few peculiarly constituted minds, mathematics are not interesting until their use and application is discovered.

Hoping that your efforts to improve the education of the rising generation of engineers will meet with the success they deserve, and apologising for the length of this letter, I enclose my card, and am,

Yours, &c.,

January 25, 1868. C. H. B.

ELECTRICAL RESISTANCES.

TO THE EDITOR OF ENGINEERING.

SIR,—The following Table of diameters and resistances of pure copper wires may not perhaps be unacceptable to electrical students and others.

The capacity of pure copper is taken at 100, and the unit of resistance used is the ohmad adopted by the Electrical Committee appointed by the British Association, one unit being equal to 1760 yards, or 1609.31 metres, of copper wire .2302 in. diameter.

The va lue of the Table consists mainly in its being a standard by which the student is enabled to ascertain the conducting power of any wire he may have to test, and also of its giving relative lengths of pounds and kilogrammes, and proportional diameters in decimals of inch and millimetres.

It is perhaps unnecessary to say that there no better apparatus for obtaining tests than the electric balance manufactured by Mr. Becker, of Messrs. Elliott Brothers.

Diameter in decimal parts of an inch $\left(d=\sqrt{\frac{C}{l}}\right)$	Diameter of m.m. $(=d\times25.4)$	Number of yards per lb. $\left(l=\frac{C}{d^2}\right)$	Number of metres in 1 kilo. $(=l\times2.016)$	Resistance in ohms of pure copper (unit of length 1760 yds., or 1609.31 mtrs.)
.2302	5.847	2.095	4.223	1.0
.226	5.740	2.175	4.384	1.038
.198	5.029	2.834	5.713	1.352
.183	4.648	3.317	6.680	1.583
.175	4.445	3.628	7.314	1.731
.160	4.064	4.34	8.75	2.068
.136	3.454	6.007	12.11	2.867
.128	3.251	6.781	13.671	3.237
.107	2.717	9.705	19.555	4.623
.10	2.54	11.11	22.398	5.30
.092	2.336	13.125	26.46	6.266
.08	2.032	17.36	35.00	8.288
.07	1.778	22.67	45.71	10.82
.065	1.651	26.29	53.00	12.25
.0625	1.587	28.472	57.40	13.59
.06	1.521	30.864	62.223	14.73
.058	1.473	33.03	66.588	15.76
.056	1.422	35.432	71.431	16.91
.054	1.371	38.104	76.818	18.18
.052	1.32	41.091	82.839	19.61
.05	1.274	44.444	89.60	21.21
.048	1.219	48.225	97.222	23.02
.046	1.168	52.51	105.86	25.06
.044	1.117	57.39	115.70	27.39
.042	1.066	62.98	126.96	30.06
.04	1.016	69.444	140.00	33.14
.038	.965	77.16	155.50	36.72
.036	.914	85.766	172.91	40.92
.034	.864	95.29	192.10	45.48
.032	.813	108.5	218.74	51.79
.03	.762	123.46	248.90	58.93
.028	.711	141.72	285.71	67.65
.026	.660	164.36	331.35	78.46
.024	.609	192.9	380.26	92.08
.022	.558	229.56	462.80	109.58
.02	.508	277.78	560.01	132.59
.018	.457	342.94	691.36	163.69
.016	.406	434.03	875.00	207.17
.014	.355	569.51	1148.10	270.58
.012	.305	771.60	1555.50	368.30
.01	.254	1111.11	2239.80	530.35
.0095	.241	1231.10	2481.90	587.64
.009	.228	1371.7	2765.30	654.75
.0085	.216	1537.8	3100.20	734.05
.008	.203	1736.1	3500.00	828.67
.0075	.190	1975.3	3982.20	942.84
.007	.177	2267.6	4571.00	1082.4
.0065	.165	2629.9	5300.00	1225.3
.006	.152	3086.4	6222.30	1473.1
.0055	.139	3673.1	7404.90	1753.2
.005	.127	4444.4	8960.00	2121.4
.0045	.114	5487.0	11062.00	2619.0
.004	.106	6944.4	14000.00	3314.7
.0035	.088	9070.3	18285.00	4329.4
.003	.076	12346.0	24890.00	5892.7
.0025	.063	17777.0	35838.00	8485.6

The foregoing Table is sufficiently comprehensive, embracing every size of wire likely to be used; but should the student have an intermediate size, he can obtain the diameter for himself as follow:—d (diameter) $=\sqrt{\frac{C}{l}}$, l being the length in yards per lb., or $d=\sqrt{\frac{.111111}{28.472}}=.0625$, corresponding to one of the diameters in Table. The value of C is 1.9th, or .111111.

An easy method of obtaining the conducting power, P, of copper wire, assuming the experimentalist to have ascertained the accurate diameter by the above formula, is to test for resistance, r, by means of the balance above referred to, and the conducting power, $P=\frac{R}{r}\times100$.

As a familiar example, one mile of .0625 copper line has, say, a resistance, r, $=16.5$ ohms; the value of R in Table $=13.59$; hence $P=\frac{R}{r}\times100=\frac{13.59}{16.5}=82.36$ per cent. of pure copper.

I am, Sir, yours respectfully,

WALTER HALL.

Telegraph Works, Mansfield-street, Borough-road, S.E.

THE LABOUR QUESTION.

TO THE EDITOR OF ENGINEERING.

SIR,—As one of those who take a deep interest in all that relates to the prosperity and success of our manufacturing industries, I have thought a good deal over certain articles of your own on the subject of workmen and wages. I have also read several speeches, made recently by great authorities, on technical education; nor have the reports of the Royal Commissioners on Trades Unions been overlooked, nor those made to the Society of Arts by the artisan deputies who were sent to the Paris Exhibition. I possess also considerable experimental acquaintance with English workmen and their ways.

Endeavouring, then, by the light thus gained to discover some reason for the increasing success of foreigners in their competition with English manufacturers, I arrive at a conclusion which I believe would be secretly acknowledged to be true by many who dare not speak out their belief. It is this: that the British workman (speaking generally) will no longer give a fair day's work for a fair day's wage.

By this, I mean that wages have been unduly and artificially raised to an exorbitant point, whilst the quality of the service professed to be rendered has deteriorated. As examples of the excessive rise, I may mention mechanics who now are paid 32s. to 36s. per week in place of 24s. to 28s., bricklayers and building operatives who receive 33s. where they used to receive 27s. In the cotton trade, lads used to work 69 hours for 6s.; now they, at the same work, get 10s. for 60 hours; women who used to get 8s. are now paid 12s., and men who used to work for 14s. now earn 20s. So that, taking into account the shorter time as well as the higher rates, the cost of labour has been increased about 50 per cent. within the last fifteen or twenty years.

Of course, work-people will say that a proportionate increase has taken place in the cost of living, of provisions, of clothing, and of rent.

This, on the whole, I deny to be so, or at least not to anything like the extent stated.

Meat is now at a fair average price. Wheat is rather high at 67s. 4d.; but between 1841 and 1857 we had five years when the price averaged 70s.; and for the whole seventeen years the average was 55s., whilst for eight years, from 1858 to 1865 inclusive, the average was only 47s. Tea, sugar, and nearly all the groceries are cheaper than ever, whilst vegetables are really as cheap and abundant in the large towns as in the country. Wool and cotton are rather below than above an average price; and the manufacturers of both staples into goods are selling their wares at a loss; so that it is only the high wages, of which I complain, that can make clothing dear. Finally, with vast sums of money seeking employment at low rates of interest, it cannot be the fault of capitalists that rents are higher. Rents are higher because a sufficiency of new houses for the increasing population is not being built. People are deterred from building by the dread of the imposition, extortion, and unfair dealing to which they will be subjected by the whole tribe of the building trades, beginning with the brickmaker, who will refuse the assistance of machinery to cheapen his part of the work; including the bricklayer, who will be fined if he perspire in hurrying to his work, who will not be permitted to use machine-made bricks, who will throw on his jacket and leave the job if his master ventures on an uncomplimentary remark about the regularity of his work; including the joiner, who will construct and fix the doors and windows in such fashion as to ensure his being sent for again to tinker up his work as soon as the tenant gets in; and including also those gossips *par excellence*, the painters and paperhangers, of whom it is commonly said, "You know when you get them into a house. but nobody knows when they will be out."

A wealthy gentleman of great experience remarked to me the other day, "We should have had thousands of cottages "built up and down in Lancashire if it had not been for the "way the building trades are behaving. Even their high "wages are a smaller difficulty than their neglectful and idle "ways of working."

No wonder that it has become proverbial that "fools build houses, and wise men live in them."

The value of houses is very largely made up of the costliest English labour. Hence high rents.

Yet we have in the newspapers numerous paragraphs about distress in the East end of London, distress in Manchester, distress in Liverpool, mingled with paragraphs recording the progress of a movement in Chesterfield to reduce the builders' hours from 58 to 54 hours per week, the latter being the time worked in Sheffield.

The Sheffield men probably obtained the advantage they enjoy by urging the expensiveness of living in a large town; and if the Chesterfield men are put on the same footing, the way is clear for the Sheffielders to revive their argument for a further reduction in hours or advance in wages.

Another paragraph records that 300 men are idling about Liverpool because only 28s. per week is offered to rivetters, and 20s. to holders-up.

Another informs us that 800 men in South Derbyshire are starving themselves and their wives, and brutally beating certain of their fellow-countrymen, in the endeavour to keep coal in that district as dear as possible. In my own neighbourhood unionist colliers are forbidden to hew more than a given stint of coal, lest any reduction should be made in their pay, this stint being the same for the wild youth who has only himself to support, and for the steady married man with half a dozen children.

These violations by artificial combinations of the free action of the laws of supply and demand are thoroughly unsound and rotten. Why does not abundant unemployed labour mean cheap labour, in the same way as abundant corn means cheap bread?—or as abundant unemployed capital means low interest? What is the use of free trade in materials, when trade in the labour that gives value to the materials is shackled and hindered in every imaginable way?

Let us take an instance of the manner in which this shackling takes place. Suppose an engineer or shipbuilder wanting six mechanics of a class where 30s. have been the wages paid in busy times. Twelve men present themselves for the job. The employer says: If you will accept 25s. you may all start work, for then I shall be able to get an order that some Frenchman will otherwise carry off. No, say the men, that's against rules. So six go to work, receive 30s. per week each, pay 10s. each to "the club" to keep the other six idle, and 9*l*. weekly is the sum received by twelve families when it might have been 15*l*.

This sort of thing is deemed manly, patriotic, a sign of good-fellowship.

Now suppose twelve fishermen offer for sale a quantity of herrings: the demand is sluggish, inadequate to the supply, purchasers at length come forward willing to take the lot at 5d. a score; but owners see that by throwing away half the fish they can obtain 6d. per score for the remainder. Accordingly speeches are made to show what an injurious influence it might have on future catches, and on other fishermen, to accept the 5d.; they end by resolving to stand firm, to insist on their rights. One who dissents is knocked down and rendered senseless until the scheme is carried out. Half the fish are destroyed, and the 6d. is won for the remainder. All other fishermen elsewhere are advised to follow their example.

This is the system which now mainly influences the rate of wages in England.

The wages now paid to a working man have to provide a good deal beyond what was necessary in old-fashioned times.

Now-a-days a mechanic must dress on Sundays in a black cloth suit, must be able to send his wife and children to the seaside for a few days in the summer, and, besides Saturday afternoon, must have a day off every week or two for his own pleasure and convenience. If he has been paid at 36s. per week, beside extras for overtime and at piecework, he will have enjoyed all these little matters, and will readily accept your dictum of Dec. 27th, that his comforts must not be curtailed.

Your scheme of the same date for cheapening the necessaries of life to a workman I consider unsound altogether, and, indeed, monstrous.

A master is to take care, in starting a manufactory in a new place, to secure freehold land sufficient to contain a complete model town; so that all the large entailed estates of our landed proprietors are to be avoided. It must have a clay subsoil, for he is to burn his own bricks. He must be a man of very large means, and a perfect "bright un" in business; for he is to combine in his own person the ironmaster, the miller, the baker, the grocer, the water company, the gas company, the brewer, the doctor, and the farmer. Church and chapel, clergyman and minister, are all in some mysterious way to cost the workman nothing.

The asylum at the end of the requirements comes in very well; but I thought, on first coming to the word, Yes, after all this we should want a lunatic asylum.

If successful, the owner would be the hugest of monopolists. If the establishment is to be owned in shares by every one concerned, you have only propounded communism over again, and that in a less practical form than it is already carried out by those American sects Hepworth Dixon tells us of, who live in little self-contained worlds, which raise all their own provisions, manufacture all their own clothing and utensils, and do everything for the benefit of the brotherhood. A strict cordon would have to be drawn around the model town, or some workman might bring in stronger beer, cheaper spirits, more attractive draperies, smarter hats and boots than the authorities chose to provide at the central store, leaving them with his wife to be exhibited in the front window of his dwelling, and to be retailed by her to those unable to resist such temptations, adding, perhaps, the inducement of credit and payment by instalments. Here we should have the "unworthy gains of shopkeeping" again, which must somehow be nipped in the bud.

