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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, December 17th, at 8 P.M. The Annual General Meeting.

SOCIETY OF ENGINEERS.—Monday, December 16th, at 7½ P.M. "On the most recent Improvements on the Injector." By James Gresham.

ENGINEERING.

FRIDAY, DECEMBER 13, 1867.

VITAL ENGINEERING.

ENGINEERING is, after all, the science of life, and of living prosperously and worthily. It is the grand old *ingenium* of the Romans, and, to this day, the French term it *le génie civil*, which we may, by a free translation, interpret as the genius of civilisation. In the old, old days, when Alfred ruled so wisely and so well, and when "good" was written "god," and the present meanings of both were much the same, and when *gast*, or ghost, like the German *geist*, stood for soul, spirit, mind, a civil engineer would have been known as *aen gastlic mon*, or a ghostly man—a man of ghost, soul, and invention. The great engineers were then the great conquerors and organisers, those who built and ruled towns long after King Lud Hudibras, and Bladud, but long before William of Normandy. They pointed out where roads were to be opened, and where castles were to be reared; but those who, by their orders, had to choose the ground more carefully, and stake out ways, and superintend the digging for foundations and the erection of masonry, were themselves hardly more than hewers of wood and drawers of water, merely set over others whose real condition was but little below their own. Even a hundred years ago, the Duke of Bridgewater retained Brindley at 3s. 6d. a day, for there was no competition among engineers; indeed, with the exception of certain petard-hoisting knights in the king's armies, there were none to speak of, all others, among those whose title might now be allowed, being surveyors or measurers, whose cleverness, if any, in construction and the management of large works was estimated as mere craftship, and without reference to the pecuniary sums really involved in its exercise.

But in our own time the engineer, when working in his true sphere, and not in the interest of mad speculation, has come to be regarded as an ingenious benefactor, a professional civiliser in all that is material of civilisation. It is by his aid that we are to make the earth more productive than nature and rude tillage have yet made it, to bring nature's stores not already utilised more readily to our use, and, in short, to live better, more comfortably, and in closer intercourse with those of our fellow-men whom we care to know. The true high-priest of physical nature, the engineer, when aided by wise rulers and public intelligence and goodness, multiplies the number of happy homes, promotes marriages, feeds new mouths, lowers the death-rate, and keeps off the doctor. In doing all this he allows nothing to stand in his way. He will move mountains, or bore right through them, and will build mountains of his own. He will drain lakes, and make

and fill other lakes. He will divert rivers, and make new ones, extend the land far into the sea, and, when it suits him, take the sea inland. He will make uninhabitable ground habitable, and a waste or a wilderness arable, draining foul water miles away, and bringing pure water from as many more in another direction. What but engineering has made London the miracle it is, the home of more than three millions, where, when once it did not contain one-tenth the number of souls, it was so often ravaged by pestilence and by fire; a city whose residents may now reach the sea in hardly more than an hour, and some of whom are now having their fresh mutton up direct from Devonshire, as if that were but a market in the next street. Any one of us, in this vast Babel, may communicate by post with anybody else within twelve miles of Charing-cross many times a day, always within two or three hours (excepting over-night letters), and that for a penny. And he may, if he have need, and can afford a higher payment, "wire" a message to Paris and have a reply in an hour, or to New York in three or four. True, all this can be done as well as in other places as in London; but only by means of an engineering unknown since the times of the Romans until within the last fifty years could so great a city have been got together and kept together in general health and comfort. King Dirt and King Smoke, if not dethroned, have been deprived of nine-tenths of their power, and plague, and fever, and cholera have been happily shorn of their greater terrors by means of better water, better air, and the removal of the heaps of organic poison which were once allowed to fester in our cesspools. There were no register-generals in the olden time, but yet enough is known to prove that we are immeasurably better off than were our ancestors. For every three deaths we, here in London, now have four births, and we can watch this increase without Malthusian anxiety. The more mouths to be fed, the more work for the engineer. His profession embodies a general committee of ways and means, and we have an accumulating fund of invention, and, beyond this, new wealth, in rising genius, to aid us in clothing, and feeding, and housing the ever-growing multitude, and in turning their energies into peaceful and productive industry. True, our newer civilization has created new wants, and often, doubtless, fostered pride where before was dependence. We have over-measured our past prosperity, too, and have entered upon speculations which have destroyed millions of the capital which it had accumulated. And our great working-class, whose industry, skill, patience, and economy make up so much of the power of British commerce, are less contented now than formerly. They want less work and more money, less plodding and more politics. They have their leagues, their platform, and their press, and are often declaring war against capital, so naturally their friend, yet so often attacked and wounded as an enemy. So, too, our British workmen will always be more costly pieces of machinery than foreigners. It takes more to grow them, and more to keep them going. We are not a miscible people, like the French, for example, and our exclusiveness puts us to extra expense. Yet Alderman Waterlow's model houses and the Glasgow dining-halls are showing how a working population with small means may live harmoniously and comfortably for far less than the usual cost. Ah! if capitalists and employers would stoop to the poor in true practical kindness, not patronising them with offensive and ostentatious condescension, but striving to understand their wants, and to bring the whole resources of wealth and science to a better provision for them, how great a blessing would be conferred upon British industry! We shall need social as well as professional engineering here. It is more the cheapness of labour abroad, growing out of the contented state of the workmen, than the technical education of which we have heard so much, that we have to fear with reference to our manufacturing and commercial supremacy. And our workmen could live happier, more cheaply, and in every way better, were there more real unpretending Christian love between masters and men. No Pecksniffian cant, but genuine mutual regard—a regard to which, when exhibited by capital, labour seldom fails to respond. Too much of our trouble with workmen comes from their feeling, and not without reason, that the masters desire to keep not only their share, but more than their share to themselves.

Happily, we have escaped the wars of foreign nations. Under their despotisms, whether in France, Germany, Russia, or America—and nowhere is there greater despotism of a certain kind than in America—we, in our own time, have witnessed wars which have ended hundreds of thousands of lives and destroyed countless

millions of property. The destruction of life and happiness by fatal engineering, where only vital engineering should prevail, if not one of the original curses upon man, is one of the oldest. May its cause be one day atoned for, and no more blood be shed by violence! Delusive hope, we fear! Yet, thank God, our own loved country has long been spared intestine wars, and it is long since it has had to war with anything like extreme power against other nations.

Without irreverence, mankind has more to hope for, next to religion and social order, from engineering than all else. Not from the hard professional practitioner who would assert a monopoly of all engineering knowledge, and with whom engineering is but another name for a "job," but from the large-hearted man who has studied his art patiently, nature reverently, and mankind lovingly.

THE BUBULINA BOILER EXPLOSION.

THE mystery attending the terrific explosion which took place, a fortnight ago, in the Mersey has been cleared up, in so far that it is now known to have been the explosion of a marine boiler. All the published accounts stated that the disaster was attributed to the explosion of gas, spontaneously evolved from the Welsh coal on board; but this, as we explained last week, appeared to us incredible, notwithstanding the tremendous force of the gas explosion, two years ago, at Nine Elms. To believe that a fine new steamship, like the Bubulina, built of Bessemer steel, should be blown into three pieces and sunk by the ignition of whatever gas might have escaped from her completely filled bunkers of coal was not only beyond all known precedent, but it involved the admission of a new, unsuspected, but ever-present danger attending all steamships—a danger of which Dr. Lardner, we may suppose, would have made the most in the early days of steam-navigation. Could it be proved that the Bubulina blew up with her own coal gas, we should expect to hear of such disasters every month, or, at least, as often as we hear of those terrible and frequent calamities, colliery explosions. That the vessel belonged to the Greek Government, and had warlike stores on board, including a considerable quantity of gunpowder, offered as probable an explanation; but it appears to be settled beyond question that the gunpowder was safely stored in the magazine in the bows, and it is certain that no explosion occurred there, inasmuch as the bow floated for a considerable time, and a number of the officers and crew who were saved were taken from it by a tug-steamer. The twenty men who were lost went down with the engine and boiler compartments of the ship, and the portion of the ship which instantly sunk was wholly separated from both the bow and stern.

The Liverpool Steam Tug Company's boats have been engaged in recovering the salvage, and their diver, Allen, has made as careful a survey of the submerged wreck as is possible in from 5½ to 6 fathoms of water. When we wrote last week, he had found two of the boilers perfect, and another was sounded 100 ft. to one side of the wreck, while another was blown upon the beach at New Ferry. We give a sketch on page 541, showing the general position of the parts of the wreck as found by Allen. The stem and stern, which floated for some time, sank about 600 ft. apart, the stem being still at anchor. The after boiler, blown furthest into the river, was found to have exploded, its face-plate driven out, tube-plate destroyed, the roof given way, and all the tubes started. Some of the tubes have been brought up by the diver. The chief engineer, who was saved, states that but 4 lb. steam was shown by the gauge a moment before the explosion; but this seems difficult of belief, when we remember that the ship was about to start. It may be that in the confusion of leaving, and with so many foreigners (Greeks) on board, many of them in the stoke-hole, one of the safety-valves stuck, and the stop-valves would not then be open. The Bubulina was formerly the Colonel Lamb, the well-known blockade-runner, and many of the same class of ships had but one safety-valve on each "piece" of boiler, and possibly there was no gauge on that which exploded.

The divers have already recovered two 12-ton guns, worth 6000l., and one was landed at Harrington-hole on Monday.

We have no doubt that the Bubulina's boilers, considering her former exploits as the Colonel Lamb, and her long subsequent seclusion, had not been properly inspected; and could Mr. Fletcher, of the Manchester Boiler Association, have seen them, we have no doubt he would have found defects in them fully accounting for all that has happened.

BROKEN RAILS.

WHEREVER the continuity of a rail is interrupted, it may be truly said to be broken. Thus every rail-joint is a broken rail, and upon the 26,000 miles of single line of railways of the kingdom, and with an average of $6\frac{1}{2}$ yard rails, there are *fourteen million* broken rails. Before the days of fish-jointing, these permanent fractures were invariably splintered, to speak surgically, and were furthermore bandaged within the soft folds of a cast-iron chair, with a compressed wooden key. With this surgery, the rail, so long as it laid still—and rails are sometimes very lively—got on very comfortably; but, unlike other cases of bone-knitting, the separated ends never united. Since Mr. Bridges Adams's invention of the fish-joint, the case of the fourteen million broken rails is, if anything, worse. The lame rail-joint, which was once carefully laid upon, and nursed upon, a sleeper of greater strength than its fellows, is now "suspended" midway between a pair of sleepers. Supported only by the weakness of a pair of fish-plates, thin strips of little depth, having no top or bottom flange, and greatly weakened by bolt-holes, the suspended joint is but one remove from a broken rail, with the fracture midway between two neighbouring sleepers. Under a falling ram, or the hydraulic press, the suspended fish-joint could not, of course, hold its own for one minute against the solid rail.

Iron rails very often break short across, under traffic, but it is seldom that accidents result from their breaking. We give elsewhere, one portion of an extensive record of rail-tests carried on during the last ten years, by Mr. Ashcroft, of the South-Eastern Railway. It not only shows that there is an extraordinary variability of quality in iron rails—a variability ranging from extreme brittleness to extreme toughness and softness, the soft tough rails having no wearing value—but it shows that certain makes frequently break in the line, and have to be replaced. Every engineer or superintendent of permanent way is aware that broken rails—new and complete fractures after the rail has been down for a longer or shorter time—are of comparatively frequent occurrence. Yet no permanent-way engineer cares to make his experience public in this respect. To do so would reflect upon himself, as having adopted rails which were not fit for their work. To do so would reflect injuriously upon his own line, as an unsafe line, because of the breakages of rails so often happening upon it. Few, very few, accidents result from the breaking of rails, speaking with reference to the number of breakages which occur. The security against breaking lies, of course, in the use of steel, which is so much stronger and tougher than iron, and no accident can be instanced as resulting from the fracture of steel rails, not but that one or two, out of nearly two million steel rails now down, have broken, in consequence of having been made too hard. With iron, however, the case is very different. They not only break, frequently without injury to passing trains, but there are many instances in which broken iron rails have been the cause of fatal or otherwise serious accidents.

Taking the Board of Trade reports on railway accidents, we find, in 1860 (page 103), that a train was thrown off the London and South-Western line, near Woking, in consequence of the breaking of a 75 lb. rail into two pieces.

In the same year (page 25) a rail broke under an express train on the Great Northern line, at Hatfield, and a passenger and a plate-layer were killed. The death of the passenger, Mr. Pym, cost the company 13,000*l.* in damages, awarded on trial.

In 1862 (page 65), three rails were broken, and others were bent, in consequence of a train running off the London, Chatham and Dover Railway. Here, of course, the rails were violently broken, and it cannot be said that they broke of themselves, under ordinary traffic. It was by similar violence, arising out of a collision, that the famous Chalk Farm rail was broken last spring.

In 1863 (page 65), a passenger train was thrown off the North-Eastern Railway, near Copmanthorpe, in consequence of the breaking of an 82 lb. rail, only three years old. The rail was found broken in four pieces. Captain Rich, R.E., who reported upon this accident, refers to the evidence he had collected, that a number of the same lot of rails had broken in the first year of their use, and that a number had been turned, and, if we may judge from the tenour of his remarks, prematurely turned in consequence of their imperfect quality.

In 1864 (page 14), a passenger train was thrown off the North British Railway, near the Bridge of Earn, in consequence of a broken rail; 120 chairs were

broken by the train jumping the line, but the rail, the fracture of which had caused the accident, had, in Captain Rich's opinion, been broken by a preceding train.

In 1865 (page 79), a compound accident occurred to a goods and a passenger train on the Great-Western Railway, near Droitwich, caused by the lamination of the top table of an iron rail, two feet in length of the top table having broken off. The rails generally were in bad condition.

In 1866 (page 82), a goods engine on the North-Eastern Railway burst the line between Whitby and Grosmont. The engine was six wheel coupled, with a short wheel-base, and weighed $35\frac{1}{2}$ tons; but the permanent way comprised a single-headed 75 lb. rail, in 21 ft. lengths, fish-jointed, and supported on sleepers 3 ft. apart. After the accident, the line was found in great disorder, and for 80 yards the rails were much twisted and broken. On the French railways, 60 ton engines are worked daily over single-headed 74 lb. rails.

In 1867 (page 20), a passenger train was thrown off the line of the London and North-Western Railway, in the Watford tunnel, because of the breaking of an iron rail. Mr. Woodhouse, the engineer to the company's way and works, was in the train, and shared the danger with his fellow-passengers. The men employed upon the line were engaged, only the Sunday before, in relaying the tunnel with steel rails; and Colonel Yollond remarks that, "It is curious that if 'another week had passed away without an accident, 'this rail would then have been replaced by a steel rail.'" The secretary of the company, Mr. Reay, wrote also to the Board of Trade, and observed in his letter that the broken rail "was found, on examination, to contain 'internal defects, which could not be detected, either 'when the rail was originally laid down or when 'turned.'"

The few instances which we have quoted of the breaking of iron rails are as nothing to the hundredfold longer category of breakages without accident to trains, or life, or property, and which, as every permanent-way engineer is aware, are never reported. But they are sufficient to show that wrought iron is not trustworthy, and that it should be replaced as soon as possible by a better material. Knowing what we now know of wrought iron, it holds the same relation to steel that cast iron did to wrought iron in 1825. And if we continue to employ wrought-iron rails under the increasing weight and speed of our express trains—let us add the royal train—it will not be long before we shall have to record a calamity which will be sadly remembered for many, many years.

THE BESSEMER PROCESS IN AUSTRIA.

THE Emperor of Austria has, as we stated in our last number, conferred upon Mr. Henry Bessemer one of the highest distinctions which it is customary in Austria to bestow upon men of science, who have rendered important services to that country and to the world at large. We think that this event makes it desirable that we should give our readers a short review of the history and present position of the Bessemer process in Austria. Amongst all European countries, Austria is the one furnished by nature with a practically inexhaustible supply of the purest iron ores known. There are two great mountains in the German portion of that empire, one in Styria and one in Carinthia, which both have the name "Erzberg," or ore mountain, and which are simply enormous crystals of spathic ore. There are similar deposits in several parts of Hungary, and other very rich mines of spathic ore in Transylvania. The Austrian spathic ore is an ironstone carrying a sufficient percentage of manganese to make the pig iron produced from it one of the best possible raw materials for steel manufacture by any process, but most particularly by the Bessemer process, the characteristic feature of which is the economy of fuel. This for Austrian iron manufacture is the question of greatest importance, since these layers of ores are, without any exception, deposited in localities very poor in mineral fuel, and relying for their supply upon the enormous forests which cover the surface of the ground. Charcoal being the fuel for Austrian blast furnaces, another element for the high quality of their products is provided for, but at the same time the limited supply of that fuel makes economy imperative in all the subsequent stages of manufacture. The Bessemer process, when carried to the extreme point of economy intended by Mr. Bessemer, produces an article of steel, say a steel bar or steel rail, with the original heat given to the iron in the blast furnace. The molten crude iron runs direct into the converter and thence into the ingot mould, without ever having been allowed to cool below its melting-point, and the

fresh ingot can be hammered and rolled out into shape before it had time to cool, and with a part of the original heat from the blast furnace still maintained in it. In this form the Bessemer process is carried on in Austria, and particularly in one steel works which belongs to the Government of that country. In this form it is more than probable a very large number of works will be carrying out their operations at no distant period, and for this most perfect form of the Bessemer process there is no other country, not even Sweden, more favourably placed by nature.

The introduction of the Bessemer process in Austria dates from the year 1862, when the London International Exhibition brought the merits of this great invention clearly before the eyes of the previously incredulous metallurgists of the Continent. Professor Tunner, the director of the School of Mines at Leoben, in Styria, and a great authority on iron metallurgy, was the first to call the attention of Austrian ironmasters and of the Government to this important new invention, and he succeeded in inducing Prince Schwarzenberg, and afterwards the Government authorities, to try his mode of manufacture in their respective works. Mr. Bessemer had lost his patent rights in Austria by having failed to work his invention in that country within the time prescribed by the patent laws, so the ironmasters of that country thought themselves free to make use of his process without any further question. Experience, however, soon proved that this was a costly mode of proceeding. The first attempts at steel-making were utter failures. Professor Tunner obtained information from Sweden, and the fixed vessels used there by M. Göranson were copied at a works named Heft, in Carinthia. This was the first practical success. The Company Rauscher, at Heft, started three or four vessels in succession, all upon the Swedish pattern, and these have continued working with good and gradually improving results to this present day. The Government works, at Neuberg, also started a Swedish vessel; but by that time the superior advantages of English practice had become known in Austria. Mr. Bessemer had offered to teach the ironmasters in such countries where he held no patents, so as to save them the expenditure and trouble of unsuccessful experiments. Mr. Bessemer's representative in Austria was Mr. Ferdinand Kohn, who, on a previous occasion, had also been decorated by the Emperor of Austria with the order of the Cross of Merit. Mr. Kohn soon succeeded in showing to the Austrian steel-masters the superior advantages of that mode of conducting the Bessemer process, at which Mr. Bessemer's inventiveness and experience had by that time arrived in this country; but it was not an equally easy task for him to fight against the prejudices and fears of steel-makers and of purchasers of steel, who had seen the first results of those unfortunate experiments, and had formed their notions of the character of Bessemer steel from those abominable productions. Gradually these prejudices, too, were overcome. Austrian iron, selected by Mr. Kohn from several different ironworks in that country, was tried and converted into excellent steel in Sheffield. Austrian engineers were admitted to the Bessemer Steel Works to study the process, and to introduce it in their respective works. Amongst Mr. Bessemer's earliest Austrian pupils were two engineers sent by Baron Rothschild, in whose works, at Witkowitz, the Bessemer process has now been successfully in operation for upwards of two years. The Government works at Neuberg were established without Mr. Bessemer's or Mr. Kohn's direct assistance; these works, however, have succeeded, under the intelligent management of their directors and with the assistance of Professor Tunner, in arriving at great perfection, and have become one of the model establishments of their kind; their productions are of the highest quality known anywhere, and the mode of manufacture is very economical and scientific. The Austrian Government have at the same time opened the doors of their works to every comer, have experimented with the different brands of iron belonging to the private ironmasters in Austria, and even in Saxony and Bavaria, and have given the results of their experience to the respective parties practically free of every charge. In this manner fears and prejudices have been effectively overcome. Several private works have been started with very good commercial success; and, in spite of the unfavourable political position of Austria in recent years for the general development of commerce and industry, this special branch has been rapidly growing in importance and power of production. At the present moment there are in Austria sixteen Bessemer converters, with an aggregate power of production of about 700 tons of steel per week.

DRAUGHTSWOMEN.

OR, by an Hibernian *taurus*, female draughtsmen. Mr. Dubs, the manager of the Glasgow Locomotive Works, has actually three or four "persons," as Mr. Mill would say, employed in making tracings in his office. They are quick and neat; but in one sense they are not "clever," for they do not, as many draughtsmen would, venture upon designs of their own. Really the quick eyes and light fingers of women are far better adapted for the mechanical employment of tracing than are the slower eyes and slower fingers of men.

At many of the larger lithographers women are employed in exactly such work, and there is no earthly reason, except such as prejudice can offer, why it should be denied them. In epical or poetical strictness, no women should have any other than domestic occupation. She should, as a girl, be trained to become a wife, useful or ornamental, according to the position and inclination of her future husband; and she should then marry, and discharge her other duties to society in the manner which that society approves. But, unluckily, not every woman has the chance, nor unless polygamy be sanctioned and accepted—and we think it will be some little time yet before it is—can every marriageable woman obtain a husband. As a rule, very poor men—and there are many—will not marry, not, at any rate, if they have anything of what we call gentlemanly feeling. They will not bind to their own hard fate, perhaps to make her a pauper, a woman who might otherwise earn a living for herself.

It is not probable that women will become engineers or foremen—forewomen, we mean—in locomotive and marine-engine factories or on railways, nor that they will be setting up in offices in Great George-street. But there is nothing to prevent their making tracings. The work is admirably fitted for them, and it is better that the trousered and incipiently moustached young women who now smoke cigars in so many offices should be relieved of it.

A correspondent sends us a letter, which we print upon another page, inveighing strongly, and with questionable taste, against Mr. Dubs's preference for female labour. Indeed, we have had to strike out one or two passages, and to qualify others, to give it even the appearance of respectful consideration for Mr. Dubs; but we have allowed the suggestion that he should be cut by the Glasgow ladies, and vituperated by the lower strata of the Glasgonian or Glaswegian female commonality, to stand in its awful portent. We wish to allow any license in reason, in these dull times, to the discussion of any question touching the position of engineers and their assistants. But we cannot sympathise with Mr. Birckel's arguments, nor do we approve his style. Engineers will, indeed, show the white feather if they are frightened by a woman, or a hundred women, for that matter. May it be a long time before we hear in Westminster, and in other fields of engineering employment, a paraphrase of the burden of the old cavalier's song:

Gentlemen, turn out! turn out!
We'll keep the ladies down!
Down, down,
Down, down,
We'll keep the ladies down!

THE THAMES VALLEY DRAINAGE.

THE Thames Conservancy is now empowered, by an Act of Parliament passed this year, to compel the authorities of the various towns and parishes lying in the valley of the Thames to divert the whole of the sewage at present discharged from their various districts into the river. The measure, which comes in force in 1869, is made more stringent by heavy penalties, varying from 50*l.* to 100*l.* a day, in the event of any non-fulfilment of the provisions of the Act. The surveyors of Richmond, Twickenham, Teddington, Hampton Wick, Kingston, and Hampton will therefore be compelled shortly to devise some thorough and effectual means by which they may be enabled to dispose of the sewage of these towns. It remains for them to decide whether independent or combined action will be advisable; but there is little doubt that a united scheme will be found the most advantageous, and will, therefore, be ultimately carried out. Two such designs have already been laid before the various Boards, and each of these may be briefly noticed. The first, a joint scheme of Messrs. Russ, Lucas, and Wilkinson, has for its main object the utilisation of the fall of water at Teddington Weir for pumping the sewage to such a height that it may gravitate over the surrounding districts.

It is proposed to construct a main intercepting sewer running beneath the towing-path from Richmond to Surbiton, a distance of about four miles, a

similar one being laid on the other side from Hampton Wick to Richmond, with a syphon crossing beneath the bed of the river at Teddington Lock, where would be situated a large collecting reservoir, into which the whole of the sewage matter is to be conveyed. From this reservoir it would be pumped through a 30 in. cast-iron main (crossing under the river) into a tank situated in an elevated position in the neighbourhood of Hounslow Heath, whence it would be distributed by an arterial system through pipes to the surrounding land. The principal feature in this design is the proposition to obtain the power necessary for raising the sewage by means of turbines to be driven by the weir overflow. Before, however, the "Boards" commit themselves to this arrangement, they should be well satisfied that they can rely *always* upon sufficient water power to work their pumps. We have seen both lock-gates standing open at Teddington, and at times a boat can be rowed up the river over the "tumbling board" of the weir. It is true that this high level is very exceptional, and could never be attained save at the top of spring tides, and then only for a very short time; but it may also happen that at these very times the turbines might be called upon to do extra duty in discharging an excess of surface drainage. Neither the economy in prime cost, nor in subsequent working expenses, would be so great as to make up for the possible occasional inconvenience of choked sewers and flooded streets. The estimate attached to Messrs. Russ, Lucas, and Wilkinson's report shows a total cost of 70,000*l.* for the construction of works which would provide for the drainage of an area of about ten square miles, occupied by a population of 50,000, with a total rateable property of 307,000*l.* Upon this sum it is proposed to levy a tax of threepence in the pound, which, they assert, would be sufficient to meet the working expenses, to pay the interest on borrowed capital, and in thirty years to repay the original amount sunk in construction. But capital will hardly be borrowed at a less interest than 4 per cent., which would amount to 2800*l.*, to be deducted from the proceeds of the threepenny rate, yielding a yearly total of 3840*l.* This would leave a balance of only 1000*l.* a year, a sum barely sufficient to meet working expenses, without taking into consideration depreciation of plant and necessary repairs.

The second scheme brought under the consideration of the "Boards" is the joint production of Messrs. Grover, Wragge, and Hertage. It is, we think, the better of the two, because it is more comprehensive, and because it proposes to provide a constant and reliable power for pumping, instead of trusting to the necessarily variable head of water at Teddington Weir. It is obvious that the cost of constructing such sewage works as are proposed for the Thames valley will not increase in proportion to their extent, so that the greater the area of land drained, the lower will be the yearly tax on the rateable property. Messrs. Grover, Wragge, and Hertage in their present amended design include all the towns and parishes lying between Chertsey and Richmond, the latter place not being dealt with in this scheme. They propose to have two pumping-stations, one situated a little below Kingston, and on the north side of the river, for the purpose of lifting the sewage collected in a sumph at that place from Surbiton on the one hand and near Richmond on the other. Each sewer will have a fall towards the sumph of 2 ft. 9 in. in the mile. The sewage, being lifted 17 ft., will pass through an iron main crossing the bed of the river, and be conveyed to Hampton, where the main pumping-station will be erected, close beside the West Middlesex Waterworks. A second iron main crossing the Thames at East Molesey will drain that place, Thames Ditton, and West Molesey. From Chertsey to Hampton a sewer will be constructed, draining Shepperton, Weybridge, Walton, and Sunbury. Teddington and Twickenham will be drained with iron mains crossing the river and making junction with the main culvert on the north bank. From Hampton the sewage matter collected in a reservoir capable of holding a twelve hours' charge will be pumped to a height of about 75 ft. into auxiliary tanks, and led thence, where needful, through main and service pipes, the solid matter having been previously separated.

The estimate appended to a carefully prepared report on this scheme amounts to 87,500*l.*, in which is included 9000*l.* for the construction of a reservoir, the necessity of which Mr. Grover seems to doubt, but which we consider would be absolutely essential to the safe and convenient working of the system. According to the report, the rateable value of property included is 372,688*l.* yearly, and the annual expense, including 4½ per cent. on borrowed capital and a sinking fund of 725*l.*, is made out to be 6525*l.*, which would im-

pose a tax of 4½d. in the pound. The same gentlemen have prepared another design for draining the towns of Richmond, Barnes, Chiswick, Hounslow, and Isleworth, at an estimated cost of 80,000*l.*, which would impose upon the resident ratepayers a tax of about 6d. in the pound.

It is certainly somewhat strange that, for so large an undertaking as the Thames Valley Drainage, there should be so little competition. Works entailing an outlay of some hundreds of thousands of pounds are not plentiful just now, and as these *must* be done, and that quickly, the engineer whose plans are accepted has a substantial guarantee of being paid. So far as we know, the two plans for the combined system we have just noticed are the only ones in the field. Let us hope that competition will be keener before the "Boards" have finally made their decision.

MR. JOHN FOWLER.

PRESIDENT, INSTITUTION OF CIVIL ENGINEERS.

MR. JOHN FOWLER, the President of the Institution of Civil Engineers in Great Britain, whose portrait we this week publish, is the eldest son of Mr. Fowler, of Wadsley Hall, Sheffield, a gentleman who, for half a century, has held a high reputation for knowledge of landed property and agricultural management.

Mr. Fowler was born in 1817. After completing his scholastic education, he became a pupil of Mr. J. Towler, of Leather, the eminent hydraulic engineer, and obtained his first practical knowledge under the guidance of that gentleman, who was then employed in the construction of the vast reservoirs which now supply the town of Sheffield with water.

When Mr. George Stephenson, the father of railways, projected the line of the Midland Company through the valley country from Derby to Normanton, and excluded from that great highway the towns of Sheffield, Barnsley, and Wakefield, Mr. Leather was employed to survey a route from Chesterfield through Sheffield, and his pupil acquired his first experience as a railway engineer in laying out a line which has since been adopted. But Mr. Fowler had far better opportunities of acquiring professional knowledge when he took part in the arduous task of surveying the rocky district through Wharfedale Wood, in Yorkshire, for a line which, though not constructed at that time, was afterwards enabled to carry out and complete. Whilst yet a pupil, he also surveyed the country for a line between Stourbridge and Birmingham, passing through Dudley and Wolverhampton; and although this line was commenced twenty years afterwards by Brunel, it fell to the lot of John Fowler to finish it.

On the completion of his professional education, Mr. Fowler became an assistant to Mr. Hastrick in the construction of several lines of railway then in progress, and amongst others the London and Brighton Railway.

He was then appointed resident engineer of the Stockton and Hartlepool Railway, and of other lines in the same district. It was at this period that he first came as a witness before a parliamentary committee, and laid the foundation of that reputation for straightforwardness, firmness, and professional ability, which he has since continued to hold in the committee-rooms of both Houses of Parliament.

At the age of twenty-seven, Mr. Fowler was selected as the engineer for constructing the large group of railways known as the Manchester, Sheffield, and Lincolnshire line, which includes tunnels, viaducts, and bridges of considerable magnitude, in addition to a dock, a floating-pier, large hydraulic works, and a steam-ferry, of all which large and multifarious work he had sole engineering charge.

From this time the name of John Fowler was established in the first rank of practical engineers, and he became, after settling in London, continuously employed in the laying out and construction of railways, docks, and other large operations requiring a high class of engineering ability, not only in the United Kingdom, but on the Continent.

Mr. Fowler is the consulting engineer of H.M. Office of Woods and Forests. He holds the same position with reference to the Great Western Railway, as well as several other important lines of railway, docks, and canals.

Amongst the principal works executed by Mr. Fowler during the last twenty years are to be found the Manchester, Sheffield, and Lincolnshire Railways; the Oxford, Worcester, and Wolverhampton Railway; the Severn Valley Railway; the Mid-Kent Railways; the London, Tilbury, and Southend Railway; the Great Northern and Western of Ireland System of Railways; the Much Wenlock Railway, and its extension east and west; the Victoria Station and Piccadilly Railway, on which occurred the first railway bridge built over the river Thames at London; the Great Eastern Railway Extension, in Cambridgeshire and Essex; the Isle of Wight Railway; the West Riding and Grimsby Railway; the Edgware, Highgate, and London Railway; the Hammersmith Railway; the St. John's Wood Railway; the Launceston and South Devon Railway; the Moreton Hampstead Railway; the Weymouth and Portland Railway; the Wellington and Cheshire Railway; also the construction of Millwall Docks, the improvements of rivers and estuaries, and the reclamation of lands from the sea.

But his *chef-d'œuvre* in railway engineering is certainly the Metropolitan or Underground Railway, which runs from Paddington to the city.

This line, projected on an entirely original basis, has proved a perfect success, both commercially and constructively; and the boldness and skill displayed in its origination and completion is beyond all praise.

The public benefit which it has conferred upon an overcrowded capital has led to its engineer being called upon not only to extend the original Metropolitan line, but also to design similar lines at Glasgow, Liverpool, and Bristol, some of which are in course of construction.

Mr. John Fowler married, in 1850, the daughter of the late James Broadbent, Esq., of Manchester, and has four sons.

THE REGENT'S PARK LAKE.

THE accident in the Regent's Park last January impressed the Office of Works with the necessity of adopting some means by which the recurrence of such a catastrophe should be prevented, and the suggestion would at once occur that it would be desirable to make the lake of a nearly uniform reduced depth, with a hard bottom, that could be easily cleansed from any accumulation of mud. At the time that it was resolved to carry out this work, Messrs. Lucas and Aird, the contractors for the Metropolitan and Saint John's Wood Railway, were finding so much difficulty in disposing of the spoil from the excavation of their works, and incurring so large a cost in carting it away, that they considered it would be worth while to propose to relieve the Office of Works from the trouble and expense of any suggested alteration to the ornamental water, by executing the work themselves at their own charge. This offer, by the advice of the consulting engineer to the Office of Works, was ultimately accepted, Messrs. Lucas and Aird undertaking to raise the bottom, and to cover it with a necessary thickness of concrete; the area being twenty acres. It is only recently, however, that any active steps have been taken in the matter, and the various sections of the lake that have been prepared gave a result rather disappointing to the contractors. These sections show an average depth of water over three-fourths of the entire area of 4 ft., in some places there being only 3 ft., and in one or two exceptional instances a depth of 8 ft. or 9 ft. in holes, the mud lying all over the bottom in thicknesses varying from 18 in. to 3 ft., and the average amount of raising required will be far less than was assumed. At present the lake is being drained of its water, a communication being opened by means of an 18 in. pipe running into a drain which passes transversely beneath the bottom of the lake and empties into the west branch of the Regent-street sewer. This pipe is placed about 8 ft. below water-level, and a channel has been cut through the mud in order that the water may be carried off by it. A second 18 in. pipe will also be laid at the bottom of another part of the lake, and led direct into the Regent-street sewer, the invert of which is some 20 ft. below the ornamental water level. When the pond has been drained as thoroughly as possible through these outlets, the few deep holes will be filled with spoil. Furrows will then be cut in the thick layer of mud in order to dry it, and the area will be raised to the necessary level by the excavation from the St. John's Wood Railway. It will probably be some months before the whole surface is concreted, and the Office of Works may be congratulated on having the bottom of their lake levelled and floored for nothing. A communication with the Regent's-street sewer will be made permanent, for the purpose of periodically running off the water when the bottom of the lake requires cleansing, and a constant, clear, and comparatively pure supply will be maintained from the surrounding surface-drainage which feeds the lake.

THE ABYSSINIAN RAILWAY SCHEME.

TO THE EDITOR OF ENGINEERING.

SIR,—In your last interesting number of ENGINEERING you cut up "the Tin-pot Railway" scheme for Abyssinia. It would seem pretty safe to cut up any railway plan for our army there on the score of cost, time, and inexpediency. In fact, railways when made on active service can be only short lines leading from the base of operations to a siege. Of course it is of great importance that a good "line of communication" be kept up between an army in the field and its "base of operations." Hence the route taken by an army on active service generally is along, or parallel to, a good road, or, if in country with railways, along a railway. Now, in the very same number of ENGINEERING, you describe a first-rate "new locomotive for common roads," that will pull a loaded wagon weighing 10 tons up a *bad road of one in twenty*; also that it thinks nothing of going over plough and grass land without sinking, and that its weight is only four or five tons. Hence, if you want machinery and engineering to come to the front in war, why not advocate the use of these engines for bringing up supplies in wagons by traction from the coast?

They will, you say, work capably over a very rough road, and they would not be likely to die from the effects of the climate. The coals they would use could be supplied from the fleet, and they would be cheaper far, as motive power, than mules or horses. Even should they not be of use in Abyssinia, they would be of the greatest use in the service, and, if adopted, they would not be eating their heads off during peace, nor would they be so expensive in time of war as the horses of the same aggregate tractive power, especially as forage is always so scarce in the neighbourhood of an army on active service. Their disadvantage is the requirement of coal, and hence they would be useless in a country where this could not be obtained—*unless they were so constructed as to burn either coal or wood.*

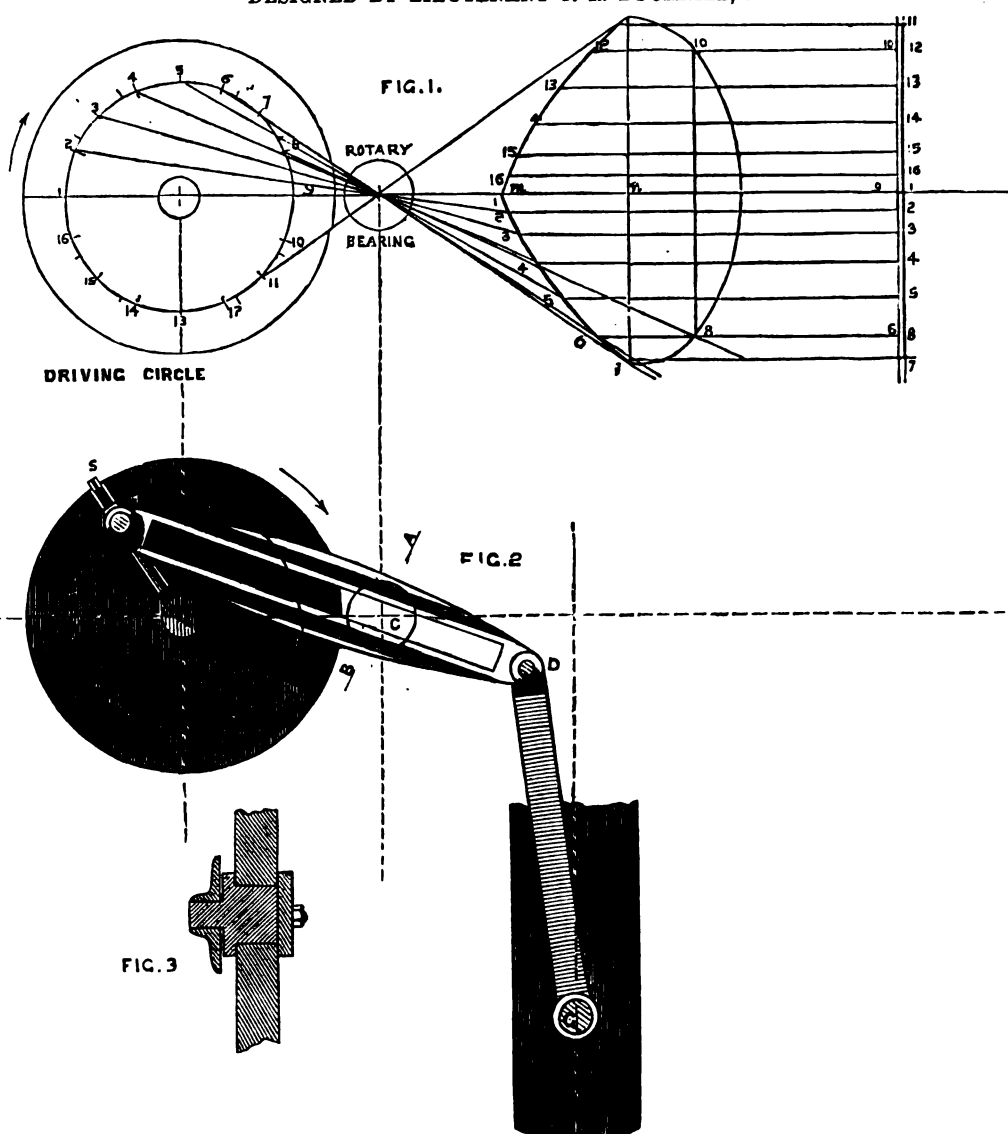
Yours faithfully,

J. T. B., R.E.

Apperley, near Leeds, December 5, 1867.

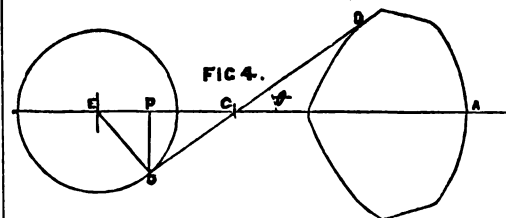
QUICK RETURN MOTION FOR SLOTTING-MACHINES.

DESIGNED BY LIEUTENANT T. R. BUCKNILL, R.E.



WE give, above, engravings of an ingenious arrangement of quick return motion for slotting and shaping machines, &c., lately designed by Lieutenant Bucknill, R.E. In this arrangement the driving-shaft carries a disc furnished with a crank-pin, O, which can be set in or out as usual by the screw, S. C is a bearing fixed in a collar, and capable of rotation; and OD is a lever that connects the end of connecting-rod and the crank-pin, this link being capable of sliding on the bearing, C. A reciprocating motion is thus communicated to the end of the connecting-rod; and if the slide carrying the tool-box be made perpendicular to the line, EC, a quick return motion is set up. Lieutenant Bucknill prefers making the central line of the guide bisect mn (see Fig. 1), so as to keep the connecting-rod as nearly in line with the guide as possible during the cutting stroke. With the proportionate dimensions shown in Fig. 1, the return stroke is performed whilst the driving-shaft is making only one quarter of the revolution.

It will be seen that the quickness of the return is increased or diminished, according to the distance of O from E. The polar equation of the curve described by the end D of the lever, OD, is thus obtained (see Fig. 4).

Let $EC = B$, distance between centres of circle and bearing. $EO = r$, radius of circle. $DO = L$, length of link sliding on C. $DC = \rho$, radius vector.

A C, prime radius.

ang. $DCA = \theta$, vectorial angle,

and C, the pole.

Then $CO = L - \rho$,and $EO^2 = EC^2 + OC^2 - 2 EC \times PC$, Euc. II, 13 $\rho^2 = B^2 + (L - \rho)^2 - 2 B (L - \rho) \cos. \theta \dots (1)$

It should be noticed that the end of the cutting stroke is not when DO is tangential to the driving circle, or $\rho \sin \theta$ is not a maximum when $\sin \theta$ is. This can be proved from (1); also, the sliding friction on C is the greatest when the reaction is perpendicular to the bearing, C, which is in the middle of the cut, and at a time when the power is a maximum and speed a

minimum. Our engravings and description of this quick return motion have been prepared from particulars with which we have been supplied by Lieutenant Bucknill.

THE ELECTRICAL ANTI-INCURSTATOR.

TO THE EDITOR OF ENGINEERING.

SIR,—Mr. Sabine has furnished a very ingenious theory of the action of Baker's anti-incrustator, but on a slender foundation, viz., his assertion that "the application of the apparatus converts a boiler into an hydro-electrical machine."

If the metallic star does draw electricity from the steam, any one who has the apparatus can prove the fact, at a cost of 10s., by inserting a non-conducting gland in end of boiler,* and bringing the copper wire attached to the star right through. Sparks of electricity will flow from it when approached.

This is so obvious an experiment that I am afraid it has been tried and failed, thus upsetting Mr. Sabine's theory at once.

Another experiment I want to see tried is this: whether the same effect is produced when the star is attached directly to boiler as when by a long wire. There is no obvious reason why it should not, except the wire acts as an intensifier.

Suppose these experiments are tried, and give affirmative results, we are led to a discovery of some importance.

Mr. Faraday tried a great many experiments on the electrical state of steam, and came to the conclusion that electric equilibrium was maintained, until, by the rushing of the steam through nozzles, when partially condensed, the condensed particles became an "electric," by their friction against the nozzles; just as a glass bar does, when rubbed with silk. The steam acted no other part than that of a motive power.

Given, then, an electric current drawn from the steam space, we conclude the existence of currents of steam of extreme violence throughout the steam space, currents quite separate from that going to the engine; for the star acts, I understand, when not within the influence of that, and of very great force, comparing its effects and the slight resistance of the little apparatus with the resistance of Faraday's 46 wooden nozzles. One more suggestion. If experiment No. 1 succeed, let vulcanite or well annealed glass be substituted for the metal arms of the star. On the Faraday theory, this should double the effect.

Yours respectfully,
H. P.

December 11, 1867.

* A current of electricity has been proved to exist in the manner suggested by our correspondent (vide page 163 of the present volume).—Ed. E.

TESTS OF IRON RAILS.

DURING the last ten years, Mr. Peter Ashcroft, the engineer of the South-Eastern Railway, has made careful tests of every lot of rails ordered for that line. These tests comprise samples of nearly every make of iron rail in the kingdom, and Mr. Ashcroft has very

kindly placed his record-book of these tests in our hands to enable us to abstract the results for our readers.

All the rails were tested by the fall of a ram of from 300 lb. to 350 lb., falling from heights increasing progressively by one foot from 5 ft., which was the height

of the first blow. The rails were cut to 4 ft. lengths and supported on 3 ft. bearings, the ram striking mid way between the supports.

The dates of the trials are not given; but the tests are recorded in the successive order in which they were made between 1857 and 1867.

NAME OF RAIL OR MAKER.	Weight per Yard.	Weight of Ram.	Number of Blows.	Blows increasing foot by foot as under.	Result of Blows.	Turned over, or not, before Breaking.	Greatest Deflection, whether turned or not.	MR. ASHCROFT'S MANUSCRIPT REMARKS.
Ebbw Vale ...	80	3 cwt.	10	5 ft. to 14 ft.	Deflected 2½ in.	Turned	2½ in.	A red short rail. Very cold short, and questionably safe. Good wearing qualities. Cold short. Of middling quality. Questionably safe. Bad. Bad. Somewhat better. These rails frequently broke in the road, and were taken out. Very hard and cold short. As before.
Same rail turned...	80	"	9	5 ft. to 13 ft.	Broke	Not turned	1½ in.	
Rhymney, first tried ...	80	"	2	5 ft. to 6 ft.	"	"	1½ in.	
Do., second rail ...	80	"	10	5 ft. to 14 ft.	"	"	1½ in.	
Bolckow and Vaughan ...	80	"	3	5 ft. to 7 ft.	"	"	1½ in.	
Bailey ...	80	"	6	5 ft. to 10 ft.	"	"	1½ in.	
Bale and Co. ...	80	"	2	5 ft. to 6 ft.	"	"	1½ in.	
Old Dover rail ...	68	"	1	5 ft. to 5 ft.	"	"	1½ in.	
Do., another ...	68	"	1	5 ft. to 5 ft.	"	"	1½ in.	
Do., a third ...	68	"	3	5 ft. to 7 ft.	"	"	1½ in.	
Mounsey and Janson ...	75	"	2	5 ft. to 6 ft.	"	"	1½ in.	A safe but not a lasting rail. Tough and red short, as proved. A probably good wearing rail. As before stated. Very good in all respects, but could not obtain the name of maker. Fair quality as to wear.
Do., another ...	75	"	4	5 ft. to 8 ft.	"	"	1½ in.	
Bolckow and Vaughan, part worn ...	75	"	4	5 ft. to 8 ft.	"	"	1½ in.	
Do., another, part worn ...	75	"	7	5 ft. to 11 ft.	"	"	1½ in.	
Ebbw Vale, S. E. R. ...	75	"	11	5 ft. to 15 ft.	Deflected 3 in.	Turned	3 in.	
Same rail, turned over ...	75	"	11	5 ft. to 15 ft.	Straightened.	Turned	2½ in.	
Ebbw Vale, another ...	75	"	10	5 ft. to 14 ft.	Deflected 2½ in.	Turned	2½ in.	
Same rail, turned ...	75	"	9	5 ft. to 13 ft.	Straightened.	Not turned	2 in.	
Derwent Company ...	not given	302 lb.	7	6 ft. to 12 ft.	Broke	Not turned	2 in.	
Do., another rail ...	68	"	6	6 ft. to 11 ft.	"	"	2 in.	
Maker unknown, worn fifteen years ...	68	"	9	6 ft. to 14 ft.	Deflected 3½ in.	Turned	3 in.	A red short rail, as proved by the smith when worked at a white heat. Very bad. Of fair quality, was twice afterwards bent under press, and finally broken. Of fair quality, finally broken under hammer. Very good in fibre and granular heads. Too cold short. As before. Both good and safe. Temperature 28° Fahr. A fair sample of a lasting rail. Did not break; a particularly tough rail. Very good. Exceptionally good; previous tests of this rail have proved very indifferent. A fair rail. Rather too cold short. Do. A safer rail, with a fine granular head. Rather too cold short.
Same, turned over ...	not given	"	4	6 ft. to 9 ft.	Broke	Turned	2 in.	
Guest and Co. ...	not given	"	8	6 ft. to 13 ft.	Deflected 2½ in.	Turned	2 in.	
Same rail, turned ...	not given	"	7	6 ft. to 12 ft.	Straightened	"	2 in.	
Do., turned second time ...	not given	"	7	6 ft. to 12 ft.	Deflected 2½ in.	"	2 in.	
Do., turned third time ...	not given	"	7	6 ft. to 12 ft.	Straightened	"	2 in.	
Ebbw Vale ...	not given	"	7	6 ft. to 12 ft.	Deflected 1½ in.	Turned	1½ in.	
Same rail turned ...	not given	"	7	6 ft. to 12 ft.	Straightened	Not turned	1½ in.	
Old Dover main line ...	not given	"	1	4 ft. fall	Broke	Not turned	1½ in.	
Derwent rail to specification...	not given	"	7	4 ft. to 12 ft.	Deflected 1½ in.	Turned	1½ in.	
Same rail, turned ...	not given	"	7	4 ft. to 12 ft.	Straightened	"	1½ in.	Overhanging weight of ends of rail greater than that of rail itself, and test therefore not a fair one. On these tests the Rhymney contract was withdrawn. All unsatisfactory.
Do., turned again ...	not given	"	7	4 ft. to 12 ft.	Deflected 1½ in.	Turned	1½ in.	
Derwent rail to specification...	not given	"	7	4 ft. to 12 ft.	"	"	1½ in.	
Derwent ...	not given	"	11	4 ft. to 14 ft.	Deflected 3½ in.	Turned	1½ in.	
Same rail, turned ...	not given	"	5	14 ft. each	Broke	Not turned	1½ in.	
Derwent Iron Company ...	not given	"	3	4 ft. to 6 ft.	Broke	Not turned	1½ in.	
Do., another rail ...	not given	"	5	4 ft. to 8 ft.	"	"	1½ in.	
Do., a third rail ...	not given	"	11	4 ft. to 14 ft.	"	"	1½ in.	
Derwent Iron Company ...	not given	"	5	6 ft. to 10 ft.	"	"	1½ in.	
Do., another rail ...	not given	"	7	6 ft. to 12 ft.	"	"	1½ in.	
Ebbw Vale ...	not given	"	10	6 ft. to 15 ft.	Deflected 2½ in.	"	1½ in.	On these tests the Rhymney contract was withdrawn. All unsatisfactory.
Worn rail out of line ...	63	"	8	4 ft. to 11 ft.	Broke	"	1½ in.	
Old Dover rail, worn ...	not given	"	10	4 ft. to 13 ft.	"	"	1½ in.	
Do., another rail ...	not given	"	9	6 ft. to 14 ft.	Not broken	"	1½ in.	
Rhymney... 350 lb.	not given	"	10	all 10 ft.	Broke	Not turned	1½ in.	
Rhymney... 300 lb.	not given	"	4	8 ft. to 11 ft.	"	"	1½ in.	
Do., another rail ...	not given	"	3	8 ft. to 10 ft.	"	"	1½ in.	
Do., a third rail ...	not given	"	7	8 ft. to 14 ft.	"	"	2 in.	
Do., a fourth rail ...	not given	"	4	{ 2 of 14 ft. } { 1 of 13 ft. } { 1 of 12 ft. }	"	"	1½ in.	
Rhymney... 14 ft.	not given	"	1	14 ft.	"	"	1½ in.	
Do., another rail ... 10 ft.	not given	"	1	10 ft.	"	"	1½ in.	On these tests the Rhymney contract was withdrawn. All unsatisfactory.
Do., a whole 18 ft. rail ...	not given	"	5	all of 14 ft.	"	"	1½ in.	
Do., second piece of 9 ft. ...	not given	"	4	all of 14 ft.	"	"	1½ in.	
Do., third piece of 4½ ft. ...	not given	"	2	both of 14 ft.	"	"	1½ in.	
Rhymney, another rail ...	not given	"	2	14 ft.	"	"	1½ in.	
Do., piece of same rail ...	not given	"	2	8 ft. and 9 ft.	"	"	1½ in.	
Rhymney rail A ...	not given	3 cwt.	1	8 ft.	"	"	1½ in.	
Do. B ...	not given	"	1	7 ft.	"	"	1½ in.	
Do. C ...	not given	"	1	6 ft.	"	"	1½ in.	
Do. D ...	not given	"	2	5 ft. and 6 ft.	"	Not turned	1½ in.	
Do. E ...	not given	"	2	5 ft. and 6 ft.	"	"	1½ in.	All unsatisfactory.
Do. F ...	not given	"	3	5 ft. to 7 ft.	"	"	1½ in.	
Do. G ...	not given	"	4	5 ft. to 8 ft.	"	"	1½ in.	
Do. H ...	not given	"	5	5 ft. to 9 ft.	"	"	1½ in.	
Do. I ...	not given	"	1	8 ft.	"	"	1½ in.	
Do. K ...	not given	"	2	all 10 ft.	"	"	1½ in.	
Do. L ...	not given	"	1	8 ft.	"	"	1½ in.	
Do. M ...	not given	"	2	7 ft. and 8 ft.	"	"	1½ in.	
Do. N ...	not given	"	1	7 ft.	"	"	1½ in.	
Do. O ...	not given	"	2	8 ft. and 9 ft.	"	"	1½ in.	
Ebbw Vale ...	not given	"	10	all 10 ft.	Deflected 4½ in.	Turned	4½ in.	All unsatisfactory.
Same rail, turned ...	not given	"	9	{ three of } { 10 ft., six } { of 15 ft. }	Broke	Not turned	2 in.	
Ebbw Vale, another rail ...	not given	"	7	all 10 ft.	"	Not turned	2 in.	
Do., a third rail ...	not given	"	7	all 15 ft.	"	"	4 in.	
Hopkins's... 82	not given	"	2	8 ft. and 9 ft.	"	"	1½ in.	
Barningham's ... 73	not given	"	2	8 ft. and 9 ft.	"	"	1½ in.	
Hopkins's ... 75	not given	"	5	8 ft. to 12 ft.	"	"	1½ in.	
Do., another rail ... 75	not given	"	5	8 ft. to 12 ft.	"	"	1½ in.	
Ebbw Vale ... 8	not given	"	8	8 ft. to 15 ft.	Deflected 4½ in.	Turned	4½ in.	
Same rail, turned ... 6	not given	"	6	all 15 ft.	Nearly straight	"	4 in.	
Same rail, turned ... 2	not given	"	2	both 15 ft.	Broke	"	4 in.	A very good sample.
Barningham's ... 78	not given	"	8	8 ft. to 15 ft.	Deflected 3½ in.	Turned	3½ in.	
Same rail, turned ... 6	not given	"	6	all 15 ft.	Nearly straight	"	4 in.	
Same rail, turned ... 2	not given	"	2	all 15 ft.	Broke	"	4 in.	