Your plan is a complete reversal of the maxim that "every "man best understands his own business," and of the modern and true tendency to a division of labour, trusting to free competition for preventing capital from making usurious profits. Let us have an equally free competition in the labour market. The artificial damming up of labour in those reservoirs of idleness so approved by Mr. Ernest Jones is fraught with danger.

Trades unions are teaching our workmen that they should shun such heresy as to "serve their masters well in all things," and that he is the model workman who can "keep a job about" longest. They consider it better policy to compel a master to pay 30s. a week, even if to one hand only, than to allow him to "shop" a dozen at 1*l*. Mr. B. Samuelson said in Manchester the other day, "On almost every occasion "when I have spoken in the House of Commons it has been "in defence of our working people, and more especially of "their right to combine. But since I have visited Man- "chester, Leeds, and other places, and found what mischief "the misguided conduct of trades' unions is bringing upon "the trade of this country, I made up my mind that, what- "ever were the causes that were helping forward foreigners "at our expense, this was one of them." The present policy of English labaur generally is unsound, dishonest, and suicidal, and capital will, I hope, find its way to "equal "skill and cheaper labour," wherever existing.

Yours truly,

COSMOPOLITAN.

THE TRIESTE GRANARY.—In our last number it was inadvertantly stated that Mr. Devaux, the inventor of the ventilating granary, was the *engineer* of the Trieste granary. Although that granary was constructed on Mr. Devaux's system, the detail plans were designed by M. R. Paulus chief engineer, and M. Flattich, architect, of the South-Austrian and Lombardo-Venetian Railway Company; and the works were carried out under their immediate supervision.

PAYTON'S CYCLOIDAL WATER-METER.

FIG. 1.

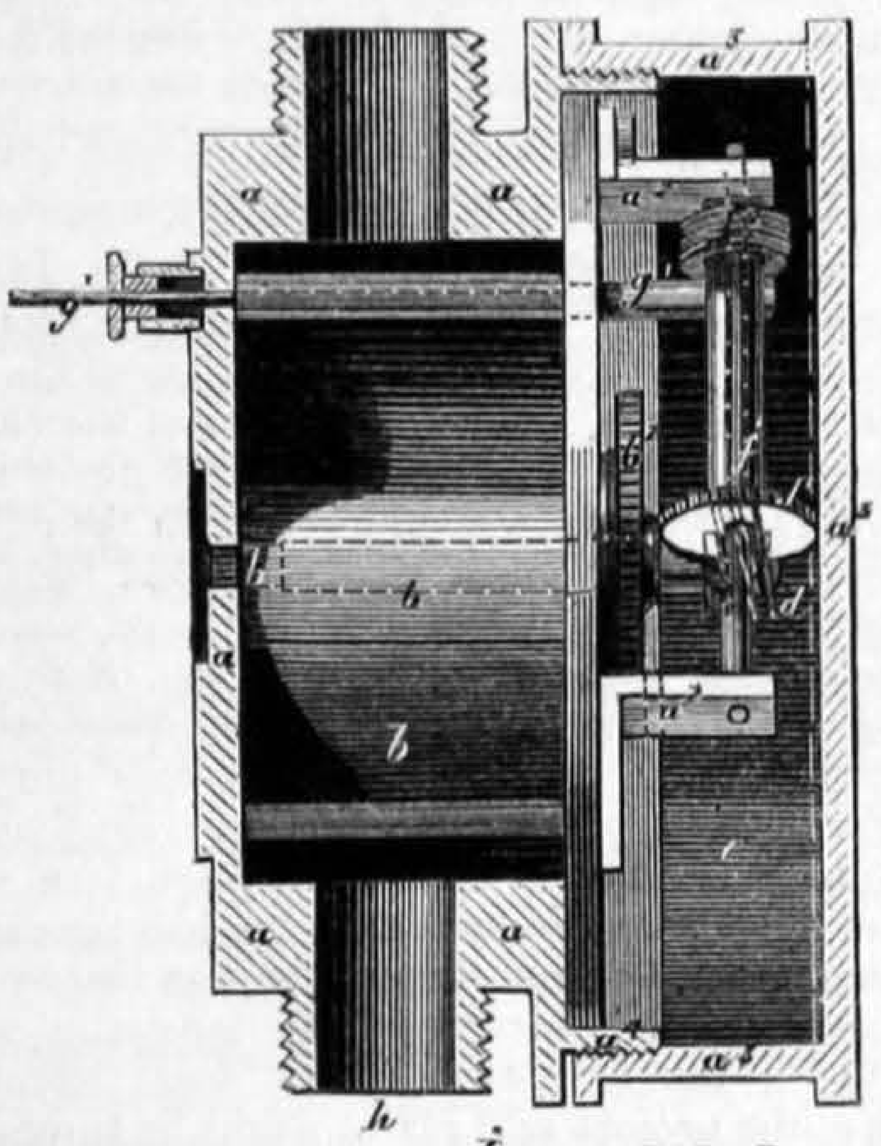


FIG. 2.

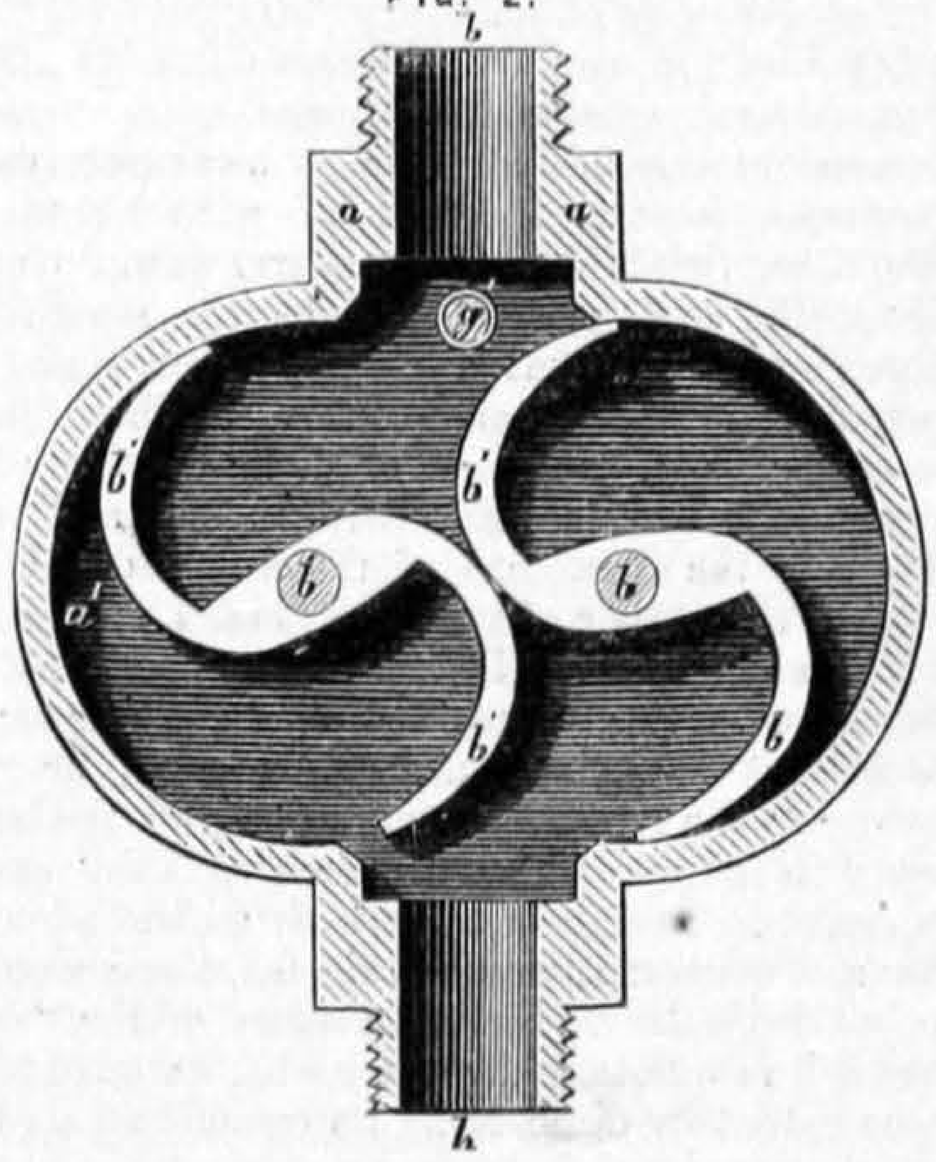


FIG. 3.

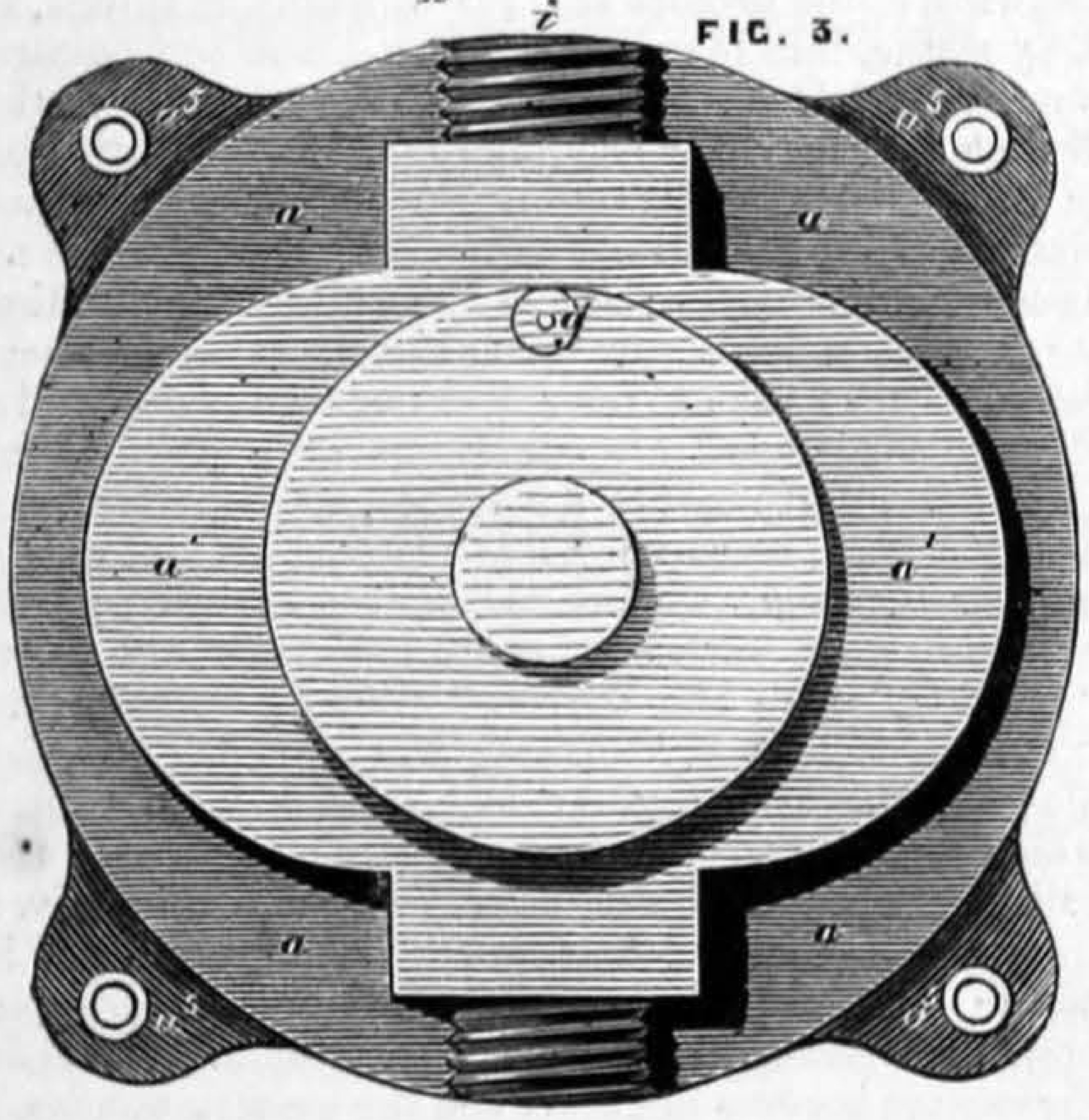
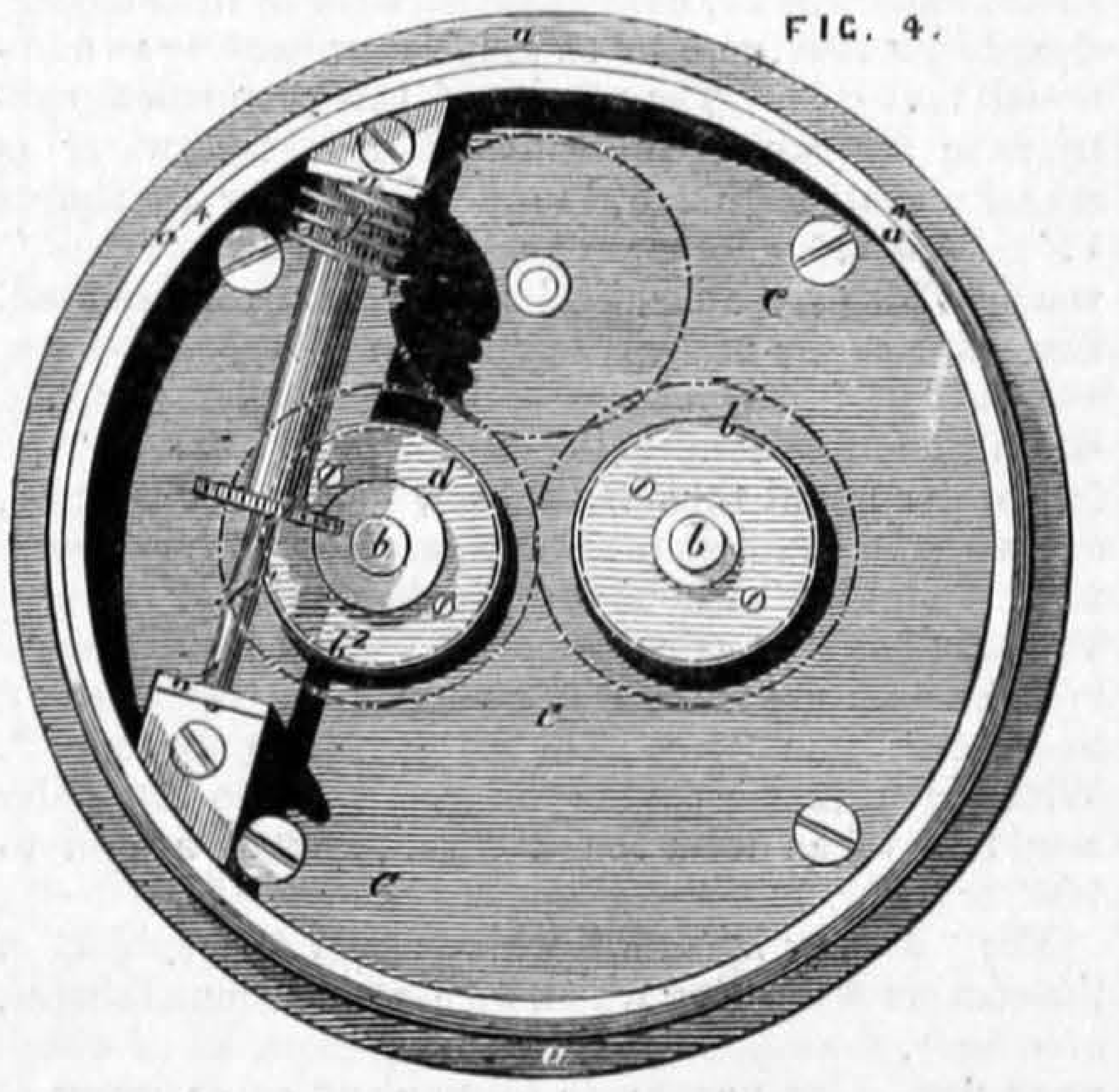


FIG. 4.



PAYTON'S CYCLOIDAL WATER-METER.

WE represent, in the above engravings, the simple water-meter designed and patented by Mr. Walter Payton, and which, under the name of Payton's Cycloidal Meter, is now being manufactured by the Liquid Meter Company (Limited), of 238, Kingsland-road. Mr. Payton's meter was exhibited at the late Paris Exhibition, and it was employed by the jurors to measure the feed water in the course of their experiments on the steam boilers in the English department. In order to ensure exactitude in these experiments, Mr. Payton's meter was submitted to a series of tests to determine whether it gave accurate results under various conditions of pressure and amount of delivery; and these tests, to which we shall refer again presently, appear to have given very satisfactory results.

Referring to our engravings, it will be seen that the meter consists of a main casing, a, in which is formed the chamber a^1, of the form shown in Fig. 2. With this chamber the inlet and outlet pipes, h and i, communicate, and through it pass two axes, $b\,b$, each of which carries a pair of vanes, b^1. One end of each of the axes, b, is supported in a recess formed in the casing, a, whilst the other ends of the axles are carried by passing through holes formed for them in the plate, c, which also serves on that side to enclose the chamber, a^1, and form a plane surface for the vanes to work against. The vanes, b^1, it will be seen, are not radial, but are of a curved form, the curve of each gradually progressing from near its axis to its outer extremity, where it moves against the inner surface of the chamber, a^1. The curve of the vanes is such that those on one axis work in between those on the other, the corresponding vanes on the two axes being at the same time maintained in contact with each other, as shown in Fig. 2. The axes, b, are formed square at b^*, and they are there fitted into correspondingly framed portions of the vanes, b^1, so that these vanes are kept in their correct relative positions. The axes themselves are connected by the toothed wheels, b^2, and one of these wheels is capable of a slight adjustment, so that the vanes, b^1, may be made to bear correctly on each other.

Upon one of the axes, b, which projects into the chamber, e, is a worm, e, which drives the worm-wheel, f, carried by the inclined axis, f^1. This axis revolves in bearings, a^2, and it carries a worm, f^2, which gears into the worm-wheel g. The axis, g^1, of this wheel passes through a stuffing-box to the other side of the apparatus, where it carries a pinion from which the indicating gear is driven, this gear giving motion to indices which point out on suitable dials the quantity of liquid passing through the meter. The action of the meter will be readily understood from our engravings. The water, or other fluid, entering by the inlet pipe, h, drives round the two sets of vanes in opposite directions, each half-revolution of the vanes involving the discharge of a quantity of liquid equal to the capacity of a cylinder having a radius equal to that of the ends of the chambers, a^1, less the space taken up by one pair of vanes.

The trials of the meter exhibited at Paris, to which we have already referred, were conducted at the Conservatoire des Arts et Métiers, the hydraulic arrangements of that building allowing the instrument to be tested under various heads of water. The water discharged by the meter was led through an india-rubber pipe to hectolitre measures, the arrangements being such that there was no occasion to interrupt the flow through the meter whilst an experiment was being made. The results of the various trials are given in the following Table, which is taken from a report on the subject made by M. Tresca:

	Duration of Experiment.		Head of Water under which the Meter was tried.		Quantity delivered, as Measured by the Meter.		Actual Quantity Delivered.	Difference.
	hrs.	min.	ft.	in.	galls.	litres.	litres.	litres.
1st series of experiments.	1	40	12	6¾	920	4180	4200	−20
	0	19	22	6½	250	1136	1153	−17
	0	17	30	2¼	250	1136	1159	−23
	0	15	39	5¼	250	1136	1169	−33
2nd series of experiments.	1	40	12	6¾	920	4180	4203	−23
	0	19	22	6½	250	1136	1174	−38
	0	17	30	2¼	250	1136	1161	−25
	0	15	39	5¼	250	1136	1162	−26

In the course of the first experiment of the second series, the flow through the meter was interrupted, but the stoppage did not affect the accuracy of the indications. In reducing the gallons to litres, the gallon was taken as being equal to 4.5434 litres. M. Tresca, in his report, speaks highly of Mr. Payton's meter, and he considers it probable that the fact of the quantities registered by the meter being in all cases slightly less than those obtained by measurement of the discharge was due to some difference in the valuation of the gallon. In the case of the greater heads of water, the flexibility of the vanes appears to enable them to bear more closely upon each other, thus preventing, to a great extent, any increase of leakage which might otherwise take place. With regard to the above experiments, we must say that we think that it is to be regretted that they were not more prolonged, as the evidence afforded by them would then have been of still greater value.

The vanes of the cycloidal meters, which we have above described, have of course to be cut to their correct curve in the most accurate manner; and Mr. Payton has designed an ingenious machine, by the aid of which this can be done very readily. Of this machine we may probably give a description on some future occasion.

COAL IN AMERICA.—The total production of anthracite coals in the United States during 1867 is estimated at 12,750,000 tons, an increase of 250 tons over the yield of 1866. 214,000 tons of coal, mainly cannel, were imported from Great Britain during 1867.

A BISCUIT MANUFACTORY.

ENGINEERING, the most comprehensive of all professions, counts amongst its branches many of those occupations which at a former age were the every-day's labour of the household, but which have passed out of the stage of primitive hand-labour into the more economical and more productive factory work. Engineering has taken the distaff and the spinning-wheel out of the hands of women; it has made the millstone independent of human and of animal muscular power. Engineering is now taking hold of the plough, and dispensing with the horses in front and ploughmen behind this implement; and engineering again relieves the skilled hand of the baker in forming the flour into dough, and in working the ovens for baking the different kinds and forms of bread, entrusting the whole series of successive operations involved in baking to the performance of self-acting machinery.

The speciality of bread and biscuit machinery construction is limited to a very small number of mechanical engineering firms; amongst these, we believe Messrs. Stevenson and Co., of Liverpool, to be the most successful. Many of the largest bakeries in this country are fitted with their plant to the exclusion of any other machinery, and it appears that this firm constructs everything required for a machine bakery, from the steam-engine to the baking-oven. One of the finest bakeries fitted out with a complete and very modern plant by the above-named engineering firm is the bread and biscuit bakery of Messrs. Gray, Dunn, and Co., in Glasgow, an establishment employing upwards of 200 "hands," and a plant of machinery requiring 30 horse power for working it. The works occupy a building four stories high, 300 ft. in length, and about 100 ft. in width; they consume about 500 sacks of flour per week, with other materials in proportion, amongst which we name the weekly consumption of 6 tons of sugar and two thousand gallons of milk. The flour is, in the first instance, deposited in one of the upper stories. It passes through spouts or tubes into a lower story, where the sifting machinery is placed; and after that the flour passes through other tubes to the ground floor, where it is delivered direct into the hoppers of the mixing machinery for biscuit-making. Biscuits, as a rule, are unfermented bread; they therefore can be passed through the machinery and charged into the oven without any interruption of the process. The machines are for this purpose arranged in straight lines in front of each oven, and deliver their products into the latter immediately after it has received the proper consistency and form. The first machine in this series is the mixer, a cylindrical vessel of cast iron, in which a number of knives is kept revolving by a central spindle. The cutters are formed like screw-propeller blades, and their action in revolving is therefore a thorough mixing of the mass. The mass from which the dough is formed, say for ordinary ships' biscuits, is wheat flour and water; it is delivered from the mixer to the "brake," a machine which is simply a small rolling-mill for rolling a plate of dough, say, 3 ft. wide and about 10 ft. long, and of the thickness required for the special class of biscuits. This sheet is then delivered to the third machine—the "cutting-machine." This is a somewhat complicated apparatus, operating upon the principle of a multifarious punching-machine, the punches having the different regular and irregular shapes of the biscuits to be cut out of the sheet of dough. The cutting-machine faces the stove, and delivers its produce into it either by the assistance of hand-labour or by a self-acting apparatus, the latter being the more modern mode. The ovens are about 40 ft. in length and 6 ft. wide. They are worked with automatic firegrates, patented by the maker, and described in our columns on page 217, vol. iii. One oven can produce about three tons of ships' biscuits per day of ten working hours. One cutting-machine is capable of supplying this quantity of cut biscuit dough, both oven and machine working continuous. The time required for the biscuits to pass through the oven is about forty minutes, the process of baking evaporates not only all the water mixed with the flour for forming the dough, but also a certain percentage of hygroscopic water held by the flour in its apparently dry state. This loss amounts to 10 per cent. of the total weight of the flour, 10 lb. of flour yielding only 9 lb. of baked biscuits. The baking of fermented bread, which is also carried out on a large scale in these works, requires a greater proportion of hand labour, and is conducted in a more primitive manner than the manufacture of biscuits. Messrs. Gray, Dunn, and Co. export their biscuits to the remotest points of the world, and have depôts for their sale wherever British commerce has obtained a footing.

INJECTORS AND "DONKEYS."

THE feed-pump and its aorta, the delivery-pipe, are to the steam boiler and engine much the same as are the heart, and its corresponding outlet, to the human system. Even if the temporary stoppage of the former do not always amount to syncope, its prolonged stoppage must, as in the case of our own great arterial feed-pump, the heart, end figuratively, at least, as it sometimes ends literally, in death. An uncertain and untrustworthy feed-pump—and we may apply the term feed-pump generally to every contrivance for supplying a boiler with water—is the worst affliction of an engine-tenter, and the curse of an engine-room.