(To be Continued.)

NOTES FROM THE NORTH.

GLASGOW, Wednesday.

Glasgow Pig Iron Market.—There is not much to report with reference to the state of the pig iron market, except that the business doing from day to day is very small in amount, as a rule, and that prices are gradually tending downwards. On Wednesday last 53s. 7½d., six weeks, was paid; on the following day the market was somewhat firm, and a fair business done at 53s. 6d. a month, 53s. 4½d. fourteen days, and 53s. 3d. cash. Since then prices have come down to 52s. 10d. one month and 52s. 8d. cash, at which prices business was done yesterday. To-day 500 tons were reported at 52s. 10d. a month. No. 1 Gartsherrie and No. 1 Coltness brought respectively, yesterday, 60s. 6d. and 59s. 6d. The following are the pig iron shipments from all Scotch ports:

For the week ending 7th December, 1867.

	tons.
This year	5,562
Last year	8,122
Decrease	2,560
Total since 25th December, 1866	579,221
For corresponding period in 1865-66	559,827
Increase	19,394

Forth Bridge Railway.—Parliamentary notice has been published of an intention to apply, in the next session, for an Act to authorise the formation of a railway in the immediate neighbourhood of the town of Alloa, on the river Forth. It is to be a loop line of railway, starting from the Stirling and Dunfermline line, touching the Forth at the narrow neck immediately west of Alloa Inch, where the river will be crossed by a swing bridge, and, after crossing the river, the line will meet the Caledonian branch at a short distance from South Alloa. The line will be about 3 miles long, and easy of construction. The bridge will also be easily made, and the necessary facilities for the navigation of the river. It is understood that the scheme is brought out by the North British Railway Company; but it will be necessary that the capital be raised by the public, as there is no other mode by which the scheme can be successfully carried through. From 50,000l. to 60,000l. will suffice, it is expected. Alloa, Tillicoultry, and, indeed, most of the county of Clackmannan, are expected to be benefited by the scheme, while it will be a great aid towards getting a complete independent line from the north for the North British Railway Company, by whom the loop line in question will be worked, the shareholders being guaranteed a dividend of 4 or 5 per cent. out of the revenue of the bridge.

Royal Scottish Society of Arts.—The second meeting of this society was held in Edinburgh on Monday night, when Mr. Swan, F.R.S.E., Professor of Natural Philosophy in the University of St. Andrews, read a paper on "New Forms of Light-house Apparatus," the consideration of which was remitted to a committee. Professor Swan also described, and exhibited in action, by means of a working model, Foucault's regulator for the electric light. An interesting discussion ensued on the merits of Foucault's invention, in the course of which mention was made of the excellent regulator invented by Mr. Hart, the well-known Edinburgh philosophical instrument maker.

Railway Bridges on the Callander and Oban Railway.—The three large bridges on the Callander and Oban Railway, and which span the Teith three times between Callander village and Loch Lubnaig, are now all but finished. The middle one, which is at the Pass of Leny, is 140 ft. span, and the others are within a few feet of the same length. The iron girders have been supplied and erected by Mr. Stewart, ironfounder, Irvine, and the beautiful structures, so expeditiously thrown across the silver Teith, reflect on him the highest honour. The bridges are all of the same pattern—the bowstring—and all of malleable iron. The other works on this railway are progressing rapidly, the permanent rails being now laid on several miles of it.

Solway Junction Railway Bridge.—On Saturday last an important step in the construction of the railway viaduct across the Solway Firth was accomplished, namely, the meeting of the two portions which have been worked from the English and Scotch shores. The last two girders required to complete the connexion were placed in position on that day, and thus the original design of the engineers has been accomplished. The portion of the viaduct now completed, which was commenced about two years ago, is about a mile in length, consists of 183 piers, and has a height of about 40 ft. above low water. As authorised by the company's Act of last session, 200 yards of iron work, or twenty bays, are yet to be added to the southern end of the viaduct. The ground piles for this extension are now nearly all driven; and, with favourable weather, and tides permitting, the superstructure may be erected in about two months.

The Sewage Question.—A very full meeting of the joint committees named on the part of the Town Council, the Clyde Trustees, and the Police Board was held last in the Council Hall, with Messrs. Bateman and Bazalgette, the two eminent London engineers, and Dr. Anderson, Professor of Chemistry, on the important subject of the sewage of Glasgow and the purification of the river. The Lord Provost was in the chair, and stated that he had called the joint committees together in order that they might have an opportunity of expressing their opinions on the various modes that he had suggested for dealing with the sewage. His lordship stated also that he did not understand that the reporters (the professional gentlemen) were to express any opinion on the subject until they had fully considered the whole question in all its bearings; but he thought it desirable that they should learn the sentiments of the various parties who had directed their attention to the matter. Several members of the joint committees thereupon expressed their opinions on the question, to the effect generally that the whole subject ought to be left to the unbiased consideration of the eminent individuals who had been invited to report thereon, and that in dealing with the question, while the more immediate object of the inquiry had reference to the sewage of Glasgow and the purification of the Clyde, they should at the same time keep in view the position of the several towns along the river, and the effect

of the sewage of these towns on the purification of the river. The reporters have already visited the vale of Clyde and the outlets along the coast of Ayrshire and otherwise; but it is understood that they will find it necessary to make a further visit to Glasgow before they can satisfactorily report on the question.

Mishaps at Greenock.—The fact that "misfortunes never come single," there have just occurred two unfortunate mishaps at Greenock. One of them is the falling of a large new quay shed in course of erection at the Albert harbour, and well high completed. The shed is 400 ft. long, 62 ft. wide, and 19 ft. high to the start of the roof, and the brick wall was 18 in. thick. Messrs. Bell and Miller, civil engineers in this city, are the engineers who are responsible for the designs. Those gentlemen visited the works only two or three days before the accident occurred, and saw nothing to excite their suspicion as to any unsound work. The roof was spanned with iron girders, which were supported to the east of the quay wall on iron pillars, and to the west on the brick wall mentioned above. It was during a sudden gust of wind from the south-east that a portion of the west wall gave way, and the entire roof fell in with a loud report. One of the workmen was taken out of the debris in a lifeless state, and other two were also injured, one of them very seriously. The contract for the erection of the shed was about 5000l., and the loss caused by the accident is roughly estimated at 2000l. The cause of the accident is unknown, but efforts are being made to institute a most rigid inquiry. For that purpose the Harbour Committee have appointed Messrs. Peddie, architect, Edinburgh; Duncan, engineer to the Clyde Trustees; and Laidlaw, of Messrs. Laidlaw and Sons, ironfounders, Glasgow. Messrs. Thomson, builder, and Black, joiner, Greenock, were appointed by the Crown, and have given in their report, which will be forwarded to Edinburgh.

The other mishap occurred in the shipbuilding yard of Messrs. Caird and Company. It proved fatal to two of the workmen, other two were severely injured, and several others were more or less hurt. The accident occurred in the erection of the frames of one of the large iron steamers which Messrs. Caird and Company are at present building. It is said that the carpenters had about thirty of the frames fixed in position from the stern, that these were bolted down to the keel with tie-bars, and held together with bolted ribbons from the stern-post and wooden bars running across, and that all the usual precautions observed in fixing frames had been adopted. When the men were pulling an additional frame into position, and bolting and tying it, a heavy northern squall struck the frame and staging, and the whole fell towards the bow with a tremendous crash, causing the deaths and injuries already referred to. "A workman, who was present on the spot," writes to the *Greenock Evening News* relative to this accident. The following is an extract: "I will give you the facts, leaving you to draw inferences. The boat was let out to the foreman carpenter to put up the frames by contract, as all jobs are done in Caird's. Time being money in this case, the men are hurried on before the work can be made sufficient, and I may say that she was only bound with one ribbon at the top, whereas there should have been three, or at least two, to keep her perfectly secure."

Shipbuilding Items.—On Monday last Messrs. Alex. Stephen and Sons launched, from one of their shipbuilding sheds, Kelvinhaugh, the fine new composite ship Rona, of 650 tons, and 15 A 1 at Lloyd's. The Rona is owned by Messrs. Sandback, Tinnie and Co., Liverpool, is to be employed in their West India trade, and is to be commanded by Captain Richard Russell. The ceremony of naming the ship was performed by Mrs. Russell.

It is stated that Messrs. Scott and Co., Greenock, whose yard has been closed for the past year owing to its French connexion at St. Nazaire, are about to resume operations with a screw steamship of 660 tons and 100 horse power, for the Anchor Line of Clyde and Mediterranean packets.

The handsome twin-screw steamer Tigre, built by Messrs. Robert Duncan and Co., Port Glasgow, and engaged by Messrs. Rankin and Blackmore, Greenock, has arrived at St. Vincent (Cape de Verde), after a passage of 13 days 13 hours from the Tail of the Bank. Captain Risso writes that she is an excellent sea boat, and steams very fast, and that he is perfectly satisfied with her in every respect. The Silver River, which left the Clyde about the same time as the Tigre, had just arrived at St. Vincent, and they were to start together on the evening of the 19th ult. for Monte Video.

The fine new paddle-steamer Islay, which has just been built by Messrs. Barclay, Curle and Co., Glasgow, for the Glasgow and Islay Steamboat Company, called in at Greenock a few days since, on her first regular trip. Her appearance, as she stayed into the quay, was very imposing, her great width and powerful paddle-wheels giving her the appearance of a vessel of greater size than she really is. Since she made her trial trip to Islay the fore-part of her stowage deck has been covered over, and a very comfortable fore-cabin made, which will be a great boon to the steerage passengers in stormy weather. Her cabin is handsomely fitted up, equal to anything on the Clyde, and the state-rooms and ladies' and gentlemen's cabins are wanting in nothing that comfort could desire in a deep-sea steamer.

Miners' Affairs.—The miners' strike still continues in the upper part of the Wishaw district. The miners employed at two of the works on the Coltness estate are still out on strike. Those, however, in the employment of Messrs. D. and J. Sneddon, Camnethan colliery, commenced work yesterday week at 4s. per day, being a reduction of 6d. The miners on the Wishaw estate are, therefore, little likely to obtain an advance this month.

From the Wishaw district we are also told that the workmen employed by Archibald Russell, Esq., have now got the advance of wages which it was originally agreed should come into force on the 1st of November last, but which, in consequence of the flat state of the coal market, was deferred till 2nd current. The miners employed by John Wilson, Esq., are still on strike, no arrangement having yet been made between employer and employed. The other pits in the neighbourhood are all wholly or partially working.

Notice was given on Saturday last to the miners connected with the various collieries in the Hurlford or Kilmarnock district of a reduction of 6d. per day on the present rate of wages. The demand at the sale pits has been very slack for some time past.

RECIPROCATING WATER-METERS.

TO THE EDITOR OF ENGINEERING.

SIR,—As I see that in your last issue of *ENGINEERING*, you have inserted an article written, evidently by its want of fairness, not by yourself, to show that the meter manufactured by this company is "necessarily uncertain of action," while that of the Manchester Water-Meter Company is "certain of action," will you kindly, in the cause of fair play, insert this, as the "case for the other side."

To work a meter with the least difference of pressure, it is "not in all cases" requisite that the reciprocating piston "shall merely change the position of a smaller valve." For instance, in the case of the Manchester Water-Meter Company's meter, one valve might be substituted for the two now employed, that would work with less friction than the smaller of these, and therefore with less loss of "head."

If it be attempted to maintain the reciprocations of the piston by causing it to *directly* (as I read the word "directly") open the regulating or controlling valve, it is *certain* "that the piston will stop after having moved the valve but half-way in its course," as the confined water on the exhaust side of the cylinder will, by its incompressibility, resist its further motion.

"In the affair known as Myer's," the reciprocating piston "does not knock open" the reversing valve at the end of each stroke; it compresses *during the stroke* a couple of steel springs, or extends a pair of india-rubber springs, or, in the case of the larger sized meters, raises a small weight, which on the completion of the stroke, being released, act upon an intermediate rigid rod and instantaneously reverse the valve, "the old, old expedient" "of so arranging a pair of springs, that, during the first half of the motion of the valve they shall resist its action, while during the last half they shall 'help it,' not being required, as the springs which are used do not act upon the valve at all until the end of the stroke of the piston."

I think it does need an "explanation to show that the London and Westminster Meter Company's meter cannot 'be depended upon for certainty of action,' and 'that, after a considerable period of use, it would not measure at all,' although it requires none to show that 'their meter would, when in perfect working order, measure accurately,' as the article candidly admits.

"When we remember that there are dozens of piston-measuring water-meters, the following extract from Myer's 'prospectus,' certainly would read 'impudently enough,' if it rested its claim for excellency merely on the fact that it is a piston-measuring water-meter; but when it founds its claim upon the fact that it combines with the advantages of a piston-meter those of possessing a valve, which is described in the prospectus as working almost entirely without 'friction,' and of being light and compact, that claim being fully substantiated, there is no impudence in the matter. 'The excellency of this instrument as a water-meter consists in its measuring the water by means of a movable division or piston fitted accurately to the interior of the cylinder, so that instead of an inferential there is an actual measurement of every quantity of water drawn through it, combined with the peculiar valve by which the water is admitted, first to one side and then to the other side of the piston, and also the lightness and compactness of the whole.'"

If you will allow me, I will draw a slight comparison between the two meters.

As the pistons in each are similar, the friction and wear in each will be the same.

The valve in Myer's meter is very simple, almost frictionless and single; the valve in the Manchester Water-Meter Company's is complicated, has four wearings, which are exposed to a disadvantageous pressure of the water, and is moreover a double valve.

The valve in Myer's, not being exposed to wear, will never be any the worse for it; the valve of the Manchester Water-Meter Company is exposed to a most prejudicial wear, and will soon be the worse for it, for the following reasons: Its main valve has attached to each end of it, rigidly, a piston working in a shallow cylinder, which is *fixed*; as the valve wears away, the pistons are brought out of truth with the cylinders, and consequently, the pistons get light and worn away on the lower side, which will act disadvantageously in more ways than one, or if the substance of which they are composed resists wear more than the valve, they hold the valve away from its seating, and the machine ceases to be a meter!

The water in Myer's meter is not admitted to any of the working parts, except the piston; in the Manchester Water-Meter Company's meter, it is admitted to all, and a little sand or mud would make short work with the valves and index. The cover of Myer's meter, on this account, needs only to be strong enough to protect the meter from being tampered with, whilst that of the Manchester Water-Meter Company's meter must be sufficiently strong to resist the pressure of the water, and consequently must be heavy.

As for the certainty of action of Myer's meter, compared with that of the Manchester Water-Meter Company's, it is greater by far, for wear in its moving parts will not affect its action (and the article referred to admits of its being capable of being put in working order), while it will seriously affect that of the Manchester Water-Meter Company's meter.

To carry my comparison into the prices of the two meters, those of Myer's are little more than one half of those of the Manchester Water-Meter Company's.

Apologising for thus trespassing on your space,

I remain yours faithfully,

ALFRED WILLMER POCOCK.

London and Westminster Meter Company (Limited),

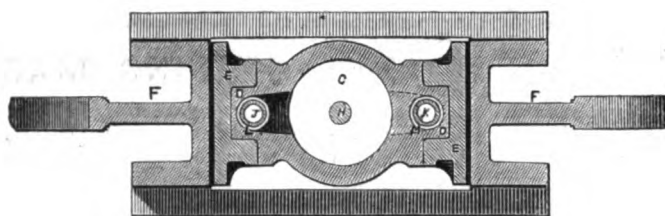
Johnson's-place, Lupus-street, S.W., Dec. 12, 1867.

[The article to which our correspondent refers was written by the Editor, and those who wish to test its conclusions, should either take the advice of any competent and disinterested engineer, or, which would be less satisfactory in the result, buy and use one of the meters. The mechanical expedient relied upon, is very old, and it cannot be depended upon to work with certainty for a lengthened period.—ED. E.]

STEAM HAMMER AT THE ATLAS WORKS, GLASGOW.

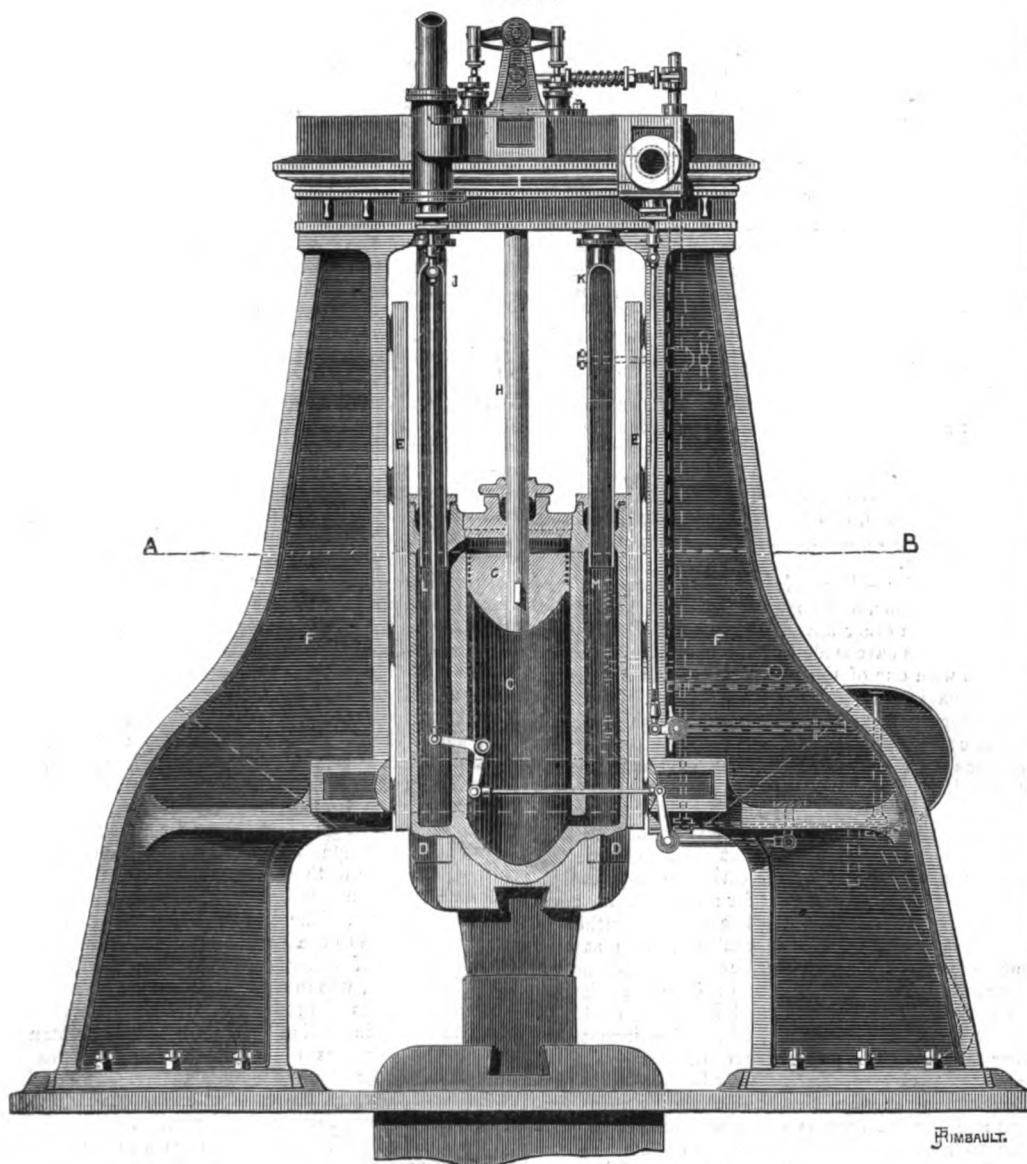
MESSRS. ROWAN AND CO., ENGINEERS.

FIG. 2.



SECTION AT A B.

FIG. 1.



WE give above an illustration of a very convenient modification of the Condie hammer which has been introduced by Mr. Rowan in his own works at Glasgow, and has given perfect satisfaction in working now for several years. Mr. Rowan has dispensed with the hollow piston-rod of the Condie hammer, and makes his steam-passages enter the moving cylinder at the sides, thereby obtaining a pair of straight circular guides for the movement of the hammer-head. The steam pipes are fixed to the entablatures of the hammer-frame, and pass through stuffing-boxes in the cylinder-top. One passage, T, is used for the single action of the hammer while the other pipe, K, takes the steam to the bottom of the steam cylinder, and makes the hammer double-acting. The Condie hammer in its original form was particularly difficult to manage when double action was wanted. Messrs. Musgrave and Sons, of Bolton, patented an arrangement of that kind in which the central piston-rod is divided into two different passages, and these hammers have come into considerable use. The present modification seems to be still more convenient, and it combines the advantage of providing ample sections of steam pipes and exhaust passages, and at the same time assisting the steadiness of the hammer-head in working. The arrangement will be readily understood by reference to the engravings.

THE SOUTH-EASTERN RAIL TESTS.

MR. ASHCROFT, the engineer to the South-Eastern Railway Company, has earned the best thanks of the profession by placing in our hands, for publication, the important series of rail tests which he has carried on during the last ten years. Few engineers would volunteer such full and suggestive information upon points so closely involving questions of the failure of the materials adopted by them in their practice, and involving, also, to some extent, the reputation of a large number of manufacturers. Few engineers, indeed few men of any profession or calling, will impart information spontaneously, and many will, even when on oath, fence with counsel to avoid "committing themselves," a consideration too often held as of greater importance than that of telling the truth, the whole truth, and nothing but the truth.

We cannot but allow, however, in considering the readiness with which the South-Eastern Company's

engineer freely placed his records in our hands, for the contempt, if it was not indeed indignation, with which he, in common with other permanent way engineers, had observed the interested cant lately started as to the "molecular deterioration" of a material so greatly superior to iron, viz., steel. The fact that a double-headed steel rail, which had shown the most extraordinary durability ever recorded of any rail, had at last been broken by great violence, and that *sideways*, was reported as having proved that "it had behaved as an iron rail worth 5 $\frac{1}{2}$ per ton would have behaved!" and it was asserted, with all the confidence of quackery, that its failure had been caused by "molecular deterioration," an infirmity to which all steel was necessarily subject. So much is generally conceded to the editorial impersonality, that many might have supposed this astute opinion to have been enunciated by some competent person, some eminent physicist or metallurgist. But no gentlemen of this class, as we happen to know, employ their pens in the journal in which the nonsense in question appeared. It was written indisputably by a young and comparatively unknown Irishman, who has had no practical experience with railways, otherwise than as a passenger, and none but the most superficial and Quixotic with engineering in any form whatever.

Mr. Ashcroft's records show but too plainly what a treacherous material is the iron rail of commerce. That many iron rails are good and moderately durable none can deny. Indeed, were we still using cast-iron rails, it is beyond doubt that many remarkable exceptions to its general brittleness would be found in favour of that material. But there are wrought-iron rails which broke, under Mr. Ashcroft's tests, as if they had been pig iron. One broke by being lifted by two men and dropped across the beak of the anvil. The piece was a short one, and weighed but about 80 lb., and the lift could not, from the height of the anvil and the reach of the men, have been a high one. Many others are marked "rotten," "bad," "questionably safe," &c. We give *all* the tests recorded, without selection or exclusion, nor have we any reason to suppose that the experience of a great company like the South-Eastern differs from that of other railway companies.

The steel rails tested did much better. Indeed, with but one or two exceptions, none were broken. One was evidently made too hard, with reference to a high degree of durability. But unlike iron, the quality of steel is now known to be completely under control, so long as the chemical tests for sulphur, phosphorus, and carbon, now employed at the best steel works, are observed, and the steel-maker can, almost at will, make either a hard or a soft rail, while the iron rail which the ironmaster may wish to be soft may turn out hard.

In connexion with Mr. Ashcroft's tests, we will here give those made upon Bessemer steel rails rolled last month at the works of the Bolton Iron and Steel Company. The rails were double-headed, and weighed 68 lb. per yard. From each of twelve days' rolling, a rail was taken indiscriminately by the inspector, and two lengths of 4 ft. were cut from it. One of these was tried, supported upon 3 ft. 6 in. bearings, by 20 tons dead weight; the other piece was tested, on 3 ft. bearings, by a ram of 1 ton weight (seven times as heavy as that employed by Mr. Ashcroft) falling 30 ft. at a single blow, only one blow being given to each sample. The anvil supporting the chocks on which the rail rested weighed 10 $\frac{1}{2}$ tons.

The tests were as follows:

	20 tons dead weight.		30 ft. drop test.	
	Deflection.		Deflection.	
November 12	in.		in.	
" 13	1		6 $\frac{1}{2}$	
" 14	1		7	
" 15	1		5 $\frac{1}{2}$	
" 16	1		4 $\frac{1}{2}$	
" 17	none rolled.		—	
" 18	do.		—	
" 19	1		5 $\frac{1}{2}$	
" 20	1		6	
" 21	1		6 $\frac{1}{2}$	
" 22	1		6	
" 23	none rolled.		—	
" 24	do.		—	
" 25	do.		—	
" 26	1		6	
" 27	1		7	
" 28	1		6	

It will be seen that the quality of the rails was remarkably uniform. None of the rails broke. We have a sample of one of the fractures, purposely broken afterwards, by nicking and repeated blows. The fracture is excellent. Fine, close, granular, and perfectly uniform throughout.

LITERATURE.

Austrian Government Report on the Paris Exhibition. Officieller Ausstellungs-Bericht. 1867.

THERE is a literature of the waste-paper basket—books which, were they to follow their natural destination, would pass from the printer's straight away to the waste-paper dealer's hands, and which in reality form the ballast of the booksellers' stores and the immobiliaries or "fixtures" on the shelves of a library. We have in this country examples of this class in many volumes "printed by order"—parliamentary blue-books, of which we do not deny the necessity and propriety of existence, while we are accustomed to look for them uncut and unread in the antiquaries' shops, or in places of a much less dignified literary position. On the Continent the official reports on international exhibitions, printed in the name and by authority of paternal imperial and royal Governments, and at the expense of their respective subjects, stand prominent in this line of literature, and their behaviour in the market has become quite proverbial with Continental booksellers. Considering the nature of these volumes and the manner in which they are produced, this is not at all astonishing. A report on the heterogeneous mass of articles collected together at a great exhibition is necessarily an unwieldy compilation of treatises, which have no connexion amongst each other, and no other mutual influence except the crowding out of all useful and detailed information upon any one branch by the space required for another class of articles. The large amount of "printed matter," and the scantiness, if not absence, of valuable information, which such a volume offers to its purchasers is in itself a bad bargain—however cheap the paternal Government may fix the selling price—and this alone would account for the unpopularity of books of the kind, were they even written by acknowledged authorities, and edited in a suitable way. But this is very rarely the case. Men of standing are unwilling to write unless they see a prospect of their productions being read and appreciated, and the mere glitter of a crown is not always—although it may be occasionally—sufficiently attractive to entice such authorities to take a share in these official productions. In Germany the popular feeling has become so manifest in that direction that the Prussian Government have given up the idea of publishing any report, and have followed the example of the British commission in inviting some suitable parties to write short papers for publication in one of the Berlin journals. In France the official report is at the same time the report of the juries, and has therefore a better *locus standi*; moreover a provision has been made to allow each reporter to get his report printed in the form of an extra pamphlet for the mere cost of the paper, and some of these single pamphlets will therefore have a fair prospect of a proper circulation, each standing upon its own merits. The Austrian Government report, of which a small portion is now before us in the proof-sheets, is likely to prove a total failure from the want of similar provisions. Its editorship is practically anonymous, since the name of Dr. Franz Neumann is no name at all, if we look for names in the registers of scientific authorities or catalogues of literature. The majority of the actual reporters is of the Neumann class, and, to get some names of standing upon the *title-page*, Baron Burg and Professor v. Schrötter have been asked, not to write a few lines, but to look through the writings of those literary nonentities, and thus to reflect a certain borrowed light upon these latter. Two well-known authorities on mining and metallurgy, M. v. Rittinger and Professor v. Tunner, who have accepted nominations as reporters, published their reports long ago independently, so that the "official" report will have to reprint these respective portions from "unofficial" sources. Of the original matter contained in this report we are not as yet in a position to give numerous quotations, but we translate the following from the report on "Railway Materials," and we believe it speaks for itself.

"Water-feeding Apparatus.—Water-cranes and one "water-reservoir for feeding locomotives show nothing new."

The "official" critique on English steam-cranes is as follows:

"England: Appleby Brothers, London; Taylor, Britannia Works, Birkenhead; Stothert and Pitt, Bath, are all exhibitors of portable steam-cranes."

There is no denying the perfect impartiality of such official criticism. On railway axles this oracle says:

"Axles.—Carriage-axles we find of iron (close-grain

"iron and fibrous iron), puddled steel, Bessemer steel, "and also numerous specimens of crucible cast steel. "Belgium shows particularly iron axles. Puddled-steel "axles are made in Prussia, which is very well represented by the Phoenix Iron Works. The excellent "steel works of John Brown and Co., in Sheffield, "make axles of their peculiar Atlas steel."

We believe these few sentences are quite sufficient to characterise the knowledge and style of the writer, and to justify no great expectations of the gross bulk of this official report. Under such circumstances it is our duty—and we claim some credit for this act—to draw out of this heap of literary rubbish one single chapter of considerable merit and value—a production worthy of a better fate than is, in all probability, awaiting it in the company in which it is placed, and which we should like to see appear by itself in the form of a small pamphlet or book, in order to save it from oblivion. This chapter is the report on "Locomotive Engines," written by M. Josef Ritter v. Stummer Traunfels, the engineer of the Northern Railway of Austria, whose name will now be familiar to most of our readers. M. v. Stummer visited the Paris Exhibition as a member of the jury, and he studied his subject with more than usual attention and care. He has, moreover, very freely availed himself of the information and drawings which have been published in our pages—a course to which he is all the more welcome since the coincidence of his general views with our own has not impaired the originality of his observations and of his style of argument. If we say we recognise "our school" in M. Stummer's writing, we know that nobody will be more fully aware than himself that we are paying him a compliment, since our columns are only the mirror for modern engineering practice in this country, and their "school" is the teaching of all successful engineers all over the world. M. Stummer's report on locomotives is a very concise and well-arranged paper on the locomotive practice of 1867, as represented at the Paris Exhibition. His general introduction we translate *in extenso*, and we shall, on a future occasion, give some abstracts of his critiques on some of the most characteristic types of locomotives. We think it right to add, that M. Stummer writes very elegant German—precise, fluent, and very rich in expression, and we must, therefore, translate somewhat freely in order to follow his meaning rather than his words.

"Introduction.—If we look at the history of the locomotive engine, and compare it with the course of progress which other branches of theoretical and practical mechanics have made in contemporaneous periods, we meet with one of the most curious and instructive phenomena in the history of civilisation. The locomotive engine, as produced and put into the shape of a complete mechanism by Hackworth, Gooch, Stephenson, and some other engineers, was originally so correct in its principles, and its design was so thoroughly practical, that, whatever may be said and written to the contrary, there has been no important change made in its construction up to the present day. This perfection of the locomotive in its early stage of development formed in itself a barrier for all further improvement of its general design. The other branches of mechanical industry, on the contrary, were at that time so far beyond the proper demands of locomotive construction, that the very tools for the manufacture of all parts of the engine, and improved modes of manufacturing the materials, had to be invented in order to attain the required degree of precision in the making of each single part. Very few engineers only have realised the truth that the locomotive in its simplest and original form is sufficiently perfect in principle to require only a high degree of precision and excellence of workmanship in order to do all that can be desired of its practical performance. Those few, however, who, with a far-seeing eye and clear judgment, have looked to these practical points have been eminently successful as constructors of locomotive engines. They have been the objects of wonder and of envy for their less clear-headed colleagues, who preferred the road of ingenious and piquant originality, and endeavoured to stigmatise their betters as enemies of progress, who should be driven from the field by the creation of wonderful and complicated, though not practically useful, machines. There appeared, consequently, long boilers and short boilers, great wheel bases and small ones, large and small wheels, outside and inside cylinders, and many more simple alterations of detail held up by their respective inventors as indispensable conditions for superior performances of locomotives; and these so-called improvements followed each other so rapidly, and were very often so diametrically opposed to each other, that engineers had hardly time

to consider one proposal before they were expected to try the very reverse principle at the bidding of some other authority. It is only from this consideration that it becomes possible to explain the endless protraction of controversies about the merits and demerits of two or four or eight cylinders of tank-engines and tender-engines, of articulated and stiff couplings, of which even the most dispassionate members of our profession cannot keep aloof. The International Exhibition of 1851 produced the first result of this search for originality in locomotive design. This was the Crampton engine, which in its own native land has been discarded after a short experience as one of the most dangerous enemies of the permanent way, and which has held its ground only on some Continental railways for a considerable length of time. The next 'improvement' in the direction of locomotive designing appeared at the Paris Exhibition of 1855. This was the Engerth engine, called into existence with the special intention of transmitting power from the engine wheels to those of the tender by means of cog-wheel gearing, and thereby utilising the weight of the tender for adhesion. This system had lost its right of existence from the moment that experiments had proved the practical impossibility of working such a mode of coupling. The fact that for years after the cog-wheel coupling had been discarded these mutilated constructions were worked and copied, and designated as 'Engerth engines' by professional men, shows how little their real principle has been recognised. Only at a very recent date, and after a long and embittered contest of parties, has this system found its proper place in the estimation of the great majority of locomotive engineers, and it is to be expected that judgment will be passed upon it accordingly in future. Since the Engerth engine gained a 'grand prix' at the Paris Exhibition, locomotive constructors would no longer content themselves with anything that was simple. 'Improvements' followed each other with increased rapidity, and grew more and more complicated and impracticable from day to day. The London Exhibition of 1862 contained no less than three such novelties, or so-called new systems of locomotive construction. M. Petiet's engine, with its colossal boiler, superheater, and feed-water heater, Haswell's duplex engine, with four cylinders and corresponding cranks and counter cranks, and a new and enlarged edition of the Engerth engine—the engine 'Steierdorf'—formed this remarkable group. They represented the tendency of the time in the most pregnant manner; and on examining the London Exhibition of 1862, the question for the first time was raised in proper earnest, whether it be possible to move on still further on this dangerous road of so called progress in locomotive engineering; and if the point then arrived at was not one of those extremes at which every progress is impossible, and a complete return upon the road is the only remaining step to be taken. In what degree such a reaction has taken place, and how far the hopes and fears entertained upon this subject have been realised, at the Exhibition of this present year will be shown in the detailed examination of the different locomotives exhibited at Paris. The greatest number of exhibited engines belonged to the French department, while the representation of other countries, and particularly that of England, was in no way proportionate to their respective powers of production. One fact is worthy of notice as an indication that the proper understanding of the purposes of international exhibitions is rapidly spreading amongst manufacturers. This is the readiness with which the greatest and most celebrated locomotive-makers furnished information upon all details connected with their constructions to the professional visitors of the Exhibition. There were only a very few firms, mostly of very inferior standing, who considered it more to their interest to practise a ridiculous system of mysteries and mystifications."

We shall, as we have said, consider M. Stummer's report further on an early occasion.

THE CLEVELAND IRON TRADE.—The pig iron market at Middlesboro, is quiet and not much business is reported, but prices are about maintained. Some large cargoes of pig have been lost in the recent gales, and will have to be replaced. The stock of pig in the district is not considered to be increasing. The foundries of the district are only moderately busy. The manufactured iron trade of the Cleveland group is still dull. A few rail inquiries for spring delivery, and other supplies for 1868, are in the market for the United States, but in a very questionable shape. A little more activity among iron shipbuilders is reported from the Clyde, and there is rather more doing in the Tyne and Wear, but the demand generally for plate and angle iron continues limited. The home and Continental demand for merchant rails is small.

THE TELEGRAPH TO INDIA.

A SHORT time since, two companies issued their prospectuses with a view to raise capital for the construction of direct and independent telegraph lines from this country to India. We took occasion then to examine into the respective merits and advantages of the respective projects in an article which appeared at page 57 of the present volume of *ENGINEERING*, and having minutely gone into the proposals of the two companies at that time, it is not necessary to do more now than refer to the former article on that subject. One of these companies, however, is now endeavouring to obtain a Government guarantee on the required capital, and a memorial with that object, signed by numerous leading merchants in London, has been submitted for the favourable consideration of the Secretary of State for India. The subject of direct telegraphic communication between England and India being thus again brought publicly forward, we may, with advantage, revert to it here, with a view to point out the necessities that exist for a such a line, and the drawbacks to the working of the present system.

About the year 1863, after the failure of the Red Sea cable, a new means of submarine communication from India westward was found in the Persian Gulf. Under the superintendence of the late Lieutenant-colonel Patrick Stewart, this cable was laid from Kurrachee to the mouth of the Shalt-el-Arab, and, at the active instigation of the same officer, a convention was concluded with the Ottoman Government, stipulating for the use of a land line in course of completion through Asiatic Turkey, from Scutari to Fao. Further, and to provide against accident between Bagdad and Bushire, negotiations were opened for an alternative land line through Persia, of which these two stations were the termini. The cable from Gwador to Fao was laid in March, and the Turkish convention signed in September, 1864. The Turkish Asiatic land line first took messages from the cable in February, 1865, and the Persian auxiliary line opened in the following month.

A telegraphic despatch to India from this country is, according to existing arrangements, given in the first instance to a telegraph company over whom the Government has no control. Neither has our Government, as yet, become a party to the Paris Telegraphic convention, although negotiations for that purpose are now being carried on. At present, therefore, it sends its own ordinary despatches much in the same way as a private individual. The Indo-European message does not therefore start from the Government hands at all. In finding its way to India, the telegram may take one of two great alternative lines—the Russian or the Turkish. To reach Turkey, or rather Constantinople, there are two principal ways, *via* Vienna or Turin. The former transmits its despatches by Servia, Wallachia, or such other route as may seem expedient. The latter, choosing the Italian coast-line and cable across the lower Adriatic, seeks the Turkish capital by Salonica and the western shores of Marmora. Once arrived at Constantinople, the India-going message comes under theegis of a convention called the “Indo-Ottoman.” This provides it with an exclusive wire through Asia, and regulates its tariff up to Fao, where a British staff awaits it for despatch by cable. But from Constantinople to Fao, or about one-third of the whole distance from London to Kurrachee, the administration is Turkish, and a convention in Asiatic Turkey is not like one in the heart of Europe. The British Government may provide for the exclusive use of one out of two wires; the Turks may, in their anxiety to do well, set up a third and in some places a fourth wire; but no provision can be made that the line shall be in working order, and the wires free from contact. The British Government may ascertain, by inspection and inquiry, what is requisite, and advise the administration accordingly; but it is out of their power to control the Government of a foreign power as if it were their own. The telegram in Asiatic Turkey is, therefore, to a great extent, at the mercy of unsystematic and unskilled superintendents and signalers, and a poorly qualified executive, except in the lower grades, where there is activity and intelligence as well as good will.

Sometimes the telegram turns off from Bagdad, and makes its way, by the Turko-Persian frontier at Khanikeen, through Persia to Bushire. In this country there is a British director and staff, whose control is so far exercised, that a message may be said commonly to traverse the 1100 miles of telegraph now set up in about an hour. But the local Government is disinclined to delegate its authority over line guards to the English officers who direct the working

of their Indo-European telegraph, and, consequently, there are occasional interruptions through breakage, and the posts are not always of sufficient strength, or examined and renewed with sufficient attention.

From Fao to Kurrachee, as also from Bushire to Kurrachee, is the only section of the whole line exclusively under Government control, and for which Government and its officers are directly responsible to the public. It is submarine, and therefore, needs no provision for daily watching. The cable stations at Gwador, Mussendorn, Bushire, and Fao are supplied with efficient establishments, and the director at Kurrachee has his own particular staff. With the exception of two or three interruptions in traffic, owing to breaks in the cable, this line has worked admirably, and has realised good returns. In addition to this, there is also the land section, or alternative line between Kurrachee and Gwador.

It will thus be understood that Government exercises no absolute control over outgoing telegrams to India, until they reach the submarine cable at Fao or Bushire; and no qualified control, except in the Persian alternative line. Home-going telegrams are despatched by Government officials, but fall out of all Government control on reaching Turkish territory, whether at Fao or the Persian frontier at Khanikeen.

In 1866, efforts were made in order to obtain an exclusive line through France and Austria to Constantinople. Lieutenant Colonel Goldsmid reported on this subject, under date 27th October of that year, that “M. de Vougy told us plainly he was ready to ‘meet our wishes, but that it was useless to arrange ‘simply for a special wire through France, unless ‘Austria would do her part as well.’ In May of the present year, Mr. L. W. Courtenay in writing to Lieutenant-colonel Goldsmid stated, ‘M. Brunner ‘has arrived here (Constantinople), and we have had ‘several meetings with Agathon Effendi. The Austrian director-general appears decidedly to object to ‘give us a special exclusive wire, but offers us ‘two direct special wires to Vienna—one *via* Bosnia ‘and the other *via* Belgrade. Our messages to ‘and from India are to have priority over either ‘of these wires, even over their own Government despatches, which would be sent by a third ‘direct wire in case the other two should be taken up ‘by our messages.’ This offer her Majesty’s ambassador at Constantinople was authorised to accept.

About the same time, viz., on the 6th May last, Lieutenant Goldsmid, writing to her Majesty’s minister in Persia, stated, “Major Champain appears to ‘have arranged, in concert with the Russian and ‘Prussian telegraph administrations, a means of communication between England and India, which promises to furnish at least a good alternative to the ‘Ottoman line in the event of interruptions on the ‘latter.’”

The irregularities accompanying the despatch of telegrams between England and India occur sometimes in the course of their transit through Europe, and at other times are clearly traced to the maladministration of the Ottoman telegraphic system. In December last, a very numerous signed memorial from all the respectable bankers and merchants of Constantinople was presented to Ali Pasha, describing in the most explicit manner the disgraceful state of the telegraph service, its corruption, and the absolute necessity of something being done to improve it. After a month’s delay, doubtless for the purpose of inquiring, Ali Pashi replied to the memorialists that he had every reason to be satisfied with the system. Viewing the prospects of effecting any real improvement in the working of the Turkish telegraphs as highly uncertain, Major Champain considers that it would be best, if possible, to avoid them altogether. In a letter to the Under Secretary of State for India, of 12th February last, that officer wrote: “I have ‘said that the Constantinople line is working badly, ‘and I allow that the opposition line by Russia and ‘Persia is no better; but it must be remembered ‘that, from the day the Indo-European line was ‘opened to the public, we have never ceased urging ‘reforms at Constantinople, and endeavouring to improve the telegraph organisation. The difficulties in ‘the way of obtaining a special wire from England to ‘Turkey are great, because the line passes through ‘many administrations who naturally, take comparatively little interest in the fate of through messages. ‘On the other hand, the line *via* Prussia and Russia ‘to Persia is, I may say, entirely in Prussian and ‘Russian hands as far as Julfa, the Russo-Persian ‘frontier. From London to Julfa the line is generally ‘well worked; but, unfortunately, the Persian line ‘from Julfa to Teheran, a length of about 500 miles,

“is not to be trusted, and up to the present, we have ‘had but one wire for half the day between Teheran ‘and Bushire. Our second wire is now being attached ‘along the last-mentioned portion; and if we can ‘but improve the line between Julfa and Teheran, the ‘telegraph to India, *via* Russia, will, I think, be ‘better than that *via* Turkey. A proposal has, however, been made by the well-known firm, Messrs. ‘Siemens Brothers, which, if carried out, will, I am ‘convinced, give general satisfaction.” That firm, it appears, have obtained promises of concessions from both the Prussian and Russian Governments, under which they would be permitted to construct, and entirely work, a double line of telegraph extending completely through Prussia and Russia to the Persian frontier. They would have to pay a royalty on each message, and would be debarred from interfering with the local traffic. But, in order to enable them to raise the sum of money required to accomplish this work, they were desirous of obtaining certain assurances from the English Government. A submarine cable in the Black Sea, to avoid the one physical difficulty presented by the Caucasian range, forms a part of their scheme. The Messrs. Siemens considered that, if a trustworthy line be once established, and the confidence of the public obtained, the through traffic would quickly increase two or threefold, and that they could ensure this, and successfully compete with Turkey, if their line, good from London to Julfa, can be met there by a line good from Julfa to India. With this idea, they requested to be granted, by our Government, the four following conditions:

1. To put the Messrs. Siemens’s line upon as favourable a footing as the Turkish or other competing lines respecting the transmission of messages, leaving the public free to decide which line they wish to employ.

2. To obtain for the Messrs. Siemens British diplomatic support and countenance in Persia and elsewhere.

3. To provide additional means for the transmission of messages between Teheran and India, in case the existing lines should prove insufficient for the purpose.

4. To give the public the benefit of a reduced tariff between Teheran and India, when, in consequence of a well-established service between London and Teheran, a large increase in the number of messages will take place.

Such, then, is the present history of telegraphic communication with India, and we believe we are correct in stating that up to the present time no actual decision has been arrived at with reference to the measures to be adopted for improving the transit of messages through Europe. One thing is, however, certain, all lines traversing the Continent, whether through Prussia and Russia, through France and Austria, or by any other route, must be subject to interruptions in the event of war in any of the countries traversed by them. Neither is it desirable that we should be dependent on one line alone, but as many routes as possible for the transmission of messages should be made available, and if one line, such as that proposed from Falmouth *via* Gibraltar, Malta, &c., could be secured, being entirely free from all foreign interference and risk of interruption, that line also should, above all others, receive Government support.

WORKMEN’S VISITS TO PARIS.—In acknowledgment of the labours of Mr. Hodgson Pratt, vice-president of the Paris Excursion Committee, who, during many months, gave nearly his whole time to the work of organising and superintending the visits of British artisans to the late International Exposition, an address from returned excursionists, and an album containing the portraits of those who have seconded his efforts, will be presented to him at a *soirée* in London, early in January. It was hoped that the president of the committee, Mr. A. H. Layard, M.P., would have made the presentation; but as he is about to leave for the Continent, the hon. gentlemen has addressed to Mr. J. T. Dexter, who is acting as hon. secretary to the testimonial committee, a letter, in which the following passages occur: “It would have given me the sincerest pleasure to have borne my testimony to the zealous and unremitting exertions of Mr. Hodgson Pratt in arranging those excursions; to his admirable tact, judgment, and good sense; to his earnest and disinterested endeavours to promote the comfort of the working men who might avail themselves of the opportunity to visit Paris, and to his unremitting attention to the duties which he had so kindly and with so much devotion imposed upon himself, to the sacrifice of his own time and interests. The success of the excursions and the enjoyment and profit which they have afforded to a large number of persons, especially to some of the ablest and most intelligent of our working men, are entirely to be attributed to him. I would be much obliged to you if you would kindly make my sentiments known, and if you would at the same time express on my behalf the great regret I feel at being unavoidably absent from the meeting.”

RAILWAYS IN RUSSIA.

THE information published in England and on the Continent generally with reference to railways in Russia has been very incomplete, and in very many cases erroneous. The following details, drawn from official and authentic sources, may therefore prove interesting:

A.—Railways already open.

	Length in versts.
1. Petersburg and Tzarasloe Selo; capital of 1,764,465 S.R.=250,000 <i>l.</i> ; worked by a company without guarantee, and pays a dividend of 8½ per cent.	24
2. St. Petersburg and Moscow; constructed by Government; worked by them; Messrs. Winans being contractors. Cost 130,000,000 S.R.	604
3. Great Russian Railway Company, having a capital of 112,252,625 S.R. in stock and obligations; the former guaranteed 5 per cent., the latter 4½ and 4 per cent. The company have drawn on the Government on account of the guarantee about 80 millions of roubles, although the line from Moscow to Nijni-Novgorod pays well. The company has in work 1637 versts, i.e., Petersburg to Warsaw	1049
Branch Wilna to Prussian frontier at Eidkuynen	178
Moscow to Nijni-Novgorod	410
4. Riga and Dunabourg, with a capital of 11,500,000 S.R., guaranteed 5 per cent. by the Government, but paying 5,000 per cent.; mostly held in England	204
5. Dunabourg and Vitepek, being a continuation of the previous line; has a capital of 16,250,000 S.R., which is guaranteed 5 per cent., and is likely to earn at least that	243
6. Petersburg, Oranienbaum, Peterhoff, and Krasnoi Selo. Belongs entirely to the house of Baron Stieglitz and Co.	40
7. Moscow and Riazan; a capital of 15,000,000 S.R., guaranteed 5 per cent., paid last year 8½ per cent.	185
8. Riazan and Kosloff; capital of 10,800,000 S.R., guaranteed 5 per cent.; will most probably pay same dividend as the preceding. Opened in 1866	198
9. Riazan and Morshansk; capital 874,500 <i>l.</i> in shares and 749,000 <i>l.</i> in obligations; guaranteed 5 per cent. The station Riazan is on the preceding line, Riazan and Kosloff. The line was only opened on 10th December	120
The three last lines are part of the system to be completed by the Kosloff and Voroneje, and the Eletz and Griaskie, with other branches.	
10. Moscow and Yaroslaff, opened to Troitzs; capital, 3,275,100 S.R.; no guarantee; paid, 1866, 10 S.R. on 150 S.R. The further completion of the line is delayed for capital	67
11. Moscow and Koursk; building by the Government; open to Tula	181
12. Volga and Don—capital of 4,800,000 S.R.; guaranteed 5 per cent. by Government; paid, 4,000	73
13. Warsaw and Bromberg; capital, 5,880,000 S.R.; guaranteed 5 per cent. This line branches out of Warsaw and Breslau	151
14. Warsaw and Breslau; capital of 6,450,000 S.R.; guaranteed by the Government, on which the company have drawn 4 million roubles	291
15. Warsaw and Terespol; capital of 7,200,000 S.R.; guaranteed by the Government 5 per cent.; only lately opened	192
16. Helsingfors and Tavasthans constructed by Government	100
17. Odessa and Balta, and Odessa and Olvropol. This line is being constructed by contractors for the Government at present; open, and will be continued to Kieff	306
18. Novo-Tcherkask and Gronseheva. This line connects the former town with the coal mines at Gronseheva, and will be continued to Rostoff on Don, Taganrog, and also to join the Great Southern lines; at present open	70

B.—Railways Constructing.

21. Koursk and Kieff; capital of 500,000 <i>l.</i> in shares, and 8,000,000 <i>l.</i> obligations guaranteed by the Government. This line is to connect No. 11, the Moscow and Koursk	488
22. Kosloff and Voroneje, being continuation of the system from Moscow to Reazan, No. 7, and Reazan and Kosloff, No. 8. Capital, 12,495,000 S.R.; guaranteed 5 per cent. by Government; about	170
23. Eletz and Griaskie, being a branch from Kosloff and Voroneje, No. 22. Capital, 773,000 <i>l.</i> obligations, and 3,021,500 <i>l.</i> shares; guaranteed 5 per cent. These two latter lines are nearly complete, and will be both open in the spring; about	85
24. Shuya-Ivanova; a branch from the Nijni-Novgorod and Moscow line; capital 253,640 <i>l.</i> in shares and 507,280 <i>l.</i> in obligations guaranteed by Government 5 per cent. Will be opened in 1868	83

25. Riga and Mitava; capital of 2,652,000 S.R., guaranteed by the Government 5 per cent., about The Riga-Libau and Kovno-Libau are not yet in process of construction.	40
26. Poti and Tiflis; capital of 16,000,000 S.R., to be brought out in England. Meanwhile the Government are constructing the earthworks, and proceeding with same	241
27. Orel and Vitepek. This line was in the hands of Messrs. Peto and Co., and is now to be made by a Russian company connected with town councils, and under a guarantee of 5 per cent.	500
28. Balta to Kieff—being the continuation of No. 17 and the junction to No. 21; thus bringing Odessa and Moscow in direct communication in 1869, except break at Kieff, where a large bridge has to be constructed, to be finished in 1871	341

For opening in 1868 and 1869 1898

Beyond these there are many other lines in project, but really more which are so far advanced as to be named with the foregoing, such as Petersburg and Wiborg, Kovno and Libau, Kharhoff and Koursk, Morshansk to Zyratzin, Rostoff-on-Don to join Southern line Samara to Ekaterinbourg, &c.

It will be observed that most of the lines are guaranteed by the Government 5 per cent. Much of the capital has been obtained in Germany, some in England. In most cases the guarantee is given payable at par exchange, in England in sterling, in France in francs, in Germany in thalers.