Nearly all so-called "donkey pumps" are more or less uncertain in action. Their own frictional resistances bear a large proportion to the force expended in working them, as may be easily proved by the comparatively high pressure of steam required to run them "light." Indeed, this is also proved by the very proportions adopted for the working parts of donkey pumps. Although the pressure to be overcome by the pump-ram is practically the same, per square inch, as that of the steam admitted upon the steam-piston, yet the area of the steam-piston is seldom less than three times, and it is frequently four times, that of the pump-ram. The ram, too, forces only while moving in one direction; yet for "sucking," in the other direction, a steam area of from twice to three times that of the pump-ram is commonly provided, and worked with steam of full pressure, and this, too, when the feed-water would flow into the pump almost by its own gravity. The steam expended is, therefore, from five to seven times that theoretically due to the resistance opposed to the entrance of the feed-water into the boiler. We say "theoretically," to show how great must be the friction of donkey pumps, and the losses of effect due to starting and stopping the column of water perhaps 100, and in some cases 200, times a minute.

In these respects all donkey pumps appear to be alike, all requiring to work them an amount of steam enormously disproportionate to the useful work done. Their mechanical efficiency may be taken, according to the quality of their workmanship, and the care with which they are packed and "fettled," as from 15 to 20, or possibly 25, per cent. at the utmost.

In this respect, *i.e.*, that of mechanical efficiency, we are not speaking at random. Within the last two years a donkey pump so objectionable in its plan, and so dangerous in its action, that we are not sure that an Act of Parliament should not be passed to interdict its use, has been nursed by one of the mechanical newspapers, and, mainly through persistent puffing, foisted upon what is known as the "engineering trade." In the last number of the journal in question we find another puff, in the guise of a leading article of nearly two thousand words, and in this, for once, we find actual data of the working of the so-called "donkey injector." These data are vouched for upon authority which we have no desire to dispute, and the result is pronounced "excellent." The result is not given in the usual term of "pounds of coal per horse power per hour," but the elements whereby it may be referred to this useful standard *are* given, and they show that, if we take a pound of coal to evaporate an average of 7 lb. of water, the "excellent result" of this "donkey injector" consists in an expenditure of nearly *thirty-five* pounds of coal per effective horse power per hour! The data rest upon the authority of a gentleman whose name is given, and of whose disinterestedness we have no doubt, although he has given a favourable certificate as to the working of the wasteful contrivance in question, and this, apparently, because it has not in his case, as it has frequently done in others, stuck fast while it ought to have been pumping.

The "excellent result" which the "donkey" puffer —we do not like to say "puffing donkey"—records is this: In feeding a boiler worked at 58 lb. pressure, each pound in actual weight of steam passed through the steam-cylinder of the "donkey" forced 61.34 lb. of water into the boiler against the same pressure of 58 lb. per square inch. Now 61.34 lb. of water (nearly a cubic foot) are equivalent to 1700 cubic inches, and the water thus forced in by 1 lb. of steam may be considered, therefore, as a column of water one square inch in section and $\frac{1700}{12} = 141.7$ ft. long. In forcing this column of one square inch section, as if it were a bar of iron, or a piston of the same area, into a boiler, against a resistance of 58 lb., $141.7 \times 58 = 8219.7$ foot-pounds of work would be performed. Now, as a pound of coal, as fired under ordinary boilers, will evaporate 7 lb. of water into steam, the work done, at the same rate, by 7 lb. of steam would be 57,538 foot-pounds; and as an hourly horse power is $(33{,}000 \times 60)$ 1,980,000 foot-pounds, it would require nearly 35 lb. of coal, at this rate, to give off an hourly "horse power." There are, we believe, engine-makers in existence—although we trust their number is not great—who are so unable to turn out engines saleable at any price, except to purchasers wholly ignorant of what steam-engines should be, that they (the makers) would be glad to obtain the endorsement of even the most incapable newspaper-writer that a carefully ascertained and responsibly verified consumption of 35 lb. of coal per horse power of useful work done per hour was an "excellent result"! Excellent, indeed, and only surpassed by the excellence of the knowledge and judgment of the author of such a profound conclusion.

Yet, supposing but little steam to be wasted by condensation in this "excellent donkey injector," that discharged from the exhaust pipe might be made to restore to the feed-water very nearly all the heat contained in the steam used in working this "excellent" apparatus. In this case, as with Giffard's much simpler and more trustworthy injector, there would then be but little loss. So the makers of the "excellent donkey" in question have concealed its wastefulness to some extent by discharging its exhaust steam through a feed-water heater, consisting of a series of tubes enclosed in a tank, and by so much representing an additional first cost. The results of this economical contrivance are wonderful indeed. The feed-water is actually heated from 67° to nearly 78°, or by almost 11° This is another equally "excellent result," vouched for by the identical authority already quoted. Inasmuch as the original temperature of the feed-water was but 67°., it is manifest that the boiler supplied steam to a non-condensing engine, and that all the feed-water might thus have been heated for nothing, and with the simplest possible apparatus, to very nearly 212°, and that without any donkey injector at all! The result is "excellent" indeed. Even had Giffard's injector been used, the water might have been heated by waste steam direct from the engine to above 100°. With a condensing engine the feed-water to the boiler would be taken from the hot well, already heated to 100° or more.

The "donkey injector" which forms the subject of the continuous puffing which we have mentioned shares, of course, the faults of all donkey pumps, all of which work with disproportionate friction and other losses of effect, while nearly all of them are uncertain of action. The special donkey under notice is, however, the worst of all in this respect, and that for reasons which any engineer's apprentice may easily perceive. In all fly-wheel donkey-pumps there is an irregular but regularly recurring antagonism between the reciprocating and revolving parts. The tendency of the former, after the initial resistance to the movement of the pump ram has been overcome, is to move through at least equal spaces, if not, indeed, through progressively increasing spaces, in equal times, while the fly-wheel, so far as it can control the pump-ram, acts to check its motion towards the ends of its strokes. This antagonism is expended upon the connecting-rod of the donkey pump, and the connecting-rod should therefore work, as in the ordinary engines, in a plane coincident with the axis of the piston-rod. In the "excellent" donkey injector under notice, however, the connecting-rod is bent sideways, like one tine of a pitchfork; and although it is of but a few inches length, and is of light section, the crank-pin is about 6 in. to one side of the centre line of the pump. The veriest tyro in steam engineering would instantly perceive that such a connecting-rod must work at a disadvantage, while a mechanic of the old school would probably insist that it could not work at all. The fact is that where all the parts are in perfect order, so far as packing and easy fitting of the wearing surfaces are concerned, the pump often actually *does* work, and that, too, for a considerable time; but that where, as is often the case, no skilful nurse is constantly at hand, the apparatus sticks fast, and that oftenest when the stoker, having, as he believes, put all to rights, has just turned his back for a moment to get a mouthful of fresh air at the door of the boiler-house. The "donkey injector" illustrated and persistently puffed in *The Engineer*—that made by Brown, Wilson, and Co.—a distinction necessary for the credit of Messrs. Tangye, Messrs. Appleby, Mr. Cameron, and other makers of donkey pumps—has often thus stuck fast, and we are frequently hearing of fresh instances of its failure. We only regret, in the interests of employers of steam power, and for the safety of all engaged about steam boilers, that those who have already been disappointed with this "excellent" and so shamelessly bepuffed contrivance do not care to have their names publicly disclosed. Were there no hesitation upon this point, we could at once give the names of a good number of firms who have experienced great inconvenience from this dangerous apparatus, while some have had to remove it altogether, as no doubt every user of it will be compelled to do in time.

IRRIGATION IN SIND.

IT is notorious that the engineers of the Indian Government do not, especially in the formation of works intended to increase the production of the soil by means of irrigation, follow in the track of the native hydraulic engineers of former years. Scarcely anything at the present day will go down with the authorities except canals, although we know that formerly many districts were, and some are even now, watered from wells and tanks. The former of these are, doubtless, the least expensive mode, where practicable, of furnishing water to the soil; and canals are the most expensive, especially when heavy head-works have to be constructed. In Sind there is a vast amount of hidden wealth concealed beneath the sandy dry surface of her soil, and it would appear that by the application of a certain amount of labour in well-sinking, with the assistance of but little scientific knowledge, the present arid plains might be turned, as if by magic, into luxuriant gardens. This was pointed out by Mr. J. W. Barnes at the last meeting of the British Association, when describing his investigations in Beloochistan and Western Sind. The subject has since been brought to our notice by a paragraph in an Indian contemporary; and as the subject of irrigation throughout India is now under consideration, we cannot do better than to refer it to our own pages. Mr. Barnes commenced his operations at a place about eight miles north-east of Kurrachee, where, after some weeks' labour, he succeeded in piercing the first water-bearing stratum, whence the water rushed up and overflowed the surface, "continuing, without intermission," says the *Overland Friend of India*, "to the present time." Water was obtained at other places in the arid country, and springs were visited which are from sixty to three hundred feet above the valleys. The source originally, of course, is derived from snow or rain. The desert country of Sind is often spoken of as destitute of rain; but the fall however, averages about 4 in. per annum. Between the eastern borders of Persia and the western boundary of the Sind and Punjab valleys is a tract of country 330,000 square miles in extent, with a mountainous and humid area, from 3000 ft. to 12,000 ft. above the sea level, from which a considerable subterraneous supply of water must be derived. Granting an average annual rainfall of 3.75 in. over this area, and as it is known that in every country a portion of the rainfall, estimated at from one-third to one-twelfth, is absorbed by the permeable strata, a vast body of water is available over the whole of the region between the thirtieth parallel of latitude and the Indian Ocean. It it recorded by navigators that large springs of fresh water burst up through the sea in the neighbourhood of Cape Ormury, The formation of this part is, undoubtedly tertiary. The theories and customs of the native well-searchers and sinkers of India are well worth study, and in Sind we now see that an excellent opportunity presents itself, which, it is to be hoped, will not be lost sight of. In the present general movement in favour of irrigation, the province of Sind has a just right to claim its share of attention and expenditure from the newly formed irrigation branch of the Public Works Department. The subject has, we are aware, already been referred to by the Director-General of Irrigation, and it is to be hoped, therefore, that the reclamation of the present sandy wastes of that province may not now be deferred till "a more convenient season."

OUR LAST NEW KNIGHT.—Professor Wheatstone, upon whom it is said the Government is about to confer a title, was appointed Professor of Experimental Philosophy at King's College, London, in 1834. He was associate of the Ordnance Select Committee at Woolwich during the Crimean war, from 1855 to 1859, and a member of various other Government commissions. He has received the degrees of D.C.L. and LL.D. from the Universities of Oxford and Cambridge, and is corresponding or honorary member of all the principal scientific academies of Europe. He is also a Chevalier of the Legion of Honour, and has received two gold medals granted by her Majesty and awarded by the Royal Society for attainments in physical science. He invented the concertina, the stereoscope, and the solar clock. He was the originator of the submarine telegraph, and his researches in electricity conduced mainly to the introduction and development of the electric telegraph in its present practical form as employed in this country. His latest invention is an apparatus for conveying instructions to the engineers and steersmen on board large steam-vessels, which has received the favourable consideration of the Admiralty.

PUBLISHER'S ANNOUNCEMENT.

We publish, this week, a two-page coloured lithograph of the imperial Saloon-Carriage on the St. Petersburg and Moscow Railway. The plate is carefully folded in every copy of ENGINEERING *leaving this office; and news-agents must be held responsible for its delivery with the rest of the paper. No copies of the plate will be sold apart from the paper.*

Advertisements cannot be received for insertion in the current week later than 5 P.M. *on Thursday. The charge for advertisements is three shillings for the first four lines or under, and eightpence for each additional line.*

The price of ENGINEERING *to annual subscribers, receiving stamped copies at places three miles away from the General Post Office, is* 1*l.* 1*s.* 8*d. If credit be given, the charge is* 2*s.* 6*d. extra, subscriptions being payable in advance.*

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS. — *Tuesday, February* 4, *at* 8 P.M. 1. "*Floods in the Nerbudda Valley, with Remarks on Monsoon Floods in India generally.*" *By Mr. A. C. Howden, Assoc. Inst. C.E.* 2. *Discussion upon* "*Freshwater Floods of Rivers.*"

SOCIETY OF ENGINEERS.—*Monday, February* 3, *at* 7½ P.M. "*On the Surveys of Proposed Lines for a Ship Canal between the Atlantic and Pacific Oceans.*" *By Dr. Cullen.*

ENGINEERING.

FRIDAY, JANUARY 31, 1868.

RAIL-MAKING IN RUSSIA.