The lines open are gradually developing the trade of the country, and receipts are gradually increasing. The last complete return is for September, and gives as follows:

Grand Compagnie:	S. R.
Warsaw branch	636,788.99
Nijni and Moscow	717,996.16
Riga Dunabourg	103,669.00
Moscow and Riazan	245,855.45
Moscow and Yaroslaff	44,962.08
Peterhoff Aranianbaum	23,012.68
Riazan-Kosloff	174,698.40
Dunabourg and Vitepek	102,601.00
Volga and Don	42,790.88
Varsovie and Vienna (Breslau)	218,540.66
Varsovie and Bromberg	89,725.49
Varsovie and Terespol	30,412.10

giving a gross return of 500,000 S.R. more than the return for 1866 in the same month, and making an allowance for increase of versts, of 300,000 S.R.

The returns of many of the lines will no doubt be considerably augmented when the other lines now in course of construction are completed. There is every probability of the trade of the country being not only very much increased, but also diverted into other channels. Thus, for instance, with the lines made to the port of Libau, and the line open connecting Orel with Vitebsk, produce from the south can be got direct to the Baltic without being nearer than 600 versts to Petersburg.

Great efforts are being made in Russia to supply as much of the materials from her own sources, and in the future greater efforts will be made. At present the aim of the department is not only to make railways, but to make them at home from home-made materials. St. Petersburg, December 9, 1867. H. B. F.

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. 652, 10*d.*) Silas Covell Salisbury, of New York, patents methods of reducing and refining metallic ores, more particularly ores of iron, and of converting iron into steel. The patentee proposes to force into blast or other furnaces used for reducing metallic oxide a blast of oxygen and hydrogen gases, or their equivalents, heated to a temperature of from 700° to 800° Fah., as well as a blast of a carbon gas obtained from hydrocarbons free from sulphur, phosphorus, ammonia, &c. The blasts are to be delivered into the furnace by means of a compound or divided tuyere. The patentee also claims converting iron into steel while the former is in the liquid state, and as it is delivered from the furnace in which the ores are reduced, by the application to or passing through this liquid iron a blast of steam or hydrogen and oxygen heated to a temperature of 700° or 800°, in combination first with an air blast, and afterwards with a blast of carbon gas. A small proportion of lead is also to be introduced into the fluid mass with a view of carrying off the sulphur and phosphorus.

Special appliances for carrying out the above processes are included in the patent.

(No. 661, 10*d.*) Charles Mace, of 14, Green-street, Sunderland, patents a steam boiler formed of a number of water spaces placed parallel to each other above the fire-grate. The water spaces are separated by small intervals, and at their upper ends they communicate with the main body of the boiler, which is of a $\square$ section. The heated gases from the fire pass up between the water spaces, and are led into a smokebox surrounding the main body of the boiler. An arrangement is provided for removing the scale from the lower parts of the water spaces, which are directly exposed to the heat of the fire.

(No. 672, 10*d.*) Lorentz Fidén, of Manchester, patents, as a communication from Claes Adelsköld, of Sweden, for making the bearings of railway axles so that they can move laterally in the axle-boxes, the lateral movement of each bearing being governed by a feather on its upper side, which works in a curved groove in the top of the axle-box. This is but a modification of Mr. W. Bridges Adams's well-known radial axle-boxes.

(No. 679, 6*d.*) Robert David Napier, of 20, Church-row, Limehouse, patents leading steam on its way from a boiler to an engine, through a "separator," in which a great proportion of the water carried with it is deposited, and from which this water is conducted back into the boiler. This use of a separator in this way is not new. Mr. Napier's patent also includes blowing off waste steam from a pipe or jet, into a larger pipe, in such a manner as to create a partial vacuum in the latter pipe, and draw in a sufficient quantity of water to condense the steam.

(No. 694, 8*d.*) Donald Nicoll, of Oakland's Hall, West End, Kilburn, patents insulating telegraph wires by plaiting them with fibrous strands and then covering the wires so plaited with insulating materials. The patent includes machinery for carrying out the process.

(No. 698, 1*s.* 4*d.*) William Clark, of 53, Chancery-lane, patents, as the agent of Léon Jarosson and Albert Bastaert, of 29, Boulevard St. Martin, Paris, a system of drying threads or fabrics by the combined action of centrifugal force and heat. In drying threads according to this plan, the hanks are hung on a frame within a turbine hydro-extractor, into which hot air is injected; whilst for drying fabrics, the latter are passed over grooved cylinders or drums, and at the same time exposed to the action of hot air.

(No. 702, 10*d.*) Thomas Burt, of Wandsworth, patents, as a communication from James Burt, of Velsen, North Holland, apparatus for transferring mud, sewage, and similar matters from the bottom of a watercourse to places where it may be required. According to this plan, the matters are dredged from the bed of the river or other watercourse in the usual way; but, instead of being discharged into barges, they are delivered into a hopper communicating with the case of a kind of centrifugal pump, which revolves horizontally, and is driven by engine power. The mud, &c., raised by the dredger enter at the upper side of the pump-case, whilst a supply of water is admitted at the lower side, and the mixed mud and water are forced by the pump through a system of jointed pipes to the shore, where it is distributed as required.

(No. 703, 10*d.*) Bernard Beard Walker, of North-road House, Wolverhampton, patents methods of constructing slide and other valves. In a cylinder fitted with a slide-valve, according to these plans, the exhaust port is arranged with its greatest length at right angles to that of the steam-ports, and in the direction of the motion of the valve. The slide-valve also, instead of having an opening or recess on its under surface sufficiently large to embrace the exhaust port and one of the steam-ports, with the space between them, consists of a hollow box, provided on its working face with three openings, arranged similarly to the ports in the cylinder face, but so disposed that the central or longitudinal exhaust opening of the valve will always work over the corresponding port in the cylinder face, whilst the other or transverse ports or openings will correspond alternately with one or the other of the cylinder steam-ports. The object of this arrangement is to reduce the area of the valve, upon which the unbalanced area of the steam can act. The patent also includes putting conical, or disc valves in a state of equilibrium by attaching to their spindles a flexible disc or cover, the circumference of which is secured to the valve-case. This disc is to be of such area that the pressure on it will balance the pressure on the valve, and at the same time it is to be sufficiently flexible to allow the valve to be freely lifted from its seat to the necessary height. Various methods of arranging the discs are described in the patent.

THE SMITHFIELD CLUB SHOW.

(Concluded from page 539.)

MESSRS. ALLCHIN AND SON, of Northampton, are makers of a special class of portable engines, with steel boilers and fireboxes, and with springs to the larger wheels. The crank-shaft is also of steel. The engine has, moreover, a superheater and a feed-water heater. The boiler is double rivetted, and intended for 85 lb. to 100 lb. steam, as required. The steel firebox is made of Shortridge and Howell's homogeneous plates, which the makers find to stand well. The outside firebox or casing, is carefully lagged, to save fuel. We do not approve of the round guide bars employed by these makers, but we suppose they form the only little departure from first-class practice which enables the makers to give so many and so important special features in an eight-horse engine selling for 230*l.*, or only 20*l.* above the scale price at which all English makers sell their ordinary portables of that size.

The Reading Ironworks Company have long made a neat pattern of horizontal condensing engine, but it is only this year that a condensing engine has been exhibited at the Smithfield Club show. We should perhaps observe, as a hint to the farmer, that although condensing engines save something in coal, they require for condensation about six times as much water as is fed to the boiler. The Reading Company exhibited a double-cylinder portable engine, the one intended for the Bury show last summer, but it could hardly have surpassed the performance of their single-cylinder engine, which really attained the best dynamical result of all in the yard, although it received no prize. The same makers exhibited fixed eight-horse engines, one of particularly simple construction and at a low price, viz., 85*l.* without boiler. In this engine we saw, what we do not recollect having seen before, the eccentric rod which worked the feed-pump continued, through a stuffing-box at the end of the pump, as a valve-spindle to work the slide-valve.

Barrows and Carmichael's double-cylinder engine had the cylinders near the smokebox, and had a large firebox, apparently for wood, well lagged to save fuel.

Tasker and Son exhibited their 24th engine, a rough imitation of Clayton, Shuttleworth and Co.'s.

Of the traction engines, Messrs. Aveling and Porter's, as on so many previous occasions, gained most attention for their simplicity and good proportion. The pitch chain is now encased in a sheet iron "tank," or casing in the manner originated by the French engineer, Albaret. This "tank" is kept partly filled with soap and water, which continually cleans and lubricates the chain while working, without any oil being required. Mr. Aveling employs his chain on the second motion, and therefore makes it of great strength and with especial care. Thus made, it lasts about two years in hard work. Other traction engines were shown, among them Messrs. Garrett's, in which the pitch chain worked direct from the crank-shaft to a wheel geared to the driving-wheel. Thus applied, the chain has but a moderate amount of strain upon it, and works at a comparatively high speed. Not enough is known to prove whether this is better than a stronger chain working at a slower speed.

As to steam cultivation, there was the well-known ploughing-engine of Messrs. John Fowler and Co., their eight-furrow balance plough, and their 12 ft. cultivator. Although the two latter were not absolutely new, they were virtually novelties of the present year, and implements of the same construction are getting through a daily acreage of light land which, even two or three years ago, would have been thought incredible.

Messrs. Howard's transverse boiler engine was again shown, and it is undoubtedly gaining in favour. Their system of cultivation, now well known, was not represented by implements, but their plan of working two implements continuously, so as to work both engines of a double engine set without intermission, is obviously an improvement upon the more usual plan.

Mr. J. Phillips Smith, of Hereford, exhibited his system of double-drum engines by drawings. If his plans are not contested by other engineers upon questions of novelty, he will give a new impulse to steam cultivation. Seven of his engines are now being made by the Worcester Engine Company, and we have in former numbers recorded our opinion of the simplicity and general merits of their arrangement.

Messrs. James and Frederick Howard, of Bedford, exhibited a new reaper and mower, which has cut about 500 acres of corn during the past harvest, and has been found to perform its work with the greatest efficiency under all circumstances. This machine em-

bodies several important improvements. Unlike ordinary reapers, it has two driving-wheels, and the draught-pole is arranged so that the evil of "side draught" is avoided. The gearing for working the knife-bar is independent of that by which the rakes and gathering-arms are driven, and this latter gearing can thus be made much lighter. In the gearing for working the cutter-bar, bevel gear is used for the first or slower motion, and spur gearing for the second motion, this arrangement giving a smoother action than that usually employed, and enabling the speed of the knives to be readily varied by altering the size of the spur-wheel and pinion. The crank is also brought down very low, so that the connecting-rod works nearly in a straight line with the knives. The main frame being carried by two driving-wheels, the cutter-bar is hinged to it, and it can thus freely adapt itself to uneven ground, so as to ensure the full cutting action of the knives. This plan of hinging the cutter-bar is a new feature in reaping-machines. Another new feature is an arrangement by which the points of the fingers can be raised or lowered whilst the machine is in action, thus enabling it to cut laid crops, even if they are laid in the direction in which the machine is advancing. The cutter-bar is placed behind the driving-wheels, so that it is *drawn* over obstructions; and it has a raised projection on which the knife vibrates, so that any grit or dirt falls away from it instead of working under the cutters. The motions of the rakes and gatherers is regulated by a pair of annular cams placed one within the other, the advantage of this arrangement being that both the rakes and gatherers are made to follow, independently, the courses necessary to give the best action. The cam governing the motion of the gatherers is so shaped that it allows them to drop down into the grain and bring it forward to the cutters, and then causes them to rise again and clear the cut grain on the platform. The machine is altogether well designed, the framework being constructed wholly of steel and iron, and there being as few working parts as possible. Messrs. Howard adopt the excellent plan of making all the details of these machines exactly to gauge, so that any damaged portion can be renewed without difficulty or delay.

Near their reaping-machine Messrs. Howard also exhibited a small water-tube boiler made on their patented plan. Messrs. Howard's boilers were described and illustrated in our pages many months ago (*vide* pages 57, 181, and 182, vol. iii.), so that it will be unnecessary that we should enter into any detailed account of it here; we may, however, state that Messrs. Howard, instead of placing the fire-grate in front, as they did in their first boilers, now place it below the horizontal bottom tubes, and cause the heated gases to twice traverse the length of the boiler amongst the vertical tubes. This is an improvement, and we believe that it has been found to equalise the circulation, and render the evaporative power of the various parts of the boiler more uniform. Messrs. Howard have been very successful with these boilers, and they are now getting them extensively adopted.

The chief novelty at the Reading Company's stand was the "clipper" mowing-machine, an American implement of which the Reading Company have taken up the sole manufacture in this country. The design of this machine is excellent, all the details being admirably proportioned. Two driving wheels, with wrought-iron spokes and cast-iron rims and bosses, carry the main frame, which is composed of pieces lying in different planes, the arrangement being such that the draught of the horses, in addition to imparting a forward motion to the machine, tends to lift the shoe, and with it the cutter-bar, &c., off the ground. The advantage of this is that, in ascending an incline when the horses are pulling hard, the knives are raised slightly, whilst, in descending a hill, when but little pull is exerted, the opposite action takes place. The knife-bar is situated slightly in front of the line of the driving-wheel axle, and this raising and lowering of the bar maintains a regular and close cut, and prevents any "digging in" of the points of the cutters when ascending rising ground. A contrivance is also provided for changing the position of the knives and fingers from a level cut to an angle of 30° whilst the machine is in motion, so as to adapt it for cutting grass which is laid from the machine. The driving-wheels are so placed, that the inner one follows in the path of the inner shoe; and as the distance between the wheels is exactly suited to the length of the outer-bar, the driving-wheels cannot beat down the cut grass. The end of the finger-bar can be raised about 18 in. above, or dropped the same distance below, the level by means of a chain and lever provided for the purpose, and it can also be folded close up to the machine to enable the latter to be turned in a small

space. The pole of the machine, which is perfectly balanced, is not used for the transmitting the draught of the horses, the latter being made to draw from an attachment which slides on the underside of the pole, and which is connected to the front bar of the frame. All the gearing, with the exception of the large spur-wheel, is completely enclosed.

In the gallery, Henry Kinsey, of the Robin Hood Works, Nottingham, exhibited three engines, two of these being horizontal fixed engines of the kind usually made by Mr. Kinsey, and the other being a small engine mounted on the top of a boiler. The plain and substantial design of Mr. Kinsey's engines is well known, and those exhibited embraced no departures from his usual plans. They were all fitted with the excellent governor which this maker has used for the last twelve months or so, and which is one of the most simple which we have seen. Its principle is the same as that of Porter's governor, small balls run at a high speed being employed, and their centrifugal action being counterbalanced by a heavy weight with which the governor is loaded. The links carrying the balls have each an arm projecting from them near the point of suspension, each link being thus really a bell-crank slung from near the point of junction of the arms. The upper surfaces of the arms just mentioned are formed to an epicycloidal curve, and they bear against the underside of a cast-iron weight surrounding the governor spindle, and capable of moving freely on it. It will thus be seen that, as the balls diverge, the weight is lifted by the arms; and as the sliding-collar to which the throttle-valve lever is connected is cast in one piece with the weight, the throttle-valve is acted upon. In the first governors made by Mr. Kinsey on this plan, the arms were not curved on their upper surfaces, and the point which was in contact with the weight had thus a sliding motion on the latter when it was being raised or lowered. This gave rise to considerable friction, and caused the governors to work somewhat stiffly; but the difficulty has been entirely got over by the simple and ingenious expedients of forming the bearing surfaces of the arms to an epicycloidal curve, so that there is only a rolling contact between them and the weight as the latter rises and falls. It would be very difficult, if not impossible, to make an efficient governor with fewer parts than that of Mr. Kinsey.

Amongst the objects in the gallery which attracted the greatest attention was the Hugon gas-engine, which was exhibited by Mr. Edward Casper, of Cannon-street, and was shown in action. The Hugon gas-engine differs materially in its construction from the Lenoir and other gas-engines, which have from time to time been brought before the public, one of its main features being the means employed for effecting the ignition of the mixed air and gas within the cylinder. In the Lenoir gas-engine this was effected by electricity, and the cost and trouble of maintenance of the necessary batteries was one of the main objections raised against that engine; but in the Hugon engine the use of electricity has been avoided, and the ignition is effected by small gas-jets carried in recesses in the slide-valve. There are two of these jets, one for each end of the cylinder, and they are supplied with gas by short lengths of flexible pipe, which accommodate themselves to the movement of the valve. Each jet as it, in its turn, effects the ignition of the explosive mixture, is extinguished; but the travel of the slide-valve is of such a length that at each stroke the recesses containing the gas-jets are brought outside the respective ends of the faces between which the valve works, when they are re-lit by fixed jets which are kept permanently burning. The gas by which the engine is worked is not led direct from the main into the cylinder, but is admitted in measured quantities into a kind of bellows, from which it passes into a small mixing-chamber, where it is mingled with the requisite quantity of atmospheric air. Other bellows then force the mixture into the cylinder, its admission being governed by the slide-valve which carries the gas-jets already mentioned, and which is a block valve working between a pair of faces, and having openings in it through which the gases can pass. The action of this valve is as follows: first, at the commencement of each stroke, it admits the mixed gases to one end of the cylinder; next it closes the port; and, thirdly, it effects the ignition of the mixture by bringing the recess containing the corresponding igniting jet in communication with the passage leading to the end of the cylinder to which the mixture has been admitted. A small quantity of water is admitted into the cylinder during each stroke, this water being converted, by the heat of the cylinder, into steam, which, by its expansion, adds to the power of the engine, and also acts, to some extent, as a lubricator.

In order to start the engine, it is merely necessary to turn on the gas, light the two fixed jets by which the small jets in the slide-valve are ignited, and turn the engine round two or three turns by hand, so as to pump some of the mixture of air and gas into the cylinder. This being done, the engine requires no further attention, except, of course, the necessary lubrication of the bearings, &c.

The engine appears to work very efficiently, and, we understand, economically; but in the absence of precise data it is, of course, impossible to say accurately what the consumption of gas, &c., per horse power per hour actually is. We trust, however, to be able to soon lay full particulars of the working of this engine before our readers, and we shall then describe its structural peculiarities more fully. The Hugon gas-engine, we may mention, is now being made in this country by Messrs. Robinson, of Rochdale, and by Mr. F. B. Vallance, of the Alicel Works, East Greenwich.

Not far from the Hugon gas-engine were a couple of machines exhibited by Messrs. Samuel Worssam, jun., and Co., of the Oakley Works, Chelsea—one of these being the "perfect" "general joiner" recently patented by Mr. S. Worssam, jun., and the other being an improved saw-sharpener. The "perfect" general joiner is a well-arranged and very useful machine, which differs from the ordinary "general joiner" in many important particulars. We shall not attempt a complete description of the machine here; but we may point out some of its principal features. In the first place, instead of its being necessary to remove the saw or saws to fit the machine with cutter-blocks for moulding, &c., as in the ordinary machine, these blocks are applied to the main spindle near the rear end, and are provided with an independent table, self-acting feed, &c. The extreme rear end of the spindle carries the boring tools for boring or mortising, and as an independent table is provided for this work also, the operations of boring or mortising, moulding, and sawing or tenoning can be carried on simultaneously, one man and two boys being employed to tend the machine. The ends of the mortices are squared out by traversing the hind table so that the work is forced against a reversible mortice chisel, whilst tenons are cut by a pair of saws placed at the proper distance apart on the main spindle, a pair of saws running horizontally, and adjustable to various heights and distances apart, completing each tenon by cutting the shoulders. The machine is also, like the ordinary joiner, fitted with the appliances for wedge-cutting, squaring up, grooving, &c. The saw-sharpener machine, by the same makers, was very neatly designed, and looked as if it would be capable of turning out good work. Saw-sharpening machines of this kind save an immense amount of hand labour, and they seem to be scarcely so well appreciated as they ought to be.

CORROSION OF CAST IRON.

It has been often stated that cast iron, when exposed to the action of sea-water or to atmospheric influences, under certain conditions becomes "rotten," an expression which is intended to indicate a loss of strength or cohesion without a corresponding alteration of volume or size. This phenomenon is entirely different from common oxidation, or rusting, which latter process shows itself by attacking the surface, and gradually reducing the size of the article, which, so far as it remains intact by this external reduction, does not seem to lose its qualities, so that the reduced strength of a rusted bar is simply proportionate to the reduction of its original section. The state of corrosion which would justify the term "rotten" is a reduction of cohesion without any apparent removal of material, and is not easily recognised externally. The nature of this change has for a long time remained unexplained, until some very interesting experiments established its scientific rationale. We believe that this scientific discovery is due to Mr. Crace Calvert, F.R.S., of Manchester, who some years back carried out a series of very interesting experiments on this point. Mr. Calvert immersed cast-iron cubes, made of Staffordshire cold blast iron, and cast one centimetre in dimension into acidulated water. Each cube was placed by itself in a corked bottle filled with 80 cubic centimetres of very diluted acid. Amongst the acids tried were sulphuric, hydrochloric, and acetic acid; their action upon the iron was very slow, and it required a long time to show any change whatever. After three months of contact Mr. Calvert found that, although the external appearance of the cubes was not changed in any way, some of the cubes, and particularly that in contact with acetic acid, had become so soft externally that a knife-blade could penetrate 3 or 4 millimetres deep into the cube. The

solutions were then removed, and replaced by fresh acid of the same kind in each bottle, this removal being continued every month for two years. After this period changes had been effected in almost all the cubes, only the penetration was more or less complete according to the nature of the acid. Acetic acid had acted most energetically of all; next came hydrochloric and sulphuric acid. Phosphoric acid showed no similar action. The result of the action of the acid was a complete change of the nature of the metal, without any alteration of its bulk or of the appearance of its surface. The cubes of grey cast iron, which originally weighed 15.324 grammes each, weighed only about 3½ grammes at the end of two years, and their specific gravity was reduced from 7.858 to 2.751. The iron had been gradually dissolved or extracted from the mass, and in its place remained a carbon compound of less specific weight, and very small cohesive force, which occupied the same bulk as the original cast iron. The composition of the cast iron and of the carbon compound which remained in its place after two years of contact with acetic acid was found by Mr. Calvert as follows:

	Original cubes.	Carbonaceous substance.
Iron	95.418	79.960
Carbon	2.900	11.070
Nitrogen	0.790	2.590
Silicium	0.478	6.070
Phosphorus ...	0.132	0.059
Sulphur	0.179	0.096
Loss	0.108	0.205

Acids, like hydrochloric, sulphuric, and acetic acid, are to be found in water under a great variety of circumstances. Sea-water contains these, or at least the elements from which they can be formed by decomposition of the organic or unorganic matter contained in them; they appear in the air, and are carried by the rain or snow down to the surface, particularly in the vicinity of manufacturing localities. The gradual deterioration of cast iron when exposed to actions of that kind—a change which is all the more dangerous, as it is not immediately apparent to the eye—may therefore be considered as a possibility, and in the presence of acidulated water or sea-water may be even called an established fact. It is probable that a coating of the metal or paint, in so far as it is impervious to water, may prevent or, at least, lessen this injurious action, but this has not as yet been established by direct experiment. There are many engineering structures relying for their safety upon the strength of cast iron in contact with sea-water, and the chances of injury from this action should never be lost sight of during the periodical inspection of such works.

NOTES FROM THE NORTH.

GLASGOW, Wednesday.

Glasgow Iron Market.—As regards pig iron, there has been a slight improvement during the last few days, but there is still a great want of animation. Prices have tended upwards from what I quoted last week to 58s. cash and 58s. 1½d. one month, which were the quotations yesterday, when 1000 tons were reported at 53s. cash. The shipments are still considerably under those of the corresponding week of last year. In manufactured iron the market is extremely quiet. Orders for merchant iron are coming in very slowly, partly on account of the nearness of stock-taking, and also from a belief on the part of the merchants that prices may be easier after the beginning of the New Year. For shipment there is also less inquiry, but this month is generally the slackest of the season. In shipbuilding iron there is more doing, and large specifications are being given out for both plate and angle iron. Prices continue much the same, but buyers appear willing to contract at the rates now current. The following are quoted as the ruling prices:—First common bars, 71. 5s.; second ditto, 61. 15s. to 71. 10s.; nail rod, 71. 5s.; angle iron, 71. to 81. 10s.; plates, 71. 17s. 6d. to 91. 10s.

The Railway Companies.—It is reported that the Caledonian and the City Union Railway Company have initiated (if not initiated) an agreement which will greatly promote the harmony and efficiency of our Glasgow railway arrangements. The Caledonian is to join the Union system, and to promote the formation of a common central terminus in Dunlop-street, which will be opened up by a wide entrance both into Argyle-street and towards the river. The new Coatbridge line, for which powers were obtained last year, will be carried out, and, through the Union system, will have access to the Dunlop-street terminus. Instead of having two separate lines, as was intended, and for which Parliamentary powers were obtained, the Glasgow and South-Western and the Caledonian, as a necessary consequence of this arrangement, will co-operate in forming a single and direct branch from the Barrhead line to Kilmarnock, and all the lines and branches south of the Clyde, like those on the north, will converge at Dunlop-street. The convenience of this arrangement to passengers will be very great, while the goods traffic of the city will be immensely facilitated through the great central depot at the College. The operations of the City Union are being actively pushed forward, and on the understanding now come to there can be no doubt that Glasgow will in a very short time be in possession of a good working system of central communication, and that the interests of all the great companies will be promoted and enhanced thereby.

Moulders' Strike at Aberdeen.—The "granite city" on the banks of the Dee is very seldom disorganised in an industrial

sense; but this state of affairs is now being changed. An expressed intention on the part of the employers to reduce the wages of the iron-moulders two shillings per week—the minimum rate being 29s. per week—the men determined to resist if the reduction should exceed one shilling per week. They worked their warning in one foundry, and have now gone on strike, and the employers in the other foundries have shut their shops, and locked out their men. A conference between the workmen and their employers is announced, and it is thought probable that the dispute will be adjusted shortly.

Extension of the Edinburgh Water Works.—I mentioned, some months ago, the last great extension of the Edinburgh Water Works. The works, which are now completed, are situated eighteen miles west from Edinburgh, about a mile on the south side of the old road to Lanark, and some of the numerous springs which have been taken in for the new supply are as far as about twenty miles distant from the city. In addition to the new main, about ten miles of piping have been laid down for the collection of these springs, and a reservoir has been constructed at Crosswood capable of storing twenty-five million cubic feet of water. The reservoir is formed by the construction of a solid embankment 50 ft. deep at the lower end of the course of the Crosswood Burn, before it leaves the broad valley of Crosswood, to enter the narrow pass below. The embankment is about 680 yards long, and is puddled in some places to the depth of 30 ft. It is a very massive and substantial work, and the tunnel through which the burn flows and the waste weir for the overflow are constructed of solid masonry. Mr. Moffat, the contractor, has been engaged upon the work for the greater part of two years, and for some time employed nearly 200 men. The reservoir is nearly 1000 ft. above the level of the sea, being the highest the company have; and so quickly does the drainage of the hill country around tell upon the storage, that the water rose, a few days ago, to a height of 18 ft. within the basin in the course of the previous twenty-four hours. The maximum depth of the reservoir when full will be 41 ft. The reservoir, it will be understood, is not intended for supplying Edinburgh with water. It is constructed for compensation purposes, and as soon as it is full the water from the numerous springs rising in the hill sides will be brought into the city. This will probably be in the course of a very few days, for forty-eight hours of rain at this season will fill the reservoir; and then a bountiful supply of excellent water may be expected, sufficient to satisfy the necessities of the community for a good while to come. It is estimated that from 600 to 700 gallons of spring water per minute will be added to the supply by the springs now brought in; and this constitutes only a part of the advantage to be derived from the new works, for the addition of a new reservoir, of the capacity of that at Crosswood, will be of great service in enabling the company to provide effectually against running short in seasons of protracted drought.