FOR some years great efforts have been made by the imperial Government to provide the numerous railways constructing in Russia with native-made rails. Whilst the principal reason influencing the Government is no doubt one of protection to "home trade," and a giving way to the cry of "Protect our manufacturers," still, they have also another very valid cause, viz., the very bad quality of the rails supplied of late years, not only by the Belgian, but also by English makers. Some of the rails supplied by the best known makers in Wales have been the veriest rubbish makable. The price may be blamed, 7*l.* 2s. 6d. per ton delivered at Cronstadt; but still it is no credit to our English name, and has led to a general cry of "No more English rails."

The Government have, during the last three years, made the most persistent efforts to establish rail mills in various parts of the country. For many years—say twenty—rails have been received from the Demidoff and Yakovleff works, in the Ural; but the quality was too good, the Siberian iron seemed too soft, or the manufacturers do not seem yet to have been able to manipulate it properly. The price the Siberian manufacturers obtained, 1.50 per pood (=13*l.* per ton at exchange of 33d.) for delivery at Moscow or some other point involving nine to twelve months in delivery from date of fabrication, was not relatively high.

Two years since the Railway Department arranged with the Department of Mines that they should, at the Kama-Votkinski Works, commence rail-making. These works draw their supplies of ore and wood fuel from their own neighbourhood, and have also large supplies of ore available from the Ural by water. Being on the Kama, a river which joins the Volga at Kazan, they have water-communication direct with Nijni, Moscow, Petersburg, and other very important points. The rails produced are of very fair quality; the price of delivery at Moscow or other towns in water-communication is equal to 13*l.* per ton. At this price these works will in future supply the Grand Russian Railway Company with all the rails required for the line from Moscow to Nijni-Novgorod—410 versts.

The Department of Mines is now busily engaged preparing to make rails at a second works in quite another direction. In the district of Baxmouth, in the government of Ekatcrinoslaff, not far from Taganrog and the Don district, not only has been found there good ironstone, but also good fluxes, various descriptions of coals, other than anthracite, besides which wood is not dear. At present these works are only projected, although the blast-furnaces are built, and money has been voted for the erection, in the ensuing summer, of the works. The same department have good mechanical works at Lugan, not far from the proposed rail mill. Any railway from the Crimea to Kharkoff must go through this district, and in 1869-70 Kharkoff will be most probably in railway communication with both Moscow and Odessa. It is also a project to go from Voronege to Taganrog, but this is not yet definite. It is said that Prince Koutchobey is at this moment abroad, in London or Paris, with a view to form a company and take up this district as a private enterprise, which the Government rather favours. These works would supply the southern lines.

The, so to speak, Midland lines will look for a supply to the works now being established by the Russian Vichsounsky Ironworks Company (Limited)—a company now building at their principal works a rail mill, having last year made with the Government a contract for the supply, during a series of years, of about 25,000 tons per annum. The price equals 13*l.* per ton for delivery at Moscow, or at other named points, costing about the same for delivery. It is said the company will commence making rails in July of this year. The ore from which the iron is made at Vichson is of very various qualities, and will give the technical director, Mr. Mackenzie, every chance of producing a good rail; but all his energy, and all his economy in the production, coupled with the assistance of Mr. Barry, the director in charge, will, we fear, not leave a profit for some time to the company. If it does, it will be most creditable to the parties concerned; for they have to obtain their ore by old methods, each man working in shallow pits alone; their wood gets dearer every year, and, until the mode of delivery is improved, that will be a serious charge. When, however, fully in work, they will produce 600 tons, or thereabouts, per week.

The lines having their termini in St. Petersburg are to be supplied partly by Finland, and partly by works in the more immediate neighbourhood of the town. In Finland, the Government have made a contract with Mr. A. J. Pootecloff, the eminent metallurgist, for *seven* years, to deliver from 300,000 to 400,000 poods per year, at 1.45 per pood—say 50,000 to 60,000 tons, at 13*l.* per ton. The delivery commences in 1869, and the Government make large advances to put the works in a condition to supply the rails. One curious condition of this contract is, that the Government may demand to have, instead of iron rails, Bessemer steel or puddled steel. In the latter case Pootecloff agrees to supply puddled steel rails at 20*l.* per ton, guaranteed for twelve years, to be taken back at 9*l.* per ton. The price for Bessemer is left open, to a certain extent, because of the difficulty of coming to an arrangement with Messrs. Bessemer; the parties concerned not wishing, on an uncertainty, to be liable to large payments.

A second contract, just made, provides for the re-rolling of old rails at the St. Petersburg Ironworks; the old rails being taken at 3*l.* 15s. per ton, and new ones delivered at 13*l.* per ton. These rails are to have tops of puddled steel; the manufacture has already commenced, and during 1868 at least 50,000 tons will be delivered.

In addition, the Great Russian Railway Company are preparing their works at the Petersburg terminus for the rolling of rails, which they will do this year, most probably commencing by the re-rolling of old rails. They will probably, from June, do about 300 tons per week.

In the event of the line from Moscow to St. Petersburg being sold, it is fully understood that one of the chief conditions will be that the purchasers shall make the rails for the remount of the road in Russia, or buy them from Russian manufacturers. Messrs. Winans have agreed to this clause.

The Government are quite prepared to pay the high prices named in the foregoing, rather than import foreign rails, and from, probably, a most erroneous view of the principles of Adam Smith, who is much read and prized by many Russians.

In many concessions now being granted for railways, the Government reserves to themselves, for a certain time, the supply of the rails and also the rolling stock. No definite arrangements have as yet been made with respect to locomotives—the railway department being seemingly afraid to grasp it with sufficient energy—possibly because the right men do not come forward: all their offers as yet have been too small to warrant any one in establishing a shop for building locomotives.

Railway carriages—say baggage-cars, trucks, cattle-cars, goods-wagons—are being produced in Moscow, at the works of Mr. R. O. Williams, an American gentleman, at the rate of about 1000 per year. Besides this large factory, there are now in existence that of Colonel Strun, at Kolomna, on the Riazan line; at Riazan, that of the Kosloff and Riazan Company; and at Moscow, that of the Moscow and Riazan line. At Jula the southern line will have large shops for repairs and car-building.

In several late concessions the Government has inserted a clause that the cars must all be made in Russia. The cost of cars may be in Moscow, as compared with that from abroad, about equal; so that further off competition with abroad ceases. In St. Petersburg, the nearness of access has not as yet made it possible to build at the price of importation.

St. Petersburg, January 15, 1868. H. B. F.

BOILER-FEEDERS.

IT would hardly require a nice experiment to prove that the muscular force expended in eating and drinking bears but a very small proportion to that which the human frame is capable of otherwise exerting. A physical analogy may possibly be acknowledged here, when we say that the resistance opposed to the entrance of the feed-water into a steam boiler, the resistance being measured in foot-pounds and at the point where the delivery-pipe joins the boiler, amounts in many cases to hardly the one-thousandth part of the power which the steam generated in the boiler is capable of exerting. Thus a boiler worked at 30 lb. steam, and supplied with 40 cubic feet of water per hour, suffices for an engine working (with a fair rate of economy) to one hundred indicated horse power. Yet the resistance opposed to the entrance of 40 cubic feet of water per hour, or ⅔ cubic feet per minute, against a pressure of 30 lb. per square inch would require but .0875 horse power to overcome it, this being less than the one-thousandth part of the useful power of the boiler, and corresponding to the consumption of about one-third of a pound of coal only per hour. As the pressure in the boiler is increased, so, of course, must be the power required to inject the feed-water; but even with a locomotive boiler worked at 120 lb., and evaporating 160 cubic feet of water per hour, but 1.4, or less than 1½ horse power, would be required; and if the engine was running 30 miles an hour, this would correspond to a consumption of about ⅛th lb., or, say, 2½ oz. of coal per mile.

Over and beyond the resistance opposed to the mere entrance of the feed-water within the boiler—a resistance which is calculable in the same manner as if the inflowing current were a solid bar of metal of the same sectional area, and thrust in with the same velocity—there are additional resistances which occur within the forcing-pump, injector, or whatever apparatus may be employed to feed the boiler. In no other case are these additional resistances and the consequent loss so great as with quick-working pumps, especially of the class commonly known as donkey-pumps. In many of these less than half a pint of water is taken up at a stroke, and the water is churned into the boiler at the rate of from 100 to 200 strokes per minute. The direction of the water within the pump is thus changed three, five, or seven times a second, in addition to the work of opening the valves with the same frequency. The pump-barrel, too, seldom if ever completely fills with water in sucking, and there is thus a blow of the ram, at every stroke, upon the water. Every mechanical engineer will understand how inevitably a loss of power must result from this cause. In one of the most objectionable forms of donkey-pumps yet presented to the public—that made by Messrs. Brown, Wilson, and Co.—the pump-barrel does not fill, at each stroke, by from one-sixth to one-fifth of its full capacity, even when working at moderate speeds, say 140 revolutions per minute. Mr. Anderson, of Erith, has made a careful series of trials of this pump of the following sizes, viz., 4 in. steam-cylinder and 2¼ in. pump-ram, with a stroke for both of 3¾ in. The water space or contents opened in the pump-barrel at each up stroke is thus 14.91 cubic inches. In a trial of 28 minutes 10 seconds, the pump making an average of 143¾ revolutions per minute, giving a total number of 4049 revolutions, 1740 lb., or 174 gallons, of water were pumped. The quantity required to fill the pump during the same time would be $\frac{14.91 \times 4049}{27.7123} = 2178$ lb., or nearly 218 gallons, thus showing that the pump filled but for 3 in. of every

$3\frac{3}{4}$ in. stroke, leaving the ram to move $\frac{3}{4}$ in. through broken water. At a higher speed the result would necessarily have been worse.

It is because of these sources of loss, and from the great frictional resistances of donkey-pumps, that they require such an excessive amount of steam to work them, an amount indicated by the very proportions given to the steam-piston and pump-ram. Thus the former is from three to four times the area of the latter, although the pressure per square inch, irrespective of all resistances apart from that opposed to the mere entrance of the water into the boiler, may be the same on both, as both communicate with the same boiler, and the steam to the donkey is not always throttled. Even for the up stroke or sucking-stroke of the ram an annular steam-piston area from two to three times greater than its own, is provided, so that the whole expenditure of steam may be from five to seven times greater than is represented by the useful work done. We have shown, in another article, how well this general view of the wastefulness of donkey-pumps is confirmed by Mr. Anderson's experiments, in which one of Brown, Wilson, and Co.'s pumps forced in but 61.34 lb. of water against a pressure of 58 lb. per square inch, for every pound, in actual weight, of steam used, a result which amounts to a consumption of 35 lb. of coal per horse power of effective work done per hour—assuming, as we do, that one pound of coal produced seven pounds of steam.

It is true that the exhaust steam of this wasteful instrument may be turned into the feed-water, and thus be virtually restored to the boiler, but with non-condensing engines the feed-water is better heated by the exhaust steam from the main engine. The water may thus be heated at once to 212 degrees, or as hot as it can be pumped. In this case seven-eighths of all the steam worked in the donkey-pump would be lost, having done no useful work. With a condensing engine, too, nothing practically would be gained by throwing the exhaust steam from the donkey into the water flowing from the hot well, inasmuch as not the one-twentieth part of that water is again taken into the boiler. To derive any advantage from the waste steam from the donkey, even in a condensing engine, a separate feed-water heater would be necessary, and this, of course, adds to the cost.

The mode of action of Giffard's injector is that which is calculated to feed the water into the boiler with the least loss of power. The fact that the water is moved in a continuous stream, instead of being changed in direction from three to seven times a second, and churned by rapid blows, constitutes an obvious advantage over any form of quick-working pumping apparatus. Of the further advantage possessed by the injector in having no moving parts we need say nothing, as it is sufficiently plain to all. At first sight, too, it would appear to work without any loss of steam whatever, since this is wholly condensed in the entering feed-water, which is by so much warmed. There must be, however, a further condensation than that due merely to the mixing of the steam with the water, viz., the condensation due to the work actually done in forcing in the water, including the overcoming of its frictional resistance in the passages of the apparatus. The work done, exclusive of the last-named resistance, is readily calculable; and in low-pressure boilers it may, as we have seen, form less than the one-thousandth part of the work done by the engine which the boiler supplies. The frictional resistance in the contracted passages is not so readily calculable, but it may be readily shown to be comparatively moderate in amount. In steam fire-engines the velocity of the escaping jet is often as much as 100 ft. per second, while in Giffard's injector, when forcing against a boiler pressure of 120 lb., equal to a column of water 276 ft. high, the greatest velocity required to generate a force sufficient to overcome this head is but about 134 ft. per second. This is known also, by the rate of delivery and size of nozzle, to be about the actual velocity in an injector working against 120 lb. pressure. Now we know that the pressure requisite in the air-vessel of a steam fire-engine to eject water through an orifice, irrespective of any frictional resistance, must be for a velocity of 100 ft. per second at least 68 lb. per square inch, inasmuch as this is the pressure of a column of water of the height (156 ft.) requisite to generate that velocity. Now, the actual pressure within the air-vessel, when working at the velocity of delivery often attained by steam fire-engines, is commonly from 90 lb. to 110 lb., or but one-half greater than that theoretically due to generating so high a rate of velocity, even when all sources of loss are disregarded. The power expended varies as the pressure generating a given velocity, including all resistances in the channel between the air-vessel and the nozzle of the branch-pipe. In general terms, the fact must be the same in the nozzle of the injector. The additional steam due to overcoming the friction could hardly, from the closely analogous evidence thus afforded, exceed that theoretically required to deliver the water at the point where it enters the boiler, as already calculated. Even were the loss by friction thus as great as the whole of the useful work done, the injector would still have an advantage of about four to one, or would, in other words, consume in total work but one-fourth as much steam as the donkey pump already noticed. We are not, of course, speaking of steam condensed by mere mixture with the feed-water; for this is all returned to the boiler, but of the further condensation of steam in doing work, and which is thus, so to speak, dynamically condensed, and which represents the real steam expenditure of the instrument.