Bursting of a Reservoir at Kelso.—While Edinburgh is rejoicing in the prospect of having its water supply greatly increased and improved, the people of Kelso have to moan the occurrence of an alarming accident to the reservoir, from which they were till lately supplied with water from the silvery Tweed. On Saturday evening last, without any warning, the reservoir in question burst, and the contained water was discharged with great violence and rapidity down upon a part of the town, placing in great jeopardy a number of the inhabitants. Severe injury happened in one or two instances, but no lives were lost. The reservoir consisted of a tank, 28 ft. by 24 ft. and 15 ft. high, formed of strong iron plates about 1 in. thick, and was capable of containing about 60,000 gallons, or 300 tons weight of water. It was fixed on the top of a mass of strongly-built masonry 40 ft. high. This still stands, and is perfectly intact. It was only the ironwork which gave way.

The Accident at Messrs. Caird's Shipbuilding Yard.—In connexion with this most untoward accident, I have now to report that the injuries of two of the workmen not killed outright at the time have terminated in death, making four deaths in all. In the local papers lengthened reports have appeared of the results of two meetings which have been held by the Greenock Shipwrights' Provident Union, for the purpose of hearing statements in reference to the late fatal accident. A number of witnesses having been examined, who allege that the frames were improperly secured, the reports conclude with the following remarks by Mr. James Boyd, who is reported to have said that, "from the evidence led, every one must see that there had been gross carelessness somewhere; that the men had been murdered. The law of the land, he added, ought to take its course, and let justice be done. He did not see for a moment why the parties on whom the charge of these frames devolved should not be brought up the same as an engine-driver or railway guard when any life was lost." The proceedings appear to have been of a somewhat extraordinary character. The workman just named has been paid off since the meetings were held, and it is said that no reason has been assigned. Another workman is also reported to have been discharged. The local Procurator-Fiscal is making a searching investigation into all the circumstances of the case. Unfortunately for the workmen, there is no coroner's inquest in Scotland. The Shipwrights' Union have taken steps to lay the evidence adduced as to the cause of the accident before the Lord-Advocate, requesting him to send a professional man to investigate the matter.

Miners' Meeting at Hamilton.—A meeting of miners of this district was held at Covan Burn Bridge a few days ago, when it was stated by the chairman that all the works in the district were idle for the purpose of considering what was to be done on the question of wages, which should now be 5s. per day, according to the arrangement by some of the Lanarkshire employers to give 4s. 6d. on an average throughout the year, being at the rate of 4s., 4s. 6d., and 5s. in three divisions of the year. It was reported that Messrs. Russell and Smart, of Ferniegair Pit, had been paying 5s. from the 1st of December, but that none of the other works had yet done so, although the men of the Home Farm Pit (Messrs. Hamilton and McCulloch) had been out on strike for some days. It was agreed by the meeting that the men of Allanton Pit (Messrs. Austin and Co.) and of Haughhead Pit (Messrs. Merry and Cunningham) also come out on strike till the 5s. be given. During the day, Messrs. Austin and Co. agreed to the terms, and the men at once recommenced work. Messrs. Hamilton and McCulloch also granted

TESTS OF IRON AND STEEL RAILS.
MADE BY MR. PETER ASHCROFT, ENGINEER OF THE SOUTH EASTERN RAILWAY.
(Continued from Page 561.)

NAME OF RAIL OR MAKER.	Weight per Yard.	Weight of Ram.	Number of Blows.	Blows increasing foot by foot as under.	Result of Blows.	Turned over, or not, before Breaking.	Greatest Deflection, whether turned or not.	MR. ASHCROFT'S MANUSCRIPT REMARKS.
Ebbw Vale ...	not given	8 cwt.	8	8 ft. to 15 ft.	Deflected 4½ in.	Turned	4½	These rails are now on the line.
Same rail, turned	—	—	6	all 15 ft.	Straightened.	—	—	
Same again, turned	—	—	6	all 15 ft.	Deflected 4½ in.	—	—	
Hopkins's rail ...	not given	—	6	8 ft. to 13 ft.	Broke	—	2½	A good wearing rail, but rather cold short.
Aberdare Company	75	—	12	5 ft. to 16 ft.	Deflected 5½ in.	—	5½	
Second piece of do.	—	—	12	5 ft. to 16 ft.	Broke	—	—	
Lloyds, Foster, and Co., STEEL	not given	—	11	5 ft. to 15 ft.	Deflected 2½ in.	Turned	2½	Very good.
Same, turned	—	—	5	all 15 ft.	Straightened.	—	—	
Aberdare Company	not given	—	6	10 ft.	Broke	Not turned	1½	
Same, second piece	—	—	1	5 ft.	—	—	—	Bad.
Same, third piece	—	—	11	5 ft. to 15 ft.	Deflected 8½ in.	Turned	8½	
Third piece, turned	—	—	2	15 ft.	Broke	—	8	
Lloyds, Foster, and Co., STEEL	78	—	11	5 ft. to 15 ft.	Deflected 2½ in.	Turned	2½	Very good.
Do., turned over	—	—	5	all 15 ft.	Straightened	—	—	
Prussian STEEL rail	78	—	11	5 ft. to 15 ft.	Deflected 3 in.	Turned	3	
Do., turned	—	—	5	all 15 ft.	Nearly straight	—	—	Bad.
Benson, Adamson, and Co., STEEL	80	—	11	5 ft. to 15 ft.	Deflected 1½ in.	Turned	—	
Do., turned	—	—	6	all 15 ft.	Not broken	—	—	
Aberdare Company	75	—	6	5 ft. to 10 ft.	Broke	Not turned	1½	Very good.
Another rail	75	—	1	5 ft.	—	—	—	
A third rail	75	—	11	5 ft. to 15 ft.	Deflected 3½ in.	Turned	3½	
Do., turned	—	—	2	both 15 ft.	Broke	—	—	Very tough and fibrous on both heads; not granular on either, as it ought to be.
Cammell and Co., STEEL	78½	—	11	5 ft. to 15 ft.	Deflected 2½ in.	Turned	2½	
Same, turned	—	—	6	all 15 ft.	Straightened.	—	—	
Same, turned	—	—	7	all 15 ft.	Deflected 2½ in.	{ Trial abandoned }	—	A perfectly safe rail, but not calculated for wearing a reasonable time.
Aberdare Company	75	—	11	5 ft. to 15 ft.	Deflected 8½ in.	Turned	8½	
Same, turned	—	—	4	all 15 ft.	Straightened	—	—	
Aberdare, second rail	75	—	11	5 ft. to 15 ft.	Deflected 3½ in.	Turned	3½	Broke in four pieces; too hard.
Same rail, turned	—	—	1	15 ft.	Broke	—	—	
Cammell's STEEL	not given	—	5	5 ft. to 9 ft.	—	Not turned	½	
Bessemer STEEL rail	not given	300 lb.	11	5 ft. to 15 ft.	Deflected 2½ in.	Turned	2½	Without showing any fracture or defect whatever.
Same, turned	—	—	5	all 15 ft.	Straight	—	—	
Blaenavon 60 lb. rail	60	—	7	5 ft. to 11 ft.	Broke	Not turned	2½	
Do., second piece	—	—	8	5 ft. to 12 ft.	—	—	2½	Very good, Indifferent, not a prepared sample.
Rochester puddled STEEL	64	—	11	5 ft. to 15 ft.	Deflected 3½ in.	Turned	3½	
Same rail, turned	—	—	5	all 15 ft.	Straightened	Turned again	—	
Do., turned again	—	—	4	all 15 ft.	Deflected 2½ in.	—	—	Nicked and broken in pieces. Very tough and very good.
Rail on Tunbridge line, 6L 14s. a ton	80	—	10	5 ft. to 14 ft.	Broke	Not turned	2½	
Aberdare Company, 7L 18s. a ton in 1865	75	—	5	5 ft. to 9 ft.	—	—	8½	
Do., another rail	75	—	4	5 ft. to 8 ft.	—	—	—	Rather coarse grained, but safe.
Howe and Co. (Stockton)	75	—	1	5 ft.	—	—	—	
Dorlédort Frères, Belgium	68	—	1	5 ft.	—	—	—	
Aberdare Company	75	—	7	5 ft. to 11 ft.	—	—	1½	Coarse and unsatisfactory.
Cwmavon	73½	—	11	5 ft. to 15 ft.	Deflected 4½ in.	Turned	4½	
Same, turned over	—	—	2	both 15 ft.	Broke	—	—	
Lancashire Steel Company, STEEL	87	—	11	5 ft. to 15 ft.	Deflected 2½ in.	Turned	2½	A good and safe rail, particularly ductile, fine granular head.
Do., turned	—	—	6	all 15 ft.	Straightened	—	—	
Blaenavon (March, 1866)	81	—	1	5 ft.	Broke	Not turned	—	
Do., a second piece	81	—	1	5 ft.	—	—	—	Very good.
Do., another rail	81	—	1	4 ft.	—	—	—	
Do., another rail	81	—	4	3 ft. to 6 ft.	—	—	—	
Aberdare rail	81	—	11	5 ft. to 15 ft.	Deflected 2½ in.	Turned	2½	Another rail being cut on the anvil, a piece broke short off the end, thus proving entire rottenness or extreme hardness. A piece of same rail, 3 ft. 2 in. long, was broken across the back of the anvil by being raised by two men and let drop.
Same, turned	—	—	2	both 5 ft.	Broke	—	—	
Do., another rail	—	—	8	{ one each 5 ft., 6 ft., 7 ft., and 8 ft., and four 15 ft.	—	Not turned	2½	
Blaenavon (April, 1866)	82	—	4	5 ft. to 8 ft.	—	—	—	A very good rail, fine and granular, indicating long wear.
Do., second piece	—	—	2	5 ft. and 6 ft.	—	—	—	
Do., third piece	—	—	3	5 ft. to 7 ft.	—	—	—	
Do., another piece	—	—	2	4 ft. and 5 ft.	—	—	—	A fine rail, indicating lasting wear.
Do., another rail	—	—	3	5 ft. to 7 ft.	—	—	—	
Barrow Steel Company, STEEL	78½	—	11	5 ft. to 15 ft.	Deflected 3½ in.	Turned	3½	
Do., same rail, turned	—	—	6	all 15 ft.	Straightened	—	—	No comment!
Do., another rail	—	—	11	5 ft. to 15 ft.	Deflected 4 in.	Not turned	4	
C. de Grelle, Belgium	not given	—	8	5 ft. to 12 ft.	Deflected 2½ in.	—	—	
A steel-topped rail	—	—	11	5 ft. to 15 ft.	Deflected 8½ in.	Turned	8½	A good specimen of a steel rail, but rather too soft.
Same, turned over	—	—	5	all 15 ft.	Broke	—	—	
Aberdare Company (July, 1867)	82	—	1	4 ft. 6 in.	—	Not turned	—	
Do., second piece	82	—	1	5 ft.	—	—	—	Not broken; rather inferior to first piece.
Do., third piece	82	—	9	5 ft. to 13 ft.	—	—	—	

the 5s., to commence on Monday next, thus leaving Haughhead Pit only on strike.

Arbitration among the Miners of the Coalbridge District.—It is stated on good authority that an effort is being made at present to establish a board of arbitration and conciliation between the miners and their employers in this district. For the purpose of carrying the arrangements into effect, a preliminary meeting of delegates will be shortly held, when resolutions will be proposed desiring the delegates to consult with the employers in their respective districts and ascertain whether they are willing to co-operative in the formation of such a board. It is reported that many of the most extensive employers of labour have frequently expressed themselves as highly in favour of such a scheme. Should the establishment of such a board become an accomplished fact in the mining trade, we may soon expect to see similar boards established in the iron and other trades, and an end to the fearful strikes and lock-outs which have proved so disastrous both to the interests of the employers and employed.

Shipment of Gas Apparatus to Monte Video.—A considerable shipment of gas apparatus has just been made from Leith to Monte Video, consisting of a cast-iron tank 81½ ft. diameter, by 20 ft. deep, with a gasholder to work in the same, and to contain 100,000 cubic feet of gas. The tank was made in plates in the usual way, and is to be sunk in the ground for about half of its depth. The guiding pillars are carried on strong cast-iron frames bolted to the plates of the tank, and form a series of ornamental openwork framing the whole depth of tank, thus dispensing with the heavy foundations usually adopted. The work, which weighs altogether about 400 tons, is all of the strongest and most modern construction, and has been executed by Messrs. Henry Balfour and Co., of Leven, Fifeshire, the same firm having also been the sole contractors when the works were originally erected in Monte Video about five years ago.

Shipbuilding Items.—Launches.—There was launched, a few days ago, from the shipbuilding yard of Messrs. H. Murray and Co., Port Glasgow, a handsome iron screw steamer of 100 tons burthen (classed), to be engine by Messrs. Donald

and M'Farlane, Paisley, intended for the canal and coasting trade.

The Berkshire, a very fine iron sailing ship of 1450 tons register, has just been launched by Messrs. Barclay, Curle and Co., from their building-yard at Whiteinch. The vessel is owned by George Marshall, Esq., of London, and will be engaged in the East India trade.

A fine iron schooner of 140 tons, named the Janette, has just been launched by Messrs. Alex. Stephen and Sons, from one of their building sheds at Kelvinhaugh. The Janette is to be employed in the African trade, and is the property of Messrs. Wm. Cooper and Co., of this city.

ENGLISH ENTERPRISE IN BELGIUM.—Messrs. John Brown and Co. (Limited), of Sheffield, have obtained a contract for 600 iron piston buffers, for 10 ton goods trucks, at 515l. 10s. Messrs Taylor Brothers, of Paris, tendered, of course unsuccessfully, at 648l. The plant in question is to be supplied to the Belgian State Railways.

THE CYCLONE AT CALCUTTA.

WITHIN the past four years, Lower Bengal has been visited by a succession of the most terrible physical calamities. In 1863, an inundation desolated the rich districts between the Ganges and the head of the Hooghly, which were passing through all the excitement and loss of a struggle between landlord and tenant. In 1864, when the whole province had begun to abandon itself to the orgies of the national festival, on the 5th of October, a cyclone swept up from the Bay of Bengal to the far north-east, accompanied by a mighty wave which engulfed at least fifty thousand human beings, and together destroyed property to the value of two millions sterling. In 1865, the same month and the same festival brought with them scarcity of food so severe as to deepen, in the course of the subsequent year, into a famine more intense than any recorded in history. What the famine spared another storm-wave destroyed in Orissa, and the loss is counted in a million of lives, and an expenditure, public and private, little short of three quarters of a million. Meanwhile, an epidemic fever has been steadily wasting the districts along the Hooghly, from Nuddea to Calcutta. Another cyclone has now, on the 1st of November last, followed the track of that of the 5th October, 1864, with a destructive violence hardly less, but with a terror all the greater, that it came at midnight. The total number of lives lost, so far as has yet been ascertained, amounts to 1016; the destruction of brick-built houses, 163; and of tiled and thatched huts, 29,231. At least one-half of the rice crop is reported to have been lost, and the vegetation which survived the recent inundation from the Ganges has also been almost entirely destroyed. Fortunately, on this occasion the wind blew down the Hooghly, and so prevented the formation in that river of the storm-wave which caused such havoc amongst the shipping in 1864; but, notwithstanding this, of the larger shipping in the river, only some twenty-six ships escaped uninjured, and three of them sustained serious damage, one being a complete wreck. Of the smaller craft, two ferry steamers have been lost, 67 cargo boats, 15 Madras sloops, 84 dinghees, 82 native boats, and 336 up-country boats. The Mutlab, which escaped all injury in 1864, has, however, on this occasion sustained serious damage. During the cyclone, the wind blew violently up the river Mutlab, carrying before it a storm-wave five-and-a-half feet high, engulfing Port Canning and its inhabitants, and carrying away the ballast of the railway for three miles, as far as Bursa; the station and a goods shed were blown down, and only the front cylinders of the railway jetty have been left. Two wooden jetties are gone, and the sea broke through into the dock by the neglected part of the banks of the Bydiadhurree. Every native hut has been destroyed, and the people, starving for want of rice and water, are leaving for Calcutta, whilst numbers from the up-stations are flocking into Port Canning.

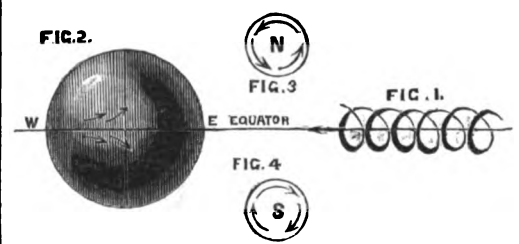
The Bay of Bengal has always been liable to severe storms, which have struck the coast at different points from Ceylon northwards. The frequency of their occurrence may be judged from the following list of those that were particularly noted, between the years 1839 and 1845, both years inclusive. There was one on 3rd June, 1839, locality not stated; another at Coringa, on 16th November following. The next was at Attock, on 28th April, 1840; one at Madras, on 16th May, 1841; at Calcutta, on 3rd June, 1842; at Pooree on the 2nd October following; and at Madras, on the 24th of the same month. On 22nd May, 1843, a similar storm visited Masulipatam; and on 1st December, 1845, Ceylon was similarly inflicted. We do not possess a reliable record of all the cyclones that have since visited the Bay of Bengal, but the foregoing is sufficient for the present purpose.

Captain Maury says that there are, in tropical climates, two kinds of tempests or storms: the monsoon, or trade-wind gales, in which the barometer remains high, and the wind steady; and the hurricanes, or typhoons, often blowing with irresistible fury, and almost invariably accompanied by a falling barometer.

The first person who endeavoured to ascertain the laws by which storms and hurricanes are influenced was, we believe, Colonel W. Reid, in England; and similar researches have been subsequently made by Redfield and Captain Maury, in America, Thom, in Mauritius, and Piddington, in Calcutta. It is difficult to state with any degree of certainty how the disturbances of wind apparent during a cyclone on the earth's surface originate. An attempt with this object has, however, been made by Dr. P. F. H. Baddeley, of the Bengal Artillery, who supposes that a mass of electrical matter descends from the sky in the form of a

spiral working downwards, which, on striking the earth's surface, is regulated in its subsequent movements and track by causes connected by the earth's rotation, and upon the prevailing surface winds. Another theory, however, may be suggested, viz., that the rotative motion is caused by the meeting of three or more currents of wind in the upper stratum of the air, blowing from different directions, giving a spiral movement to the air in the immediate vicinity of their point of meeting, and this, being forcibly deflected by the violence of the shock, communicates a similar motion to the substratum, and which receives a forward movement on the earth's surface, regulated probably by the causes assigned by Dr. Baddeley.

In the West Indies, the Bay of Bengal, China Sea, and the Southern Indian Ocean, the wind in a hurricane has two motions, the one a turning or veering round upon a centre, and the other a straight or curved motion forwards, as in Fig. 1. When storms occur on the north side of the equator, they turn from the east, on the right hand, by the north, towards the west, or, in other words, they revolve against the hands of the watch; and in the southern hemisphere



their motion is in the opposite direction, or with the hands of the watch, as shown in Figs. 2, 3, and 4. This is doubtless owing to the rotation of the earth from west to east, the rapidity of which motion gradually declines from the equator towards the poles, forming, as it were, a current from the point of greatest disturbance, or the equator, towards the poles, where the force of rotation is reduced to a minimum. Nearer the centre or vortex of the cyclone, the more violent is the storm, while the centre itself is a calm which travels, according to Captain Maury, a mile or two an hour, and sometimes forty or fifty. In the centre the barometer is low, rising as the periphery of the whirl is approached. The diameter of these storms is sometimes a thousand miles, and sometimes not more than a few leagues. These storms have their origin somewhere between the parallels of 10° and 20° north and south, travelling to the westward in either hemisphere, but increasing their distance from the equator until they reach the parallel of 25° or 30°, when they turn towards the east, or recurve, but continue to increase their distance from the equator—that is, they first travel westwardly, inclining towards the nearest pole; they then recurve and travel eastwardly, still inclining towards the pole; and such is their path in both hemispheres.

Mr. Piddington states that, in the Bay of Bengal, storms (excepting the monsoon gales) always come from the eastward, and travel to the westward, the exact course being east south-east to west north-west. Their tracks are lines more or less straight or curved, and varying in their direction as they approach the coast, when they are no doubt influenced in their course by the mountains, rivers, and other inequalities of the earth's surface. The speed at which they travel averages generally from three to fifteen miles an hour, although in one case the high rate of thirty-nine miles an hour occurred. The usual size of these vortices in the Bay of Bengal is from 300 to 350 miles; but they sometimes contract to about 150 miles, in which case their violence is invariably very much augmented. The only safe rule for ascertaining the approach of storms in the Indian and China Seas is a close attention to the barometer and simpesometer. "Off the Sand-heads," says Piddington, "the signs of a hurricane are mostly light airs from north-east to south-east, with very hazy or clear hot weather; often with a very deep blue sky for a day or two preceding the storm, a heavy swell, close sultry weather, and a strong set to the westward on the reefs; and this both when the storm has passed to the southward, and also where it passes directly over the Sand-heads. . . . In all cases there is a fall in the barometer when at distances of 150 to 200 miles from the centre of the storm. . . . The barometer sinks under the first half of the storm in every part of its track, except perhaps on its extreme northern margin, and thus affords the earliest and nearest indication of the approaching tempest. The barometer rises

"again during the passage of the last portion of the gale."

The following extracts from an account of the hurricane of 1st of November last, given in the *Madras Athenaeum*, will be found interesting from a scientific point of view. It appears that the weather had for some time been a foremost topic of conversation at Calcutta. The rains had apparently ceased, when, to the astonishment of all, they set in again on the 26th October. On the morning of November the 1st the telegraphic report from Saugor showed that the barometer there was falling rapidly; and the report from Cuttack showed the same. Upon receipt of these telegrams, Mr. Blandford telegraphed to Saugor for additional observations at half-past twelve. The answer was that the barometer showed a continued fall, and that the wind was increasing in violence. The last report from Saugor was at seven p.m., when the barometer unaltered stood at 29.42, the reduced observations showing 29.305; the wind was then blowing violently from the north-east. An attempt was made to get another report from Saugor at eight o'clock, but the assistant reported that it was very difficult to reach the barometer, and in a few minutes afterwards the line stopped working altogether. Mr. Blandford is of opinion that in all probability the storm formed in the north of the Bay of Bengal, and the centre passed at no great distance to the eastward of Calcutta, proceeding in a nearly northerly direction. The lowest barometrical record at the Surveyor-General's office was at three a.m. on the Saturday morning, the storm being then at its height, when it stood at 20.6. The wind, which had been blowing steadily all the preceding day from north-east, at five p.m. suddenly increased in intensity, and an hour after was blowing in heavy gusts from the same direction, varying in pressure from one to twenty-five pounds per square foot. At half-past twelve a.m. it veered round to north-north-east, and carried away the anemometer of the Government Observatory, preventing any further observations from being recorded there.

EDITORIAL EDUCATION.

"EDUCATE! educate! educate!" exclaimed Mr. Lowe. "Teach our future masters to read and write." Very good: but it would perhaps be well to begin with our "public instructors. Some of them are marvellously ignorant. It was in 1798 the *Anti-Jacobin* used to amuse itself with the crassitude of the young man who conducted the geographical department of the *Morning Chronicle*; but seventy years later we perceive very little improvement in the average journalist. It would be really a work of charity to establish a school for editors.

An evening paper the other day published a letter from a Cambridge man complaining of the difficulty of his examination papers in algebra. This was what grieved and perplexed him!—

$$\begin{aligned}\sqrt{x}\sqrt{y} &= c^2, & a^2(a')^2 &= (a'')^2. \\ \sqrt{x^2-6} + \sqrt{y^2-11} &= 7, & x^2y^2-11x^2-5y^2 &= 45. \\ x - \frac{1}{y} &= 1.8, & y - \frac{1}{x} &= 4.5.\end{aligned}$$

Out of eighty-three candidates for the examination, of which this is a specimen, more than half, he says, were plucked! We are sorry for Cambridge, if that is true.

Any well-educated boy of twelve ought to be able to solve those three equations in twenty minutes. The first and second are merely exercises in language. The first means

$$\begin{aligned}3x+2y &= 18, \\ 2x+5y &= 3y.\end{aligned}$$

The second means:

$$\begin{aligned}x+y &= 7, \\ x^2y^2 &= 100.\end{aligned}$$

As to the third, it can be solved at a glance, without putting pencil to paper: $x=2$ and $y=5$. If a Harrow youngster in the lower forms were to make a mull of such equations as this, he would have rather a bad quarter of an hour with Middlemist.

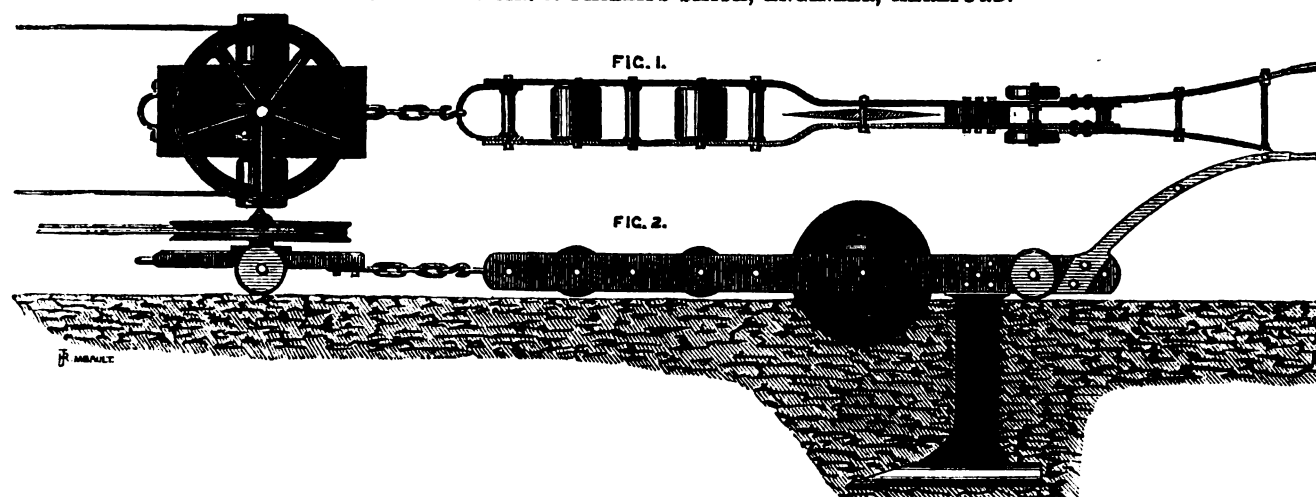
The writer should have tried to solve his equations, instead of exposing his incapacity in an evening paper. And it might perhaps have been as well if the editor, supposing him quite ignorant of elementary algebra, had asked advice before printing so absurd an epistle. "To pluck a man," says this unhappy Cantab, "when he does not deserve it is fearfully cruel, not only to himself, but to his relations."

We don't know what a *man* may deserve who could not solve such equations as those, but we know what a *boy* would get.—*Echoes from the Clubs.*

THE CALEDONIAN RAILWAY.—The inspection of the rolling stock of the Caledonian Railway carried on by Mr. D. K. Clark, C.E., of London, is progressing very favourably, although it has proved to be a more arduous and laborious task than was at first supposed. Mr. Clark has found it necessary to go into a great number of details very thoroughly and minutely in order to satisfy himself, and to be able to satisfy those who have called for his professional assistance, upon the true state of this important affair. Mr. Clark's report is expected to be very complete, and to do full justice to the merits and demerits of the case. We understand that this report is not likely to be completed before Christmas, although Mr. Clark is devoting a great deal of time and industry to this subject, and employing a large and efficient staff for his assistance.

MOLE PLOUGH AND TACKLE.

DESIGNED BY MR. J. PHILLIPS SMITH, ENGINEER, HEREFORD.



We give, above, an engraving of an arrangement of mole plough and tackle designed and patented by Mr. J. Phillips-Smith, the engineer of the Herefordshire Steam Ploughing Company, and which has been used by him with much success on heavy lands. The peculiarity of the apparatus consists in the arrangement for carrying the pulley or snatch-block, this being supported upon a small carriage, which is connected to the plough by a short length of chain. The carriage just mentioned is carried upon a pair of small wheels or rollers, and the effect of the arrangement is that the pulley is always able to adjust itself to the direction of the rope, notwithstanding any irregularities of the ground on which the implement may be in use.

THE MIDLAND RAILWAY.—The Midland Railway Company have issued a notice that 5,000,000*l.* additional capital will be required to complete the works to which they are committed, 2,150,000*l.* of this sum being for the cost, beyond the Parliamentary estimates, of the extension to King's-cross, while 1,350,000*l.* increase is also shown in connexion with the Chesterfield and Sheffield line, and 1,500,000*l.* is for new engines, plant, &c., "to meet the requirements of the increased traffic." It appears that the Midland propose to raise their new capital, which will bring their total authorised capital to a sum exceeding 30 millions, by creating 3,750,000*l.* in shares, and taking borrowing powers for 1,250,000*l.* Nearly three-quarters of a year, however, must in any case elapse before this addition can be brought upon the market, and even then the process, it may be assumed, will be gradual. The directors intimate in relation to the "enormous excess" now found to be inevitable in the cost of their extension to King's-cross that the expense of carrying the works of a railway into London "seems such as to defy all previous calculation;" but, looking at the number of such works executed within the past ten years, the correctness of this plea must be considered to some extent questionable, and it may be apprehended that there has been a want of vigilance and accuracy on the part of the persons engaged. The general meeting of the company, when fuller information may be looked for, and when the policy of the Carlisle and Settle line and other extensions may again come under discussion, does not take place till February.

THE DURABILITY OF ARMOUR-PLATED VESSELS.—The armoured iron-built frigate *Resistance*, 3710 tons, 600 horse power, just taken into the steam basin at Portsmouth for repairs and a thorough refit, offers an opportunity for obtaining reliable data relative to the fastening of armour-plating on the sides of our ships of war, and the condition of the teak backing behind the armour-plates, that is possibly worth some serious consideration. The *Resistance* is one of our earliest ironclads, commenced at the same time and at the same place—the Victoria Docks—as that of the *Warrior*, and she has therefore carried her armour as long as any of our ships, and, moreover, has been kept in a long commission and been on foreign service. When our armoured ships were placed in dock on their return from their first and experimental channel cruising, it will be remembered that there was a good deal said about the "weeping" of discoloured water from between the lower edges of the lower tiers of armour-plates; the acid of the teak acting upon the iron, the wasting of the bolts, and the loosening of the plates. Our apprehensions have been very materially modified on all these points since that time, but still no steps have ever been taken to obtain undeniable evidence in the matter, and the *Resistance* being now about to be partially pulled to pieces to enable her to receive the new style of armament in the course of her repairs and refit, it seems, as we have observed, a fitting opportunity for learning all we want to know on the subject. Let a section of the ship's plating in the centre of one midship square—say four or five plates—be unbolted and taken off her side, and a full examination made into the present condition of the bolts on which the plates hang on the ship's side, and of the teak backing and its iron rib-work which supports them, or rather which would have to support them if struck by an enemy's shot.—*Times*.

HULL.—The hull graving dock is to be increased in length 83 ft., making a total length of 300 ft. The depth is also to be increased to the extent of 4 ft. 6 in.

THE METROPOLITAN DISTRICT RAILWAY.

MORE than a year since* we described, with much detail, the already executed and projected works of the Metropolitan Extension and District Railways, and we would refer our readers to those articles for information respecting the lengths, gradients, station-accommodation, and general particulars respecting the combined lines. The contractors have been actively pushing forward their work during the past twelve-months, and comparatively little remains yet to be done before the railway can be opened for public traffic between Westminster-bridge and the existing Metropolitan Railway, with which a junction is completed at the South Wharf-road, Paddington.

The numerous and lengthened delays in acquiring property have been the principal difficulties the contractors have had to deal with; for, with one or two exceptions, the route of the railways has proved to be favourable for executing, and rich in materials for constructing the work—clean fine sand, sharp gravel, suitable alike for concrete or ballast, and clay, with which a great part of the tunnel has been built, having been excavated from Westminster Abbey to the Great Western Railway Hotel, at Paddington. The length of tunnel between Bridge-street and Princes-street running between Westminster Abbey on the one side and the hospital on the other—a distance of 330 yards, 308 yards being of girder-covered way, and 22 yards of arched tunnel—was completed last winter, during the severest weather, in six weeks, the contractor, in accordance with an agreement made with the parish authorities, being liable to heavy daily penalties for every twenty-four hours of delay. The work included the deviation of the Victoria-street sewer from the north to the south side of the railway the construction of a new drain behind each retaining wall, that on the north side being an intercepting sewer running into the low-level system at the Thames Embankment. A packing of peat, 7 ft. thick, was introduced behind the south wall of the tunnel for a length of 300 ft., adjacent to Westminster Abbey, to reduce the vibration of passing traffic, which, it was considered by Mr. Bidder, might endanger the safety of its foundation. Through this peat the new Victoria sewer was carried in a 4 ft. 6 in. diameter iron pipe. In order to expedite the work in this length, as much as possible, only so much earth was removed as was necessary for constructing the side walls, the centre part or "dumpling" being covered in, and left to be removed at a convenient time. This is now being done, and the concrete invert is partially laid. As all the spoil here is gravel, it is screened in place, the sand separated, and raised to the street level in buckets, and the residue used for the concrete inverts or stored for ballast. At present the sewage from the diverted Victoria sewer is conveyed through a syphon under the railway into a drain on the north side, but this is only a temporary arrangement pending the completion of the low-level sewer. Legal or financial impediments have hitherto protected Tot-hill-street, and between Princes-street and the Broadway, Westminster, nothing has been done. At the latter place, various houses are being destroyed, to clear the site of the St. James's Park Station, which will

probably be a temporary terminus for trains running from Little Moorfields, in the city. It will be similar to the ordinary type of Metropolitan railway stations described and illustrated by us in a previous number, and is to have three temporary platforms 330 ft. long, with an engine-siding in tunnel branching from the main line, and running under Tot-hill-street with a 10-chain curve. The works between this place and the Emanuel Hospital are in a backward state, but are practically completed from the latter point to Ecclestone-street South. The gradients from Westminster fall towards Victoria Station, which is the lowest point on the line, and where is a pumping-engine. The station is in a fair way towards completion: all the principals are in place, and the roof is nearly covered, whilst the booking-offices are finished outside and framed within. The platforms are not laid down, but the dwarf walls upon which they will rest are built. A thickness of 2 ft. 6 in. of concrete covers the whole area of the station, in order to make it as water-tight as possible, the rails being several feet below the natural drainage level. In Victoria-street and facing the station, the tunnel, long since finished and covered in, is being laid bare and strengthened, the sides with concrete, the arch with an extra four rings of bricks toothed into the old work. This is being done to support the weight of a large building, the erection of which was not contemplated a year ago.

From Victoria Station to Ecclestone-street the railway is constructed in arched covered way on a 10-chain curve. This length is a part of the route of the Grand Union Railway, deposited by Mr. Thomas Bouch, session 1863-64, and which was then, in one or two instances, amalgamated with Mr. Fowler's scheme. From the corner of Coleshill and Ebury-streets the works are completed to Sloane-square.

Two hundred feet west of the former streets, 138 yards of open cutting between retaining walls are complete. They are 28 ft. high from rail level to string course, and strutted with cast-iron struts 11 ft. apart and 14 ft. from rails. The open space is surrounded with a parapet 10 ft. high, in accordance with agreement with the Marquis of Westminster.

The Sloane-square Station is well forward, being nearly roofed in; another pumping-stage is erected here, and is at work—with a temporary pump, however. The Ranelagh sewer is carried across the station in an iron tube, 9 ft. diameter, at such an angle that the clear span is 67 ft. We shall give the detailed drawings of this work next week.

Various short lengths of covered way are completed between this station and the one at Brompton, where the Western Extension of the Metropolitan ends by a junction with the District Railway, which is constructed in covered way to Gloucester-road, and, after passing through the station there, under the widening of the Cromwell-road, turns northwards towards Kensington. From Prince Albert-road to Gloucester-road Station, a distance of 341 yards, where two lines run side by side in a double tunnel of the ordinary section, with 2 ft. 4 in. side walls, arches 25 ft. span, and a centre pier 4 ft. 7 in. thick, resting on concrete foundations 2 ft. 6 in. deep, the undersides of which are 4 ft. 6 in. below rails. There are four overhead sewer crossings in this length, three of them 3 ft. 9 in. by 2 ft. 6 in., and one 5 ft. 6 in. by 3 ft. The Gloucester-road Station is 308 ft. long, with three platforms, two 14 ft. wide and one 15 ft.

* *ENGINEERING*, vol. ii., pp. 328, 346, 382.

The roof covering the building is 83 ft. 11 in. span. Beyond this station, the railway, still in double tunnel, is carried under the widened Cromwell-road, where it ends, with a bell-mouth, skewed with an angle of 30°, made in seven spiral courses, 15 ft. long at springing, and toothed into the square brickwork. After a short length of open cutting with side slopes, the District Railway again crosses underneath the Cromwell-road, which is carried by askew bridge with faces at an angle of 29° 30'. A double connecting line between the West London Extension Railway and the Inner Circle is nearly completed, the one, commencing by a junction with the District Railway at the Brompton Station, curves to the south-west, and runs into the West Brompton Station of the former railway, while the other crosses beneath the West London, further north, and curves towards the north-east until it joins the first connecting line, with which it runs parallel for a short distance, when it again diverges, and makes a junction with the Metropolitan Extension Railway at Kensington Station. A triangular piece of ground is thus enclosed, bounded towards the north by the Metropolitan, and towards the east and west by the diverging forks of the connecting District Railway. A bridge, giving access to this land, is to be erected adjacent to the Gloucester Road Station; and Mr. Fowler, in conjunction with the contractors, is constructing a trial portion of it in concrete, with a view to determine the fitness of that material for arches. The portion of the bridge in question, a flying arch, is constructed without wing walls; it springs out of the slopes on either side of the railway, resting on skewbacks of concrete 4 ft. thick, mixed in cement in the proportion of one part of cement to six parts of gravel. It is 75 ft. clear span, with 7 ft. 6 in. rise, 3 ft. 6 in. thick in the crown, and 5 ft. 6 in. at the haunches. The width is 12 ft. The experimental length contains a mass of concrete weighing 200 tons, made in the proportion of one part of fresh blue lias lime to six parts of gravel screened through $\frac{1}{2}$ in. meshes; the centring formed a large mould with close planked sides, into which the concrete was tipped and the whole was completed in fifteen hours. After three weeks have elapsed, to allow the mass thoroughly to consolidate and harden, the centres will be struck, and the side planks removed, after which it will be subjected to severe tests, the results of which we hope to give in detail. Should the structure be trustworthy, a new and most important fact will have been proved, and we shall be able to rely upon concreted materials for arched superstructures as well as for foundations. The bridge in question will ultimately be 42 ft. wide; and if the present experiment be satisfactory, it will be completed in the same material, the faces being covered with cement, and tooled into voussoirs to represent stone. The works upon the connecting lines are nearly finished. From the Cromwell-road Extension to Earl's Court they are in open cutting, with slopes $1\frac{1}{2}$ to 1, and a formation width of 60 ft. At Raspberry-lane, Earl's Court, the two lines are spanned by a narrow bridge, which is simply a very short length of covered way. From this place to 70 yards west of Earl's Court-road the lines run between retaining walls about 18 ft. high, with a distance between them at rail-level of 54 ft. 9 in. From the ends of these retaining walls to Warwick-road, a length of 200 yards, the railways are in open cutting 16 ft. deep. At Warwick-road the westward connecting line diverges towards the West London Extension Railway. It was originally intended to effect a junction with it on the eastern side of the latter cutting through various coal-sidings; but as this was not acceded to by the company, additional powers were taken, during a subsequent session, to cross beneath the West London, and rising on the other side, to run parallel with it, effecting a junction at the Hammer-smith-road Station, without interfering with the sidings. The District Connecting Railway falls therefore with a gradient of 1 in 62 from the Warwick-road in an open cutting, and is carried beneath the West London with a 13-chain curve. The crossing is a very oblique one, being 115 yards long, and its execution was rendered difficult from the constant traffic, which could not be interrupted. This work, which is just completed, was carried out as follows: The cross sleepers supporting the permanent way (an ordinary double-headed rail, resting on chairs) were removed, and longitudinal timbers, 14 in. by 5 in., substituted; under these, and crossing them square with reference to the centre line of the Metropolitan Railway, and consequently diagonal to the rails above, were thrust balks of timber 14 in. square, placed 5 ft. apart. These balks were long enough to project 7 ft. on each side of the trenches that were subsequently excavated for constructing the side walls of the low-level

line, so that the permanent way was carried by this system of cross-timbering, which had an ample bearing surface. Between the balks, 5 ft. apart from centre to centre, girders 15 in. were placed. The trenches beneath were then excavated, and the side walls built up to the level of the girders. These walls have a thickness of 4 ft. 6 in., 18 in. of brick and 3 ft. of concrete, with counterforts 2 ft. wide coming beneath each girder. After the sides were finished, and the girders bedded, stringers 14 in. by 7 in. were placed between them under the longitudinal sleepers, which had replaced the cross sleepers of the West London permanent way. The spaces between were then covered in with 3 in. planking. This most difficult work was completed without any accident; and although upwards of one hundred trains were daily passing on the main line, and the sidings were in constant requisition, the traffic was not in a single instance interrupted.

(To be continued.)

METROPOLITAN TRAMWAYS.

TO THE EDITOR OF ENGINEERING.

SIR,—I have understood that the new companies who at present seek to reintroduce tramways in the metropolis propose to use rails that do not project above the general level of the road, and even that they intend to use wheels without flanges. How far this may be correct, I don't know; but, assuming that it is so, as the most favourable supposition for the tramways, considered with reference to the ordinary traffic, it seems to me that hardly any of the objections to tramways in the London streets are removed or even modified. An iron rail, no matter of what size or shape, laid down in a street will in a very few days have a groove cut in the material of the street on each side of it, by the numerous wheels of the ordinary vehicles running against it, and wearing or pressing down the comparatively soft material at the side of the rail much faster than the rail itself, and as soon as a very slight indentation is formed, the process goes on at a constantly accelerating rate, because the depression first made tends to keep each subsequent wheel in the same track, while at the same time it holds water, to soften the material operated on. The grooves thus formed render it impossible to cross the line of rails at a sharp angle with anything like the certainty and accuracy required in driving in the crowded streets of London. Besides this, your correspondent "Observer," in your last impression, has correctly pointed out that although the rails themselves should form no impediment to the ordinary traffic, yet the cars travelling along these rails without deviating from their line would of themselves form a dangerous obstruction, because the present dense traffic is rendered possible only by the constant deviation to one side or another, and the ever-varying speed of each individual vehicle to accommodate its neighbours.

The road between Westminster-bridge and Kennington-gate, where tramways were tried some years ago, was in every way much more favourable for the experiment than many of the roads now proposed to be occupied, and yet all these inconveniences were constantly felt, and were almost daily productive of accidents and more or less serious damage, which were subjects of daily complaints, and at last compelled the removal of the tramway. All this was matter of common observation when the system was formerly tried; but there are, besides, some more particularly engineering objections to the system, which I have not seen previously noticed, but which frequently struck me very forcibly when travelling on the line of the tramway in the Westminster-bridge-road. The theory of the tramway is, of course, that the rolling resistance to motion on a smooth iron rail is so much less than on the ordinary roads that a pair of horses can move with ease two or three times the usual omnibus load, and probably the advocates of the tramway will promise also to travel much quicker. On a road, however, that deviates much from the level this advantage is materially diminished, because the resistance of the surface of the roadway is then only a part of the total resistance to be overcome, and the tramway in no way diminishes the tractive power required to haul the load up an incline.

The Kennington tramway did not deviate much from the level, and therefore all the more forcibly illustrated another objection to the system which I wish specially to point out. The tramway cars, holding two or three times as many passengers as the omnibuses, have to stop proportionately often to take in or discharge passengers; and the number of the cars is also proportionately diminished for any given amount of traffic. The cars can easily be stopped by the brake; but the starting of so large and heavy a mass by a pair of horses is a serious matter, owing to its great inertia. I believe I am correct in saying that, in the case of the Kennington tramway, owing to the stoppages being more frequent and the inertia very much greater than with the ordinary omnibuses, the average time required for the journey was greater, and the horses were much more distressed by the former than the latter. These evils would have been much greater than they were had it not been that it became the general practice of the male passengers and some of the more enterprising females to enter and leave the cars while in motion; but this, I suppose, will hardly be upheld as a proper or safe practice for general adoption.

From all this it seems to follow that the use of road tramways should be confined to such places as combine these desiderata: a tolerably level road; ample width of roadway in proportion to the ordinary traffic, so that the tramway shall not obstruct it; and, finally, that the bulk of the traffic should be between the termini of the line, or at least between fixed stations, and not taken up at every point of the route, as is the case with the present London omnibus traffic.

I am your obedient servant,

D. T.

London, December 11, 1867.

TO THE EDITOR OF ENGINEERING.

SIR,—Allow me to express my thanks to your correspondent, "Observer," for his good wishes expressed in your paper of the 6th inst. In doing so, I crave permission to take exception to his opinion that "a tramway must be so constructed that the vehicles can leave the rails and traverse the streets." Nor do I think that any engineer who has been engaged in laying down street tramways would advocate their construction on any other principle than that of their use by carriages with flanged wheels. What is required, in order to prevent nuisance and obstruction, is that no impediment shall be offered by the tramway to the passage along or across it of ordinary traffic.

I am not prepared to admit that "former experience" in London is conclusive as to the fact of street tramways worked with flanged wheels being voted a "complete nuisance." If "Observer" will take the trouble to refer to the history of the matter, he will find that in every case sustained, it was the rail and not the carriage wheel that was proved to be the nuisance. It was the projection of the rail above the level of the street that was the fruitful cause of annoyance, obstruction, and accident. The records of every case in which street tramways were condemned will show that it was the form of rail employed, and that alone, which made the tramway a nuisance.

Your correspondent says: "What would we think of an engineer that would propose running our locomotive railway system through and across our streets?" I am at a loss to understand why this question should have been proposed in connexion with street tramways. No one, that I know of, ever proposed so absurd a proceeding. He asks further, however, "Is the speed that the cars were driven at five years ago calculated to reduce the amount of accidents that daily occur?" An ingenious attempt is made here, it appears to me, to create the impression that tramway carriages travel at a high rate of speed, similar to that of locomotives, and thus increase the dangers of the streets. I was in the habit of riding on Train's tramways, and do not remember that they ran at a dangerous speed—certainly not anything like that of a locomotive engine; indeed, it was not more than about six or seven miles an hour. Moreover, as a tramway carriage can be stopped in one fourth the distance that an omnibus can, the danger is considerably lessened. Statistics prove the fact. The coroner of New York reports, as the result of his inquiries, that omnibuses are more dangerous, by six times, than tramway carriages.

Your correspondent imagines a fearful catastrophe from the collision of a hansom cab with a tramway carriage. Had he not just previously praised the driving of London cabbies, I should have supposed he intended to convey the impression that the blame would be theirs. Not so; he argues that it is the tramway carriage which is the source of the danger. "Observer," however, reassures me. He says: "Do we not see such collisions daily with the present system?" Exactly so; we do. Experience, however, of street tramways shows that they materially lessen the number of such collisions.

Several assertions are made respecting what the company intend to do with cab-stands, the possibility of carriages using the portion of the street upon which the tramways are laid, and other points, important no doubt, but which are matter for the consideration of the select committees to which the bill will be referred. If the promoters are able to prove to the satisfaction of those committees that tramways can be "constructed so as not to impede or injure the ordinary traffic of the streets," they will prove their case, as tramways so constructed would, it is now universally admitted, be of great local and public advantage.

An attempt is made to create a prejudice by asserting that two-thirds of the street will be taken up by a railway and a cab rank. The use of the word railway, to which in England a definite meaning is attached, in preference to tramway, is calculated to mislead the public. Let us ascertain, however, what really is proposed. It is simply an omnibus, of sufficient width inside to accommodate its passengers with comfort; in order to do this it will run upon rails so constructed and laid as to be perfectly level with the surface of the street, having no groove of sufficient width to admit the narrowest carriage wheel, and thus to present for all ordinary traffic a roadway as free from obstacle as at present. By means of the system each carriage will accommodate three times the number of passengers that an ordinary omnibus does, and thus the street will be proportionately relieved of such vehicles.

In reply to the last query of "Observer," I have only to remark that the company have deposited a petition for a bill, and hope to bring their case before Parliament in regular course, that it may be heard and decided upon its merits. I will merely add that in his last sentence "Observer" correctly describes the evil of previous tramways—the flange rail projecting, as it did, above the surface of the street. The company propose to lay an entirely different rail in this instance, one which completely obviates every objection hitherto sustained in this country against street tramways, and hence they have good hopes that success will attend their efforts, and that London will, ere long, enjoy all the advantages of public carriages as superior to the ordinary omnibus as the first-class railway carriage is to the old stage wagon.

Yours truly,

A MEMBER OF THE METROPOLITAN
TRAMWAY COMPANY, LIMITED.

London, December 17, 1867.

THE BOMBAY GAS COMPANY.—According to the recent report, the Bombay Gas Company were supplying last month 8675 private and 2308 public lights. The quantity of coal carbonised between the 1st of January and the 20th of September of the present year was 4354 tons, producing 37,902,000 cubic feet of gas, and yielding a revenue of 21,000l.

COWES.—Mr. J. White is building three dispatch vessels, of 225 tons each, for a Turkish company, and a steam tug for the Government. Mr. J. S. White has also laid down, at East Cowes, the keel of another Turkish steamer of 225 tons.

TELEGRAPHY ON THE CONTINENT.—There are complaints that telegraphic communication on the Continent was recently greatly interrupted by severe weather. Despatches forwarded experienced more or less serious delays, especially on the lines of Prussia, Switzerland, and Italy.



Vote him down
Eugene Fluckiger

PUBLISHER'S ANNOUNCEMENT.

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ENGINEERING.

FRIDAY, DECEMBER 20, 1867.

NATIONAL ECONOMY.

WHILE so much is being said on behalf of improved technical education—and with a great deal of which nearly all of us fully concur—those who urge the advantages of new schools, new professorships, and new courses of study should remember that the laws of political economy are as immutable as those of nature herself, and that there can be no commercial effect without an adequate and definite commercial cause. The *Ecole Centrale*, the *Conservatoire*, and the provincial *Ecoles des Arts et Métiers* of France, and the polytechnic schools of Germany cannot, by themselves, have possibly enabled those countries to surpass us in cheapness of production, inasmuch as the foreign mills and workshops possess no processes, plant, or appliances superior to our own. Nor is it likely that they ever will.

The whole problem of successful foreign competition is solved by the fact of the cheapness of foreign labour and skill—manual and mental. Say what we may, we waste our national labour in many ways, while other nations economise theirs. We waste the labour of our working men by maintaining so many barriers to its cheap and free exercise, and in the constant misunderstandings between masters and men. The cost of everything is measured by the cost of the labour in obtaining it. Air requires no labour to obtain it, at least in open, above-ground spaces, and hence it costs nothing, and bears no price. Water, not so universally diffused, often requires extensive works to bring it to where it is wanted, and its cost is therefore measurable by the interest upon, and maintenance of, the works established for supplying it. And this interest and maintenance are strictly governed by the cost of the labour expended in making the works of supply, irrespective, of course, of any considerations of monopoly. So with coal and iron—their cost is always governed by the cost of the labour expended in getting, hauling, and converting them, to be added to which, of course, is the interest upon the plant and works established for carrying on the necessary operations. The cost of a quarter of wheat, or of the carcass of an ox, is quite as strictly made up of the cost of labour; and the cost of labour nearly corresponds to the cost of living.

We waste in a hundred ways, and thus we cannot live as cheaply, and cannot, therefore, work as cheaply, as Continental workmen. Every workman, every human being, must have food, shelter, and clothing: and, beyond these, the workman must have something of what, comparatively speaking, are luxuries in order to work on contentedly. If he be a man of the least forethought and consideration—and if he be a good workman, he certainly will be—he must see before

him some opportunity for his children to attain at least as good a position as his own, and, distrusting social philanthropy, he must endeavour to make some adequate provision for his own old age.

Now the homes of workmen are but seldom built and owned either by themselves or by their employers. More commonly, when a large manufactory or works of any description are established, as is often the case, in a district which before was almost uninhabited, speculators, who of themselves produce nothing, obtain the control of large tracts of adjacent land and run up a town of badly built houses, and the workmen, new to the place, can do no better than take them at high rents. This has been practically the case at Middlesboro'-on-Tees. The Peases, of Darlington, Richardson, and Birkbeck, and Gurney, of Norwich, bought up the whole site of the town many years ago, and they will not part with building land except at high prices. Rents, therefore, are high, and so are all the expenses of living, and so, of necessity, is the price of labour. Indeed, the cost of living is nearly as great in Middlesboro' as in London. At Le Creusot, Messrs. Schneider possessed the freehold of the town, and they built good houses for their workmen, and let them at rents paying but a moderate return upon the capital invested. What they thus apparently lost in the higher interest upon capital was fully made up in the corresponding saving in the price of labour. As the workmen saved money, many of them bought the houses they had rented, and thus became proprietors with a permanent interest in the town. In the principal manufacturing towns in America, as at Lowell, Lawrence, Nashua, Manchester, Chicopee Falls, Holyoke, and elsewhere, the manufacturing companies have considerable landed property, upon which they have erected long rows of well-built brick "tenements," generally three stories in height, and these are rented, at almost nominal rates, to respectable occupiers, as "boarding-houses" for the work-people. The work-people are generally unmarried, and, when they marry, they usually leave the factories. The board and lodging in these boarding-houses is very good and very cheap.