There are two experiments which those concerned in introducing the injector should make, and the results of which they should give to the public. Both are exceedingly simple, and they would settle points which now form the subject of some dispute. The first is to ascertain the frictional resistance to the moving column in the injector. This trial would be the easiest possible. No steam would be employed to work the injector, but, instead, a strong air-vessel would be fitted to the inlet water-pipe, and a jet of water be driven through the injector by means of a force-pump worked to a sufficient pressure. As soon as the jet, forced by means of a pump working against a high pressure in the air-vessel, once entered the boiler, a comparison of the pressures, as shown by steam-gauges on the air-vessel and in the boiler, would at once show the relative frictional resistance in the injector. If the injector were the wasteful contrivance which Brown, Wilson and Co.'s pump unquestionably is, the gauge on the air-vessel should show a pressure from seven to eight or even ten times greater than that in the boiler, or, say, from 840 lb. to 1200 lb. per square inch where the boiler pressure was 120 lb. Our own opinion of the actually necessary pressure in the air-vessel would be that it would not exceed, if it reached, 240 lb., in which case the jet would be injected into the boiler, and that with but about one-fourth the power required to work the famous "donkey injector." Were there no frictional resistances, an air pressure of 240 lb. per square inch, corresponding to a head of water of 552 ft., would give an effluent velocity of about 188 ft. per second, which would, of course, be far more than would be necessary to force the water into a boiler against a pressure of 120 lb. In any case, the proportion of useless work to the useful work done would be as the excess of pressure in the air-vessel compared with the boiler pressure.

The next experiment should be that of applying the injector to draw from a measuring tank a given quantity of water of known temperature, and to exactly measure in a receiving vessel, under a fixed atmospheric pressure, the quantity and temperature of the water so received. The difference in quantity between the water drawn up and the water delivered would represent the steam condensed in the process, and from the difference in the temperature of the water drawn and the water delivered an estimate could at once be made of the loss of heat in useful and useless work. In the discussion upon his paper on injectors, read at the Society of Engineers, Mr. Olrick quoted an experiment by M. Villiers, of St. Etienne, in France, the alleged result of which appears to be too good to be true. M. Villiers drew 1700 lb. of water at 70° from a measuring tank, and delivered it by means of the injector into an empty boiler loaded with atmospheric pressure to 60 lb., the steam pressure acting upon the injector being also 60 lb. The water received in the boiler was 1807 lb., showing that 107 lb. of steam had been condensed. Its temperature was 140°, so that there were originally $1700 \times 70 = 119{,}000$ pound-degrees in the feed-water, and $1807 \times 140 = 252{,}980$ pound-degrees in the water delivered, the difference being 133,980 pound-degrees. Now this, divided by 107 lb., the steam which only could have produced the change in quantity and temperature, would give 1252° for each pound of steam, which is even more than it could have given out, inasmuch as steam of 60 lb. pressure has but 1175° of sensible and latent heat, and in cooling down to 140° could give off but 1035°. This at least is the only way in which established data enable us to deal with the question. If the experiment of M. Villiers can be repeated in this county with the same results—and the experiment is very easily made—we shall hear no more of loss of effect in the injector, nor see monstrously wasteful and unquestionably dangerous patterns of donkey-pumps persistently puffed in the newspapers.

COMPOUND INTEREST.

The subject of railway expenditure, involving the wide question of railway economy, is intimately dependent upon questions of compound interest; yet while this is well known to railway men, they sometimes apply the calculation of compound interest in the wrong place, and so as to cause a positive loss to the property under their care. It is now practically established as a fact, that one quality of a certain class of railway material, although twice as costly at the outset as another, is six times as durable. Hence, one would naturally suppose, the dearer material would be much the cheaper in the end. But by calculating the compound interest upon the increased cost, and supposing the material to last for, say, fifty years, or even for ever, if that were possible, certain railway men succeed in satisfying themselves that the final cost of the better material becomes so great as to outweigh all its other advantages. The fact is, however, that no question of compound interest really enters into the matter at all. Railway companies do not borrow money at compound interest, but at simple interest; and the payment also of dividends to shareholders is, so far as its relation to capital is concerned, precisely the same as the payment of simple interest upon debentures. It is easy to say that *if* such or such a sum were funded at compound interest for so many years it would produce so much, but neither railway dividends nor interest payments *are* so funded. Whatever the individual shareholder might do with his dividends, these, so far as the company is concerned, form a yearly (although variable) rate upon capital, and twenty years' successive dividends of, say, 5*l*. each per share amount to 100*l*., and to no more. In a case which was assumed in our leading article last week, a ton of material costing 14*l*. was estimated to last forty-eight years, where a ton of a different and inferior material for the same purpose cost 7*l*., and lasted but eight years. The superior material bears a yearly interest charge, at 5 per cent., of 7s. more than that upon the inferior material, and this amounts, in forty-eight years, to 16*l*. 16s., and to no more, although were the same excess of cost (7*l*.) funded at compound interest, it would make a very much larger return. In one case a total, of principal and interest, of 47*l*. 12s. lasts for forty-eight years, being less than a pound a year, while in the other a total of 9*l*. 16s. lasts for eight years, being 24s. 6d. a year, besides an average annual charge of 2s. a year for "relaying" at the end of every eight years.

When, however, a railway company establishes a specific fund for renewals, this may be, and commonly is, invested at compound interest. In this case, if a ton of new steel rails cost 7*l*., in addition to a ton of old steel of the same value, $8\frac{1}{2}$d. added yearly to a fund at 5 per cent. compound interest will return 7*l*. in forty-eight years, whereas it would require 7s. yearly for eight years to return 3*l*. 10s.—the difference in price between a ton of new and old iron rails. If, however, a railway company chose to fund the original difference in cost, say 7*l*., at compound interest, they would have either to borrow the money at, say, 5 per cent., and thus pay an annual charge of 7s., or, which comes to the same thing, withhold that amount from dividends. At the end of eight years, 2*l*. 16s. would thus have been paid in simple interest or withdrawn from dividends, and then, also, 3*l*. 10s. would be required for renewing, and 15s. relaying, making 7*l*. 1s. in all, while the original fund accumulated at compound interest would amount to 10*l*. 7s., leaving but 3*l*. 6s., or less than one-half that originally put aside, to be put at interest for the second period of eight years. It is evident that such a fund, thus subject to periodical and heavy drains would soon be exhausted—long before the steel rails would require renewal.

That our correspondent, F. F.—who will be recognised by his initials as being one of our leading permanent way engineers—has fallen into a grave error in his mode of calculating the cost of rails will be evident by reference to his own table. In this he gives the cost of iron rails up to the end of the first period of eight years as 11*l*. 16s. 5d., and up to the end of sixteen years as 24*l*. 1s. 6d., and so on. Taking out from the table the costs of the rails during the successive periods of eight years, we thus have:

		£	s.	d.
During 1st period of eight years	...	11	16	5
„ 2nd „ „	...	12	5	1
„ 3rd „ „	...	18	1	6
„ 4th „ „	...	26	13	2
„ 5th „ „	...	39	6	5
„ 6th „ „	...	57	19	7

—so that, supposing F. F.'s calculation to be correct, during the sixth period of eight years the rails would have cost about five times as much as during the first eight years, although the same amount of work would have been got out of the rails, and they would have cost the same price per ton.

TO CORRESPONDENTS.—Owing to the pressure on our space, we are compelled to leave over, until next week, a number of letters which are in type.

THE PERKIOMEN RAILWAY BRIDGE.—The Perkiomen Railroad bridge across the Schuylkill has been contracted for by A. B. Burton and Co., of Philadelphia. The structure will consist of three spans of 170 ft., and one span of 125 ft.; total length, 635 ft. The bridge is to be built on the plan known in America as the "isometrical truss."

TRIAL OF A 10 IN. ARMOUR-PLATE.—A fair honest fight between armour-plating and guns took place on Tuesday, on board the Thunderer target-ship, in Porchester Creek, in the upper waters of Portsmouth harbour. The plate was from the rolling mills of Messrs. John Brown and Co., Atlas Steel and Iron Works, Sheffield, and was no less than 10 in. in thickness, by 15 ft. in length and 3 ft. 9 in. in breadth. It was selected as a "test" plate from a score of plates manufactured by Messrs. Brown for the central broadside armour of the turret-ship Monarch, 5100 tons, 1100 horse power, building at Chatham. The plate was bolted on to a wooden backing of upwards of 4 ft. in thickness, supported by iron and oaken beam struts of immense strength. The gun was the ordinary test gun—95 cwt. 68 smooth-bore, but on this occasion fired with 16 lb. in lieu of the ordinary 13 lb. of powder. The distance between the muzzle of the gun and the face of the armour-plate was 25 ft. Nine shots were fired, and all struck the plate within a square space of 34 in. The greatest indentation made was only 1.7 in., and the least 1.5 in.; no cracks, surface or otherwise. The trial, indeed, gave the plate an extraordinary degree of credit. It was the first 10 in. plate tried on board the Thunderer; but, in comparison with a series of 8 in. and 9 in. plates previously tested on board, its resisting powers to the impact of shot was very much in excess of what was simply due to its exceptional thickness. The plate is now being taken down from its backing on board the Thunderer, and will be sent round to Shoeburyness, where it will be further experimentally tested with the 10 in. rifled gun and *maximum* charge of powder.

PUBLIC WORKS IN ITALY.—Public works are dragging on slowly in Italy, and trade very bad, as the premium on gold is 14 to 15 per cent. There are various railway schemes on the boards, but all waiting for money. On the Ligurian line the Porto Vado tunnel, 1200 metres in length, is nearly finished, as is also the section of railway between Vado and Spotorno. The works of the Piazza del Duomo, in Milan, which have been suspended during the winter, are shortly to be resumed, the City of Milan Improvements Company (Limited) having effected a loan of 3,000,000 francs with a bank there. A project for a canal for the irrigation of Lombardy, to be derived from the Lake Maggiore, has been brought forward by Signor Tatti. A scheme for the water supply of Venice, the water to be brought from the river Sile, near Treviso, is soon likely to be commenced. The works of the Spezzia tunnel are likely soon to be resumed. This tunnel is about 3500 metres in length.—*From our own Correspondent.*

RAILWAY TRAINS.—In 1866 the distance run by railway trains in England and Wales attained the astonishing aggregate of 117,313,154 miles, or 22,000,000 miles more than the distance separating the earth from the sun. The distance traversed by Scotch railway trains in 1866 was 17,680,579 miles; and by Irish railway trains 7,814,120 miles. The aggregate distance run by railway trains in Great Britain and Ireland in 1866 was thus 142,807,853 miles, as compared with 139,527,127 miles in 1865, showing an increase in 1866 of 3,280,726 miles. To the total of 142,807,853 miles set down for 1866 passenger trains contributed 73,383,356 miles, and goods trains 69,424,497 miles, showing an increase in 1866, as compared with 1865, of 2,176,538 miles in the distance run by passenger trains, and of 1,104,188 miles in the distance run by goods trains.

THE COTTON TRADE.—The average deliveries of cotton from Liverpool to the trade thus far, this year, have been no less than 58,050 bales per week, as compared with 33,400 bales in the corresponding period of 1867 and 36,700 bales in the corresponding period of 1866. The average weekly consumption of cotton in the United Kingdom, in 1867, was 49,090 bales, as compared with 46,850 bales in 1866. The trade has thus been gradually extending its operations during the last twelve months.

ANOTHER STEAM LINE.—The Belgian Government has just concluded, for a period of ten years, a contract with an English company for the establishment of a service of steamers every month between Ostend and Brazil. The directors of the enterprise are Messrs. Tait and Co., who have recently established a monthly service of steamers between London and Brazil. The concern will be known as the London, Belgian, Brazilian, and Rio Janeiro Steamboat Company; and four ships, of from 1600 to 1800 tons each, will be put upon the line, viz., the City of Limerick, the City of Buenos Ayres, the City of Brussels, and the City of Rio Janeiro. The contract which has been just concluded with Belgium takes effect in March. The company's ships will run from London to Ostend, and then *viâ* Falmouth to Brazil.

NAPIER *v.* POOLEY.

TO THE EDITOR OF ENGINEERING.

SIR,—I must trouble you with a few remarks on the account of the case Napier *v.* Pooley in your last week's issue.

First as to the height of the water in the boiler, and the length of the return pipe from the anti-primer. You say that Mr. Gray discovered that when the water was half-glass, the bottom of the return pipe was half an inch above the water level, and the latter was ⅝ in. above the top of the tubes; and I don't dispute this statement, but I reply that when I first saw the boiler I learned from the engine-driver that the usual practice was to keep the water near the top of the glass, and I afterwards saw for myself that it was oftener a good deal above the top of the glass than below it, and on the first day that Messrs. Kennedy, King, and Hodkinson were present, I believe the water was at least 2 in. above the top of the glass, and within 7 in. of the crown of the boiler, for the upper cock of the gauge-glass gave quite solid water when full open; on seeing which Mr. Hodkinson, not knowing, as I did, that it was of frequent occurrence, spoke to the engine-driver and to one of the Messrs. Pooley against it, on the ground that it was not giving the anti-primer a fair chance; this did not elicit any hint that the object of keeping the water so high had any reference to the anti-primer.

Again, you say that one reason that actuated Messrs. Pooley in refusing to pay us was that they considered that the apparatus, as applied, had increased the priming; but the above took place on the 17th of December, after the anti-primer had been twelve weeks in use, and we had not then received, nor did we, till the second day of the trial, receive, any intimation that the so-called priming was supposed to have been increased; for the fact is, as Mr. Gray allows, that it was an idea of his after the anti-primer had been disconnected (in Christmas week, I believe), and the notion was inferred from his having collected from the end of the steam-pipe next the cylinder 10 lb. per hour while the anti-primer was at work, and only 5 lb. (4 lb. according to Mr. Chater) from the same place after disconnecting it. Now a strong effort was made by the defendants' counsel to make it appear that I had examined the boiler and engine before applying the apparatus with the view of seeing what there was to cure, and that it was applied mainly, if not altogether, to cure evils which I myself saw; but Mr. Gray's experiments and deductions reduce the curable evil to some portion of 5 lb. per hour, and according to the salt experiment mentioned in your second and last paragraph, and which, it must be recollected, was not tried till after disconnecting the anti-primer, three-fourths, at least, of this 5 lb. was condensed steam, leaving at the most 1¼ lb. per hour, or *an ounce every three minutes* of unvaporated water escaping with the steam, and which I think might very probably have passed up in the shape of spray when the passage was direct, though at the time there was strictly no priming. Of course, if this were gold-dust it would be worth collecting; but is it conceivable that I applied a pipe 9 in. diameter to allow an ounce every three minutes to flow back to the boiler? For, according to Mr. Gray, all the rest of the nine or eleven gallons per hour was probably condensed steam. But, even if I had mistaken the whole of the eleven gallons per hour for priming, should I be fit to be at large if I were to be at considerable trouble and expense fitting a 9 in. pipe in a confined space for the passage of less than 2 lb. of water per minute, when an inch pipe would have done ten times the required work? The reason I did put in a 9 in. pipe was that with a boiler of nearly the same power, but with 12 in. to 15 in, of steam room, I had frequently found a pipe equal in section to a 7½ in. pipe not large enough for taking away the priming water separated from the steam by my arrangement.

Of course we should have carried the return pipe lower, if we could have done so without blocking up the end by being too close to the tubes; but it will be seen, from what I have said, that there was not the least occasion to alter the usual level of the water.

One word as to the trial. You say that Mr. Gray was stopped by our counsel from giving evidence of the shortness of the return pipe. But that was only in his cross-examination; our counsel had no power whatever to prevent that evidence being given by Mr. Gray on his examination in chief, and if the defendants neglected to get a barrister sufficiently of an engineer to understand the case, whose fault was that? Both of ours, after a short consultation, understood the case, at least, as well as the majority of engineers, and I maintain, without fear of contradiction, that neither of them asked a foolish question, either in consultation or in court.

In conclusion, allow me to say that I think it would have been much wiser on the part of the defendants if they had acceded to our reiterated request, backed in court by the urgent appeal of the judge and jury, to allow the case to be referred to some unbiassed practical engineer, when each party could have suggested experiments for the elucidation of the question.

Apologising for troubling you with so long a letter on an article which, on the whole, I feel obliged to you for inserting, as, with the few corrections herein, it completely establishes the correctness of the decision of the jury; but thinking I am entitled to have these corrections made,

I am, Sir,

Birkenhead, Jan. 28, 1868. R. D. NAPIER.

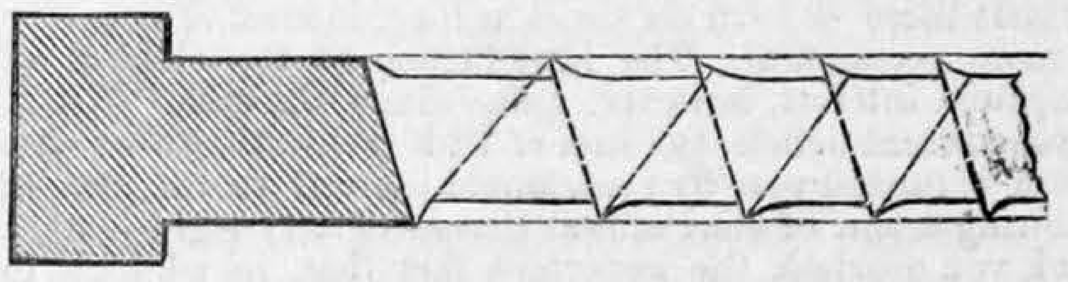
[A "separator" identical in principle with Mr. Napier's has long been applied by Mr. Penn to the larger marine engines made by him, and a similar apparatus is applied, in an excellent form, to the boilers at the Lambeth and Chelsea Waterworks.—ED. E.].

COAL IN CHINA.—There has been some discussion of late at Shanghai with reference to vast coal bearings which are said to exist in the southern provinces of China. The extent of these bearings is estimated at no less than 87,000 square miles. A confirmation of these calculations, even to a moderate extent, would completely change the character of the Celestial Empire. At present coal does not cost much less than 3*l.* per ton at Hong-Kong or Shanghai.

RAILS, CHAIRS, AND THEIR FASTENINGS.

TO THE EDITOR OF ENGINEERING.

SIR,—I was interested (on perusing my last week's ENGINEERING) to find you had a correspondent offering such sound and practical remarks in reference to rails, chairs, and their fastenings. It is, in my estimation, as important to ask the question, What is the best method to be adopted for fastening chairs? as to ask, Whether is steel or iron best adapted for rails? I do think, with "Old Platelayer," there has been no improvement offered as yet for securing chairs. I have frequently noticed the twisted spike or pin has started, and I fancy the "twist" has little if any hold, and, if held in an inverted position, presents the form of a piece of square bar, and can really have little or no hold, as it is merely *driven* into the wood sleepers; and the yielding tendency of sleeper and earth, when the weight of each succeeding carriage is passing over it, "rocks" it loose, and



raises it "partly" out of its presumed secure and resting place; and if the purchase was increased, it would be "wholly" lifted out. Dampness causes the wood to expand, but there is nothing on a twisted pin to enable the swelling of the wood to grasp. It ought, therefore, to be narrowly looked into. If it were possible to get a thread twisted round or raised on a bolt or pin like a joiner's ordinary screw-thread, only at wider spaces apart, I am of opinion an improvement is then arrived at, as they could either be driven or screwed in. The wood would expand while receiving it, and moisture would cause the body of wood between each thread also to swell, whereby it would be sure to grasp more firmly, and make it more secure. Supposing they then start, one turn with a screw-key would tighten them—an improvement over the others, I think.

Hoping you will give this insertion in your next issue, I am your humble Subscriber, RUSTIC.

COALS ON THE PACIFIC COAST OF AMERICA.—Coal exists at various localities along the Pacific coast from Russian America to Patagonia, and is now mined to a limited extent. But all these coals are of later date than the true carboniferous, and appear to be the production of periods from the jurassic to the tertiary. They are of all grades of the bituminous class, from the mineral pitch, or asphaltum, to anthracite. But, under present circumstances, these deposits of coal are invaluable to the commerce of the Pacific.

THE 3 FT. 6 IN. GAUGE IN AMERICA.—The Montreal *Trade Review* says that two railroads, the Toronto, Grey, and Bruce, and the Toronto and Nipissing, are to be undertaken next season, both on the narrow-gauge system—3 ft. 6 in.

COAL FROM EAST SIBERIA.—A cargo of about 220 tons of Saghalien coal has been imported into the San Francisco market by Freeman, Smith, and Co., from the island of Saghalien, East Siberia. It has been practically tried by some principal blacksmiths and foundrymen, and proved to be of superior quality, both for steam and forging purposes, and it is thought that it will become a regular and valuable article of importation, as its high cooking qualities, freedom from sulphur, and nature of the ashes (its forming no slag), speak strongly in its favour. We subjoin an analysis made by the Pacific Chemical Works. Specific gravity, 1.288; volatile combustible matter, 35.70; fixed carbon, 56.45; moisture, 1.8; earthy matter, 6.05; gas evolved by 10 lb. avoirdupois; coal, 32 cubic feet.

A HIGH-LEVEL GOLD MINE.—A gold mine in the deep valley of the Alps, near Salzberg, is the highest in Europe which is now worked. There are two tunnels near this mine entirely surrounded by glacier ice. The miners of this region undergo great hardships from exposure and avalanches. It is stated by one authority that there is a locality deep within one of the iron mines of Dannemora, where the mass of ice is one hundred and twenty yards thick.

A RAILWAY TUNNEL IN ALGERIA.—The railway tunnel at Constantia, in Algeria, is finished. It is nearly 3000 ft. long.

WELL-BORING IN ITALY.—The Italian Government has lately granted three privileges for boring wells on the territories of Farnuovo, Taro, and Medesano. Two of them have been given to American capitalists.

STREET BRIDGES FOR FOOT-PASSENGERS.—We learn that the authorities of Paris have accepted a tender for the construction of an experimental iron bridge for foot-passengers for the junction of four streets. This experiment is not new, as is well known. The bridge over Broadway, in New York, has been completed for some time, but is not in very general use on account of the labour and time expended in ascending and descending. Visitors may, however, obtain a magnificent view of the street from this elevation.—*Journal of the Franklin Institute.*

ENGINE-DRIVERS IN INDIA.—The *Friend of India* says that, owing to the heat, half the engine-drivers on the East India Railway are sick. "The other day," it adds, "a train was stopped at Hooghly with the stoker dead and the driver dying.

THE NEW YORK ELEVATED RAILWAY.—The first half-mile of the experimental elevated railroad in Greenwich-street is fast approaching completion. Its constructors seem confident that the line, when finished, will be accepted, and its continuation to the Central Park authorised. It is stated that a company has been formed to build another elevated road through the city, upon a plan of Mr. H. Montgomery, who uses corrugated iron for the beams and supports. He asserts that he can complete a durable track from the Battery to Union-square in ninety days.

STEEL *v.* IRON RAILS.

To the Editor of Engineering.

Sir,—As an engineer having the responsible charge of a line of railway, and therefore always alive to questions affecting the cost of renewals, I have read with much interest the various articles in Engineering relating to the alleged economy attending the substitution of steel for iron rails. Whilst agreeing to a certain extent with the arguments in favour of steel rails, and whilst myself using them freely in parts of the line subject to heavy traffic, I cannot at present see my way to the wholesale substitution of steel for iron rails. Your statements in favour of steel rails appear to me to go somewhat too far; and I cannot help thinking that, in your last leading article on this question, you have fallen into some errors of calculation or, at any rate, of stating the question.

At first sight it appears undeniable, that if a certain article costs twice as much as another for the same purpose, but lasts three or even six times as long, it must of necessity be more economical. The introduction of the element of compound interest, however, quite alters the case. When, in your recent article, the sum of 8½d. is mentioned as that which, if funded year by year, would amount to the cost of renewing a ton of steel rails at the end of forty-eight years, I think you overlook the important fact that, in addition to providing for renewal, the *first outlay* has been accumulating at compound interest for the whole of the period of forty-eight years, and will therefore have amounted to a very considerable sum. Your second mode of illustrating the economy of steel rails, even if correct, does not appear to be so simple and easily comprehended as it might be. Surely the correct method of ascertaining the cost of rails, whether of steel or iron, for any given periods is to calculate to what sum the outlay would accumulate if invested at compound interest. As this is the sum which the owner of the rail might thus have realised, so is it the cost of his having invested his money in rails instead.

Let me put the figures in this way, which appears to be the correct one, at the same time saying that, if wrong either in the principle or its application, I shall be only too glad to be set right. I will adopt nearly the same prices as those used in your illustration.

Iron rails at 7*l.* 5s. per ton, laying 15s.; total 8*l.*; duration, eight years; value of old rails, 3*l.* 10s; nett cost of renewals at end of every period of eight years, 4*l.* 10s. Steel rails 14*l.* 5s. per ton, laying 15s.; total cost 15*l.*; duration, forty-eight years; value of old rails, 7*l.*; nett cost of renewal at end of period of forty-eight years, 8*l.*

1st. Iron rails, 1 ton at 8*l.*

	£	s.	d.
At end of eight years, at 5 per cent. compound interest	11	16	5
With cost of renewals added (4*l.* 10s.) ...	16	6	5
At end of sixteen years	24	1	6
With renewals	28	11	6
At end of twenty-four years	42	3	0
With renewals	46	13	0
At end of thirty-two years	68	16	2
With renewals	73	6	2
At end of forty years	108	2	7
With renewals	112	12	7
At end of forty-eight years	166	2	2
Deduct value of old rails 3*l.* 10s., making the total cost in forty-eight years	162	12	2
2nd. Steel rails, 1 ton at 15*l.*			
At compound interest for forty-eight years ...	156	0	0
Deduct value of old rails 7*l.*, making the total cost in forty-eight years	149	0	0

There is in this instance, therefore, some, though not a very considerable, economy in the use of steel rails. If, however, the calculation be carried on through another period of forty-eight years, the result will prove to be largely in favour of the iron rails, owing to the rapid accummulation of interest on the sum expended on the steel rails.

Let us now inquire what would be the relative economy of steel and iron rails, if the former lasted only three times as long as the latter.

One ton of iron rails, as before, lasting eight years, costs at the end of twenty-four years 42*l.* 3s., less 3*l.* 10s. old rails= 38*l.* 13s.

One ton of steel rails, as before, lasting twenty-four years, will cost 48*l.* 7s. 6d., less 7*l.* for old rails=41*l.* 7s. 6d.

In this particular instance, therefore, steel rails would cost not less, as you suppose, but more than iron rails.

A little consideration of the foregoing figures, and a few similar calculations, will show that the question of the economy of steel rails depends not merely on the *relative*, but also on the *actual* duration of the rails. Thus, there is a wide difference between the comparative economy of steel and iron when the periods of duration are, say, six years and one year, or forty-eight years and eight years respectively, although in both cases the steel has outlasted six iron rails. For example, a ton of steel rails, at 15*l.*, lasting six years, would cost 20*l.* 2s., less 7*l.* for old rails, or 13*l.* 2s.; a ton of iron rails, at 8*l.*, lasting one year only, and renewed year by year at the former rates, would cost 31*l.* 11s. 5d. at the end of six years.

These calculations support the conclusion at which I long since arrived, that in situations where iron rails wear out very rapidly, say in a few months or in a year or two, it is far more economical to lay steel rails. Where, however, iron rails last for periods of twelve or fourteen years, as they do on lines of moderate traffic or on branch lines, it would be anything but economy to substitute steel rails at present prices.

In estimating the relative advantages of steel and iron rails for station-yards, goods lines, and main lines of heavy traffic, no practical engineer will omit, in addition to the money consideration, to give due weight to the decreased risk of accident, the less frequent interruption to the traffic, and the diminished injury to the permanent-way timber, due to the less frequent renewals of steel rails.

Yours faithfully,

January 29, 1868. F. F.

"ENGINEERING AT CROYDON."

To the Editor of Engineering.

Sir,—I have read the letter in the last number of your journal, and signed "An Old Subscriber," and I take upon myself to reply to it, as the figures quoted in your article are the same as used by me in my inaugural address as President of the Society of Engineers and therefore I take this opportunity of defending my statement, which is impeached by some interested or ignorant individual.

My statistics were culled from Dr. Westall's Mortality Tables of the parish of Croydon, which, I have every reason to know, are accurately and carefully compiled. But your correspondent has the effrontery to give statistics from public documents which were not in existence at the time he wrote his letter. He tells you that, "according to the Registrar-General's returns, the death-rate was 20.9 per 1000 for the past year (1867), and in 1861 it was 17 per 1000." I have made inquiries this day (Monday) at the principal office for the sale of public documents, and also at the establishment of Messrs. Eyre and Spottiswoode, who are the printers of the Mortality Tables, and, in each case, I have been informed that the return from which the writer of the letter in question quotes is not yet in existence. This simple fact should carry with it the condemnation the writer who penned that letter so justly deserves.

The success of the works of Croydon, in a sanitary point of view, have been so great that the simple principles they practically expound commend the system adopted, to the disparagement of a whole host of nostrums that are being attempted to be forced by fair and foul means on the authorities of the towns of this country. I take it that your correspondent of last week has some motive in view in attempting fraudulently to disparage the Croydon works and Croydon system. Whatever the aim and object of his ambition may be, let him seek it by means fair and open. Fair criticism is always of value; but to confront truth with falsehood is base indeed. I have my reason for believing that your correspondent is either the author of papers in the *Medical Times*, or has drawn his inspiration from the lucubrations of the luminary who has penned certain articles which have appeared in your medical contemporary, and which are based upon an hypothesis that will not bear scrutiny; for the groundwork of the whole theory is as false as the suppositions of your correspondent.

In order that the following figures may be understood, it should be known to your readers that Croydon, and Croydon sub-district, in the Registrar-General's returns, include a number of other parishes and places, as well as Croydon parish. The sub-district which is the nearest approach to correctness includes the parishes of Addington, Coulsdon, and Sanderstead, and the hamlet of Penge. The statistics taken by your medical contemporary are based upon the supposition that the parish of Croydon has only increased between 1861 and 1867 at the same rate per annum as it did between 1851 and 1861, and hence the grievous blunders fallen into; whereas between 1851 and 1861 the population increased from 20,355 to 30,240, and between 1861 and 1867 from 30,240 to 50,755. The way in which the present population is arrived at is simply this: There are 9197 houses on the rate-books in the year; from this 370 must be deducted as empty, leaving 8827, the occupants of which pay rates; by multiplying the number of inhabited houses by 5.75, which is a number somewhat less than actually found to exist on the average in each house at the last census, we get the present population of 50,755.

The return of births and deaths I am about to quote are from the certified copies of the Registrar of Births and Deaths, as furnished to the Local Board of Health weekly, and can be verified, on inquiry, by the Registrar.

Births and Deaths for 1861.

	Population.	No. of births.	Birth-rate per 1000.	No. of deaths	Death-rate per 1000.
Croydon District ...	46,474	1465	31.52	810	17.42
„ Sub-district ...	37,093	1174	31.64	647	17.44
„ Parish (census)	30,240	1010	33.39	557	18.41
„ „ (end of year)	30,944	1010	32.63	557	18.00

Births and Deaths for 1867.

	Population.	No. of births.	Birth-rate per 1000.	No. of deaths	Death-rate per 1000.
Croydon Parish... ...	50,755	1767	34.81	843	16.60

I cannot give the death-rate for the sub-district, as the returns are not yet published by the Registrar-General. It will be seen that the mortality of Croydon parish, instead of being 17 per 1000 in 1861, was 18; and in 1867, instead of being 20.9, it was actually 16.6 per 1000. The correctness of the return is corroborated by the birth-rate, which shows by the rate of increase, as the death-rate does by the rate of decrease, the value of the sanitary operations that have been carried out in the parish. The rate of increase of the parish of Croydon may be known from the fact that, on the average of the last four years, the plans of about one thousand houses have each year been deposited and approved in the public office of the Local Board of Health.

The great value of sanitary works in saving life may be ascertained from the fact that, for seven years before any works were constructed in Croydon, the average mortality was 23.66; the year before the adoption of the Public Health Act, it was 28.16, the population of the place being then only 19,380. The average rate of mortality for the last ten years has been 18.15, and for the last year 16.60; so that we see, with an increase of 160 per cent. in the population, the death-rate has decreased 40 per cent. between the extreme periods.

The figures given as the deaths in Croydon include the deaths in the union workhouse, which is the workhouse for nine parishes and two hamlets.

I remain, Sir, your constant Reader,

Baldwin Latham,

Engineer for Public Works, Croydon, &c.

6, Westminster-chambers, Westminster, S.W., January 27, 1868.

STEEL RAILS.

To the Editor of Engineering.

Sir,—I have been much interested in the steel *v.* iron controversy in your paper, and am of your opinion, that to have a good and economical permanent way where the traffic is heavy, and the life of an iron rail less than, say, eight years, it is essential that steel should be used; but I think in your article on "Railway Economy," in your issue of January 24th, you have overstated the saving to be effected by the use of steel. The question seems to me to be simply this: Is it more advantageous to expend an additional 7*l.* per ton to obtain a more durable material than the ordinary iron rails, or to fund that amount at interest to renew the iron from time to time? Then the case would stand thus (taking your figures): A ton of steel costing 14*l.* and lasting forty-eight years, and worth, when worn out, half-price, 7*l.* On the other hand, iron rails costing 7*l.* when new, and requiring renewal at a cost of 4*l.* 5s. every eight years. The 7*l.* (the difference in cost between iron and steel) if funded at 5 per cent. compound interest, would amount in eight years to 10*l.* 7s., from which 4*l.* 5s. being deducted, 6*l.* 2s. (not 3*l.* 6s., as stated in your article) would remain. If this calculation be carried on, it will be seen that the fifth lot of iron rails would be worn out and the fund exhausted in forty years; so that, if the steel only lasted five times as long as the iron, there would be a saving of 3*l.* 10s., the difference in value of old iron and old steel. Or to put it another way: a sinking fund to renew iron rails at a cost of 4*l.* 5s. every eight years would be 8s. 6d. per annum; to renew steel in forty years, 1s., which, added to 7s. (interest on the extra cost of steel), would only amount to 8s., or a saving of about 6 per cent. per annum, in addition to the advantage of having a good road instead of (comparatively) a bad one.

With regard to the Derby steel rail, has not your correspondent understated the value of steel at 11*l.* 10s. and old iron at 40s.? Would not 14*l.* and 4*l.* be nearer the mark?

Your obedient Servant,

P. W. D.

HEATON'S STEEL PROCESS.

To the Editor of Engineering.

Sir,—Will you allow me to correct an error in my letter in your last? It was in April, 1867, not 1866, that Mr. Hargreaves paid Mr. Heaton a visit at Langley Mill.

I am, Sir, your obedient Servant,

January 28, 1868. N. N.

LEIPSIC WATERWORKS.

To the Editor of Engineering.

Sir,—In your account of these works in your issue of the 17th inst, you state that the details of the work were carried out or "matured" under the immediate superintendence of Mr. Grissell. I beg of you to allow me to contradict this statement.

I am, Sir, your obedient Servant,

Balls Pond-road, Islington, N., Thomas Docwra.

January 29, 1868.

Aëronautical Exhibition.—The Council of the Aëronautical Society have decided upon holding an exhibition in London of objects connected with aëronautical science in the month of June. Arrangements have been made for the exhibition to be held at the Crystal Palace, where ample opportunity will be afforded for experiments. The importance and interest of some of these experiments are indicated by the fact that the Shipwrecked Mariners' Society have allotted 50*l.* as a prize in connexion with one of the objects of exhibition, viz., "the best form of kite, or other aërial arrangement or modification thereof, for establishing a communication from a wreck on shore or between two vessels at sea." The late very successful experiments in Paris, conducted by M. Giffard with a captive balloon, have suggested their repetition upon the forthcoming occasion, when Mr. Glaisher will probably prosecute further experiments, and an opportunity will be afforded to inventors to propose means for controlling ascent and descent without loss of gas or ballast. The objects for exhibition, and for which prizes will be offered out of the funds now raising, are light engines and machinery, complete working aërial apparatus, models (working and stationary), plans and drawings, articles of interest commemorating previous experiments, kites or other similar apparatus proposed to be used in cases of shipwreck, traction, or in the attainment of other useful ends; paintings of landscape and cloud scenery as observed from a balloon. The interest excited among inventors in this and other countries has been manifested so strongly that, although the idea has only been made known through the members of the society, already many new inventions have been promised for exhibition. The display of light engines particularly is likely to be large, and further applications are being made to Mr. F. W. Brearey, the honorary secretary, at the Crystal Palace.

From the North.—Messrs. Denton, Gray and Co. have received an order for a new screw steamer (to run in the coal trade) from Messrs. Appleby, Ropner, and Co. Messrs. Schlesinger, Davis and Co. launched, on Saturday, an iron screw steamer for a Hamburg house, and also to be employed in the coal trade. This vessel, named the Pfeil, is to be fitted with engines of 80 horse power nominal by Messrs. Thompson, Boyd and Co., of Newcastle. The Ormsby foundry has received an order for five miles of iron pipes in connexion with the Abyssinian expedition.