Large ironworks are carried on most cheaply where the coal and iron-stone mines are upon the same freehold property, the manufacturers having railways of their own. In the Cleveland district, the Earl of Zetland enjoys a royalty of 5d. per ton of ironstone drawn from beneath his moorland property, which property he has done nothing to develop. This is equal to 1s. 4d. per ton of pigs made. The Dowlais Company once held their whole large leasehold property under an old and long lease from a former Marquis of Bute, at 90l. a year. Now, however, the trustees, under Sir John Guest's will, pay royalties, to the present Marquis of Bute, amounting probably to 25,000l. per annum, equal to nearly 3l. per head for each of the work-people employed above and under ground. The Ebbw Vale Company work freehold property, and, but for heavy losses independent of the cost of manufacture, would be one of the most prosperous concerns to be found anywhere. The royalties levied by non-producing landlords, who have done nothing to discover or to develop the mineral wealth of their property, act as an excise duty, and place us by so much at a disadvantage in respect of foreign nations.

Where large ironworks are upon freehold mining property, with mineral railways of their own, and where workmen's towns are built, and well built, by the proprietors, the cost of labour will be much less than under ordinary circumstances, and that with increased comfort to the work-people. It is as much to the interest of employers to look after their work-people as to their manufactories, and in one sense (and that in no way derogatory to the workmen) the men really form the most valuable "plant" of the establishment. If they possess faculties of organisation, they sink these altogether in the routine of their employments, and it is by so much the more incumbent upon their masters to do all in their power to cheapen the price of food, of shelter, and of clothing to them, by giving them the benefit of wholesale markets and keeping out middle-men as far as possible. It is the fact that, with the shopkeeping instincts of our race, English labour pays a higher and more odious tax to middle-men than that of any other nation in the world. We have non-producers everywhere—thousands here and thousands there who had rather buy and sell, or negotiate, or plead, or create business out of litigation, or live upon a legacy, or obtain a post under Government, than perform any productive work; and all these thousands are directly supported by English labour.

In respect of meat and bread considerable savings might be effected on behalf of workmen, if masters

would establish, in connexion with their business, a commissariat department, and would ascertain, by themselves dining from the provisions, taken indiscriminately, that they were sound and good. And it would be folly to deny that beer is one of the necessities of life to the English labourer. Now the gallon of porter, which is retailed to the working men at perhaps 1s. 6d., does not contain above 9d. worth of malt and hops, and the prime cost of brewing is very small, nor is the skill required at all exclusive. The burden of the malt tax ought to have been long ago removed, and workmen and labourers encouraged to brew their own beer. Even now, under the malt tax, the cost of extra Suffolk, or extra Kingston, Ware, or town-made malt, the finest in the market, is 69s. per quarter, and that of brown malt for porter ranges from 50s. to 57s. A quarter of malt will make 3½ barrels of London porter, and each barrel requires on an average 3lb. or 4s. 6d. worth of hops, bringing the price of the malt and hops to, say, 21s. a barrel, or 9d. per gallon.

The future of British labour is greatly in the hands of employers. Instead of treating their workmen as machines, to be put on and off at a moment's notice, they must be treated as fellow creatures, giving their whole available time to their employers, who should in return protect them, by every beneficent means, from the exactions of speculators, grasping landlords, tradesmen, and middle-men. No course could be more beneficial for the masters. They would thus lessen the cost of labour, while actually increasing the comforts of the working-man.

HARBOUR OF ST. HELIER, JERSEY.

REFERRING to our article on the competitive plans for the improvement of this harbour, and to the letter of Mr. Lyster on the subject, we are glad to find that the views we then enunciated merit the approval of so eminent an authority as that of the engineer to the Mersey Docks and Harbour Trust. We gave sketches of some of the principal designs, but as Mr. Lyster did not at that time appear as a competitor, we last week added a reduced copy of the plan he kindly forwarded to us, and which it appears he had some years ago submitted to the local authorities at their request. This was the first of our becoming aware of the existence of Mr. Lyster's plans, and inspection will show that he, too, is very decided on the desirability of adopting the western side of the harbour and the shelter of the Hermitage and Castle Rocks as the proper position for quays and landing-stages; in fact, we cannot see how it is possible on the other side of the harbour to construct any works that could be of the slightest use until the western breakwater was fully completed, and even then, besides, the few feet of water they would have alongside the berths would be utterly useless in a heavy south-westerly gale, such as the harbour is continually exposed to. But we must differ from Mr. Lyster on some points. We have carefully studied the subject, and must stoutly maintain that to us the Platte Rocks seem to form the natural termination to any western breakwater. From the corner where his is deflected inwards to these rocks, the soundings show a ridge, along which it must be much cheaper to construct the works, besides adding to the area of the harbour a considerable extent of the deepest water. A similar shoal runs off at an angle to the Oyster Rocks, and we feel confident that at some future time a groyne, as ingeniously suggested in one of the plans, will be run out to them, as such a work could not involve any very great expense, and be a wonderful protection to ships rounding to bring up sharp under secure shelter as soon as they had passed the beacons. Again, why carry the communication with the shore to such a distance, so as to sever the direct connexion between the outer quays and landing-stages with the new North Pier and inner harbour, which, by the addition of locks and gates, can so easily be turned into excellent floating-docks with 20 ft. to 25 ft. of water? Facility of communication between the different quays is a great point in any port, and as good foundations can be obtained for an iron viaduct skirting the edge of low-water mark, and in a direct line from the new North Pier to the Hermitage Quays, the cost of such, irrespective of other advantages, would, we think, be found not to exceed that of the longer though shallower route by the shoal known as the Castle Bridge.

Jersey is a rising spot, and a well matured and carefully carried out plan of improvement, capable of gradual development, would tend much to increase the commercial and manufacturing importance of the place, whilst an abundant supply of cheap labour and immunity from many of those taxes which press heavily else-

where ought there to encourage a moderate amount of manufacturing industry. The twenty to thirty thousand tourists that annually visit this salubrious isle, and bring no small profit to its inhabitants, demand, too, some safer means of landing and embarking than that afforded by open boats in a heavy gale. No time should be lost in setting about the work, or we may have to record some disaster entailing a heavy loss of life that would bring discredit on the town.

We are led to these remarks by the difficulty the committee seem to have in making up their minds. It has already entailed a delay of many months, and, unless speedily overcome, may cause the loss of the coming season for an active commencement of the works. Many inquiries have been addressed to us from various competitors as to what is doing in the matter. To none of them have we been able to reply; but, remembering the definite promises made in the invitations that were issued to tender, seeing, too, that all the most eminent harbour engineers of the day have contributed their ideas, it ought not to be so difficult a task to award the palm of merit, and we trust that the confidence inspired by the circulars bearing the honoured signature of the chief justice of the island may not in this, as is frequently the case in similar competitions, be misplaced. With thirty-seven designs to choose from, we are amused to see that a lawyer with a local habitation and a name has, by a selection of a little of all sorts, managed to produce a scheme, the description of which fills three columns of a St. Helier paper, and a perusal of which recalls to our memory the good old nursery ditty:

Little Jack Horner sat in a corner,
Eating a Christmas pie;
He put in his thumb, and he pull'd out a plumb,
And he cried, "What a clever boy am I!"

GUNPOWDER OR NITRO-GLYCERINE?

THE diabolical outrage of last Friday afternoon has given rise to much speculation regarding the nature of the explosive material which was employed for the execution of the almost hellish designs of the conspirators who took part in the outrage at the Clerkenwell House of Detention. There was no hesitation at first in affirming that it was a barrel of gunpowder that was laid down at the base of the prison wall, and it seems that it was only after the full extent of the havoc with human life and property was discovered that suspicion was raised as to the probability of the explosive agent being the much-dreaded nitro-glycerine. The explosion on board, and the destruction, of the European steamer at Aspinwall, last year, seem to be fresher in people's minds than the Lotty Sleigh and Erith catastrophes, in both of which there is no shadow of doubt regarding the explosive material. As may be inferred from the heading of this article, we are not disposed to be led away by the suspicions which have been cast in haste, excitement, and, we fear, in ignorance upon nitro-glycerine. At this distance of time, we are able to survey the facts of the case more calmly than it was possible on Friday and Saturday last for the descriptive writers on the daily press to do their allotted work. Still it was scarcely with them that the nitro-glycerine idea originated. Their acquaintance with modern chemistry, physics, and mechanics is much too limited to justify them in authoritatively putting forth any well-founded hypothesis. But, indeed, the idea that it was nitro-glycerine or some other liquid explosive had not its origin in the fertile brains of the ready writers, but rather with persons whose professions would lead us to expect that they had some knowledge of chemistry and physics. Let us inquire into the facts of the case. This, however, is rather difficult, owing to the fiction and fancy which have been so largely imported into it.

A barrel, somewhat resembling an ale barrel of about 36 gallons capacity, and containing some explosive agent, was laid at the base of the prison court-yard wall. At least two men were engaged in moving the barrel into position, so that the idea of gun-cotton may not enter into our calculations: that substance is of too light weight to require consideration. The barrel was covered with something of the character of tarpaulin after it was got into position, a fuse was inserted into the barrel underneath the tarpaulin, the other end was ignited by a lighted match or fusee, and the explosion immediately ensued. Was it an explosion of gunpowder or nitro-glycerine? An officer from the garrison at Chatham says that 100 lb. of gunpowder would be quite sufficient to do all the destruction of which we have been apprised. The destruction done, the mechanical work performed, was undoubtedly great, but was it *too* great for the amount

of force stored up in 100 lb. of gunpowder? For we may fairly assume that the 36 gallon cask would be well filled, if not even packed, and that it would contain much more than 100 lb. of powder. The shock from the explosion was distinctly heard at Croydon, 8½ miles distant from the House of Detention: that does not militate against the hypothesis that gunpowder was the destructive agent employed. Corporation-lane is a very narrow thoroughfare, being not more than 20 ft. broad. The wall forming the boundary of the prison grounds is built of brick. It is 25 ft. high inside and 21 ft. outside, the difference between the heights inside and outside being due to the difference of the courtyard and street levels. It was natural for the wall to fall inwards, as was the case. The thickness at the base of the wall is not more than two and a half bricks, or about 24 in., while at the top it diminishes to a brick and a half, or about 14 in. To this it must be added that the portion blown down was very old, and therefore not stable enough to resist the action of any very extraordinary amount of mechanical force. The portion in question is about 100 square feet, being about 13 ft. or 14 ft. below, and extending to about 60 ft. at the top. In this there is nothing incompatible with the supposition that the barrel was filled with gunpowder; neither is there anything in the great destruction done to the dwelling-houses opposite to the prison. They were not built of granite and casemated, but simply of London bricks. The houses were old and somewhat rickety, and from their height—three stories—they would not be able to give much resistance to the force rebounding from the prison wall.

Now, according to the results of the experiments of Count Rumford, which nobody has ever yet falsified, it is possible for very small amounts of gunpowder to do a great amount of work when exploded in a confined space. In the first instance, Corporation-lane is, at the spot where the explosion occurred, very much confined, being narrow, and having on the one side a high brick wall, and on the other high houses. Then there is the fact that the barrel was a strong oaken one, with the staves three-quarters of an inch thick; and as it had all the appearance of an ale barrel, it would, almost as a matter of certainty, have not fewer than six iron hoops. This gives a confined space, the walls of which would not collapse, like the walls of Jericho, with a blast of a trumpet, but would yield great resistance until the gases resulting from the decomposition of the explosive agent would acquire their greatest heat, their greatest expansion, and, necessarily, their greatest eruptive force—an approach, in a sort of way, to Rumford's experiments just alluded to. In one instance, Rumford loaded a mortar with ¼th of an ounce of gunpowder, and placed upon it a 24 lb. cannon, weighing 8081 lb. He then closed up every opening as completely as possible, and fired the charge. The mortar burst with a tremendous explosion, and lifted up the enormous weight. In another experiment he used 28 grains of gunpowder, confining it in a cylindrical space which it just filled. Upon being fired the powder exploded and tore asunder a piece of iron that would have resisted a strain of 400,000 lb., or upwards of 178 tons! That is with 28 grains of the explosive, mark you. And what is 28 grains to 100 or 150 lb.? The moral probability, then, if not even certainty, is that the explosive was gunpowder, and nothing else.

But we are told that it was probably some liquid explosive; and petroleum is suggested, as the barrel staves that were found smelt strongly of some oily soft substance. Even the learned doctor, the senior resident surgeon of the Free Hospital, Gray's-inn-road, seriously suggests petroleum or some such liquid as it. Well, this assumption may be dismissed by stating the fact that petroleum is *not* explosive; and we may also state that it could not be any other liquid but nitro-glycerine, for it is the only liquid explosive which we know of, unless we include such chemical novelties as chloride of nitrogen, and perhaps one or two other nitrogen compounds. That the barrel staves smelled strongly of petroleum, we can believe as being very likely indeed; for it is just in such barrels that petroleum, naphtha, and paraffine oil are sold in large quantities. There is no mistaking the odour of those substances, and the barrel staves will retain the odour for a long time. It would be well to examine them well, for probably they are coated with a thin layer of glue on the inner surface, as is generally the case with mineral oil barrels. Was there much smoke immediately after the explosion? If so, the explosive was almost certainly gunpowder, and not nitro-glycerine, as that substance practically gives no smoke when it explodes. Then, as to the mode of exploding it. Heat applied to it by a simple fuse—

such as seems to have been observed by various independent witnesses—would not explode it. One of the means by which it may be exploded is to cause commotion in it by exploding a percussion cap in it, or by employing powerful percussion to it when spread on a hard surface. This was not the plan adopted. Further, nitro-glycerine *has no odour*, any more than glycerine or trinitro-cellulose, which our readers know is the chemical name for gun-cotton. But, to conclude the consideration of this subject for the present, an absolutely certain means of determining whether or not nitro-glycerine was the death-dealing explosive employed is available even yet. A few fragments may be cut off the staves with the greatest impunity; let this be done, and let them be sharply struck with a hammer on an anvil. If they have absorbed any of the nitro-glycerine, *there will be a sharp detonation or explosion*. It is our firm conviction, also, that a 36-gallon barrelful of nitro-glycerine would have laid very much more of London in ruins than is the case, so great is the explosive power of this new agent of destruction.

A "MOLECULAR" BUGBEAR.

As long as engineering questions remain to be discussed, we must expect to meet the perennial quackery which ever seeks to clothe the utterances of trades' interests with the garb of scientific truth. Just now one of the most important industries in the kingdom is seriously threatened, if not with extinction, at least with the loss of a very large share of its former command of a profitable market. The manufacture of iron rails for railways is being rapidly contracted in its extent and profits in consequence of the growing use of steel, and already a natural alarm has spread in the iron trade, and every argument is being employed to show that the material which abundant experience has proved to be the best is after all unsafe, or at least that it will by-and-by become so. This alarm is the more natural when it is considered that a ton of steel rails has been found to be from five to ten and in some cases even twenty-two times more durable than the same weight of iron rails, and hence that every order for, say, 20,000 tons of steel rails deprives the ironmasters of orders to the extent of 100,000 or 200,000 or possibly 440,000 tons of iron! The stronger the proofs that this is and must be so, the greater of course are the efforts made to show that is not and cannot be so. A vast trade, in which a million's worth of iron may be sold where perhaps 200,000*l.* worth of steel would serve the same purpose will not be abandoned without a struggle. True, old rails may be rolled over and over, when mixed with a proportion of new iron, but the mill-master makes the same profit at each re-rolling as in making the new rail. He merely receives his pay partly in old iron at its market value.

The proofs that *new* steel rails are incomparably superior to *new* iron rails are now too numerous to admit of any dispute whatever. To say so is indeed to say no more than that wrought iron is better than cast iron, or cast iron better than stone or wood, where only strength and durability are required. If a steel-master wished to frame an indictment against iron rails, nothing could so help him as the startling table which we published last week, compiled from the record-book of the engineer of the South-Eastern Railway Company. There is no reason whatever for supposing that his experience has been exceptional, yet the results of his trials are enough to show that it must have been, and yet is, one of the greatest anxieties of his life to procure rails fit to bear the passenger traffic, or, indeed, any traffic on his line. One lot "frequently broke in the road, and had to be 'taken up';" a number of others failed miserably under test, and in at least one case an important contract had to be withdrawn. The continuation of these tests, which we give this week, bears out still further the singular variability and often treacherous character of iron rails, and it is surprising that we do not have to record even more fatal accidents than we do from their frequent failure in use.

The steel rail, at least when new, will withstand the blow of a ram nearly seven times heavier than that used for testing iron rails, and falling from a still greater height. A ram weighing 3 cwt., and falling from 5 ft. to 10 ft., will often break an iron rail at the first blow, where a steel rail of the same section, and supported on the same bearings, often stands the fall of a 1 ton ram falling from 20 ft. to 35 ft. Any one interested may see the latter test applied, almost any day, in Sheffield, Bolton, Barrow, or at Dowlais, and, for that matter, at many other places—say Man-

chester, Ebbw Vale, and other seats of the steel-rail manufacture.

But we have had lately started the unfounded and amusing theory, or rather assertion, of "molecular deterioration" in steel—the assertion that it will answer for a time, after which its constitution becomes altered, and it fails. We must make ourselves clear upon the point that no theory is offered as to this wonderful change, now heard of for the first time, in steel, but that it is pure assertion or conjecture, advanced with all the confidence of assertion. Now a theory, still more an assertion, or even a physical conjecture, should be accompanied with something like proof to give it substance or value. And what is the pretended proof offered in the present case? Just this: a steel rail, which had outworn twenty-two faces of iron rails, laid end to end to it, in the same line, and bearing the same traffic, was finally broken sideways, and after having been greatly bent by a heavy engine, which was thrown off the line at this very rail, in consequence of a collision which occurred there between two engines. Truly, this is proof of "molecular deterioration"! Under the same circumstances an iron rail would have gone like a pipe-stem. Another case is that of an over-hard steel rail, put down two or three years ago, when it was made by the Barrow Company, just then learning their business in steel-making. This rail cracked, as we explained, a fortnight ago, just as hundreds of iron rails have cracked when made too hard. So far this is all the evidence adduced as to "molecular deterioration," and, until last week, the Chalk Farm rail—the circumstances attending the failure of which showed its surpassing excellence of quality—was the sole proof relied upon!

The proof, however, that no molecular change goes on in steel, when not repeatedly strained beyond its elastic limit, is clear and conclusive. It is afforded by many years' experience with steel tyres, which are subjected to a far greater wear than rails without breaking. Of these (tyres) many thousands are now running, and those which have been actually worn out have been found to be tough to the last, while many authorities upon steel maintain, and apparently upon good evidence, that steel is even improved by long use.

Partly worn steel, as we showed a few weeks ago, has been tested and found to be actually stronger than new steel of good quality, although it cannot be said whether it had the same excellent quality at first, or whether it had improved during use.

Engineers who are informed as to the respective qualities of steel and iron have no difficulty in perceiving that the pretence of the "molecular deterioration" in steel is a mere diversion in the interest of the iron trade. If such deterioration were really going on, trials of partly worn steel could be at any time made to disclose it. But we believe that, of the fifty thousand steel rails now down in the London and North-Western line, not one is to be taken up for the purpose of demolishing this molecular bugbear.

DRAUGHTSWOMEN.

It appears from the remarks of one of our correspondents that we have not been sufficiently explicit for some of our readers in describing the position of the female *employés* in the drawing-office of Messrs. Dubs and Co. As the organ of the noblest and proudest of all professions, we are accustomed to consider all our readers to be *gentlemen*, and we therefore thought it unnecessary, when stating that Mr. Dubs had taken some girls into his service for the purpose of making tracings, to add that, as a matter of course, their drawing-office, and everything that belongs to it, is so fitted out as to afford a sufficiency of comfort and a pleasant workroom for these girls. We hope our correspondent will understand us when we now say, for the information of himself and others taking his view, that the room in which the three draughtswomen have their office is an apartment of 23 ft. length, 13 ft. 3 in. width, and 11 ft. high, fitted with three plate-glass windows, 8 ft. high and 3 ft. 6 in. wide; that it was originally fitted out for the inspectors of foreign railways, who occasionally are sent to the works where engines are manufactured for the purpose of superintending their manufacture. The partitions, which are common desk partitions fitted with ground plate-glass, were then required to afford to each of the different inspectors the possibility of keeping his own papers and his own work undisturbed. They are no more like "prison cells" than the desks in a telegraph-office, which also are high enough to prevent any person seeing his neighbour or his writing. In fact, it was even an erroneous statement on our part that

the glass partitions reach to the ceiling, as they leave some 5 ft. clear height undivided, and are only about 6 ft. in height. As for the fitness of women for the class of work they are employed at in the Glasgow Locomotive Works, we have already said all that need be stated. "Youngsters" are much better employed in reducing drawings from full size to scale, or drawing out details from a general plan, than in the mere mechanical work of tracing, which is least of all suited to teach descriptive geometry or anything else, and only acts as an agent in creating dislike to the drawing-board and its monotonous drudgery. The way Mr. Dubs employs his apprentices is more useful to themselves, and less monotonous, and there is therefore an advantage gained by this arrangement for all parties concerned.

A NEW GANGES CANAL.

MR. STRACHEY has recently submitted to the Government of India a scheme for a canal, which may be called a second Ganges Canal, from the Sardah, where it enters the plains of Burmdeo. This project has often recommended itself to engineers from the ease with which it may be carried out; and so long back as April, 1862, it was recommended to the Government of India by the commissioner appointed to report on the Province of Oudh.

The volume of water discharged at Sardah during the cold weather, at the point where it leaves the hills, is 6390 cubic feet per second. This is not very much less than the volume of water discharged by the Ganges in ordinary seasons at Hurdwar, which is stated to be 8000 cubic feet per second. There are none of the difficulties to be encountered in the construction of a dam or headwork at the Sardah, which cost so much money and so much trouble in constant repairs at Hurdwar. The commissioner took the evidence of officials experienced in canal construction, and well acquainted with those parts of Rohilkund and Oudh through which the proposed canal would necessarily pass, and all gave strong testimony to the facility of constructing the canal, and recorded their conviction that it would not cost half so much money as the Ganges Canal. To their evidence the commissioner adds the following from his own personal observations:

"I have traversed the whole country through which the proposed canal would pass, from the Ganges to Burmdeo, and I have done this in a wheeled vehicle, carrying my luggage in native carts, and I have encountered no obstacle whatever in the construction of a canal. At Burmdeo I examined the river, and the facility for constructing a dam, or headwork, was obvious to the most superficial observer. On the Nepal side of the river there is a natural rocky barrier extending for more than a mile, varying from fifty to eighty feet high, which would form an effective barrier to the river escaping on that side when a head was constructed. On the British territory side there is no barrier or elevated ground to impede the water being conveyed into a canal, and I believe, with Mr. Colvin, that, if desirable, the whole river could be emptied into a canal. The country through which it would run, unlike that through which the Ganges Canal runs, is almost destitute of wells, and the extent of good culturable land at present lying waste is enormous.

The waste lands of Rohilkund and Western Oudh have been estimated at about one million acres, but the waste lands are inconsiderable when compared with the great area of cultivated lands through which the canal would pass, and which suffer periodically from insufficient rains. The Zemindars examined by the commissioner declared that they were too poor to construct masonry wells, and that rutchas wells do not last more than one season. They all said that they would derive vast benefit from a canal running through their territory. The commissioner has attached a map to his report, in which he traces the probable line of country through which the canal ought to pass. It commences at the point where the Sardah debouches from the hills at Burmdeo, passes close to the town of Madho Tanda, runs through the district of Mahomdee Setapoore, skirts the cities of Lucknow, Roy Bareilly, and Selon, and enters the Ganges a little above the bank opposite to Allahabad. The distance that the canal would run is estimated at about 300 miles, and there can be no doubt whatever that the construction of such a canal would be of vast benefit to the people, and would largely increase the revenues of the State. It must be remembered that the land assessments in Oudh have hitherto been made for short periods, and the greatest advocates of permanent settlements have never urged their adoption in new countries that have recently come into our possession, where measurements of areas are imperfect, and where there are vast tracts

of culturable lands, belonging to Zemindars, lying waste and unassessed. This is eminently the case in Oudh, and the commissioner, while advocating the principle and practice of permanent settlements in the correctly measured and fully cultivated districts, expressly excepts large portions of Oudh from such permanent settlement. The Government has also recently excepted from permanent settlement such lands as canals will pass through; and although this resolution will prove to be a great hardship in some of our older territories, it would not be considered as such in Oudh.

M. EUGÈNE FLACHAT,

Président de la Société des Ingénieurs Civils.

M. EUGÈNE FLACHAT was born in Paris, in April, 1802. His father was the author of a large engineering project, that of a ship canal from Paris to Havre, a project which would have been undertaken and completed but for the introduction of railways. The subject of our notice, after the completion of a collegiate course, studied engineering under his brother, M. Stéphane Flachet Mony, now the manager of the Commeny collieries, and of the forges and engineering works at Forchambault. M. Stéphane Flachet, a graduate of the School of Mines, was at that time engaged in the surveys, &c., of the important work projected, as already noticed, by his father.

Subsequently, between 1825 and 1827, M. Eugène Flachet spent two years in England, where, with the permission of Mr. Telford, the elder Brunel, and Mr. (now Sir) John Rennie, he closely attended upon and studied the works of the Caledonian Canal, St. Katherine's Docks, Shadwell Basin, London Docks, and the Thames Tunnel. On his return to France, he executed, in conjunction with his brother, a number of artesian wells and other deep borings. Soon after he was commissioned by the Russian Government to carry out a series of surveys in the southern provinces of that empire, embracing many various projects of engineering interest.

On his return from Russia in 1832, M. Flachet was engaged in the construction of large warehouses in Paris, and he was also occupied with projects for docks at Havre and at Marseilles, in which he carefully applied the results of his studies in England. He wished to make these purely commercial ports, and it was not until thirty years afterwards that the French Government fully adopted this idea by rejecting the military works which it had been previously intended to execute at both these harbours.

Between 1832 and 1837, M. Flachet associated with himself, in his works, a number of young engineers, graduates of the Central School of Arts and Manufactures, and he directed, in conjunction with them, a great variety of works, including ironworks, suspension-bridges, gas-works, canals, the construction of steam-vessels, the opening of mines, and water-works. Among this group of then young engineers may now be counted M. Petiet, the manager of the Northern Railway of France, M. Vuillemin, the manager of the Eastern Railway, M. Mayer, M. Chobrinzinski (of the Northern Railway) M. Barrault, M. V. Bois, Romme, &c., all of whom now hold prominent places among the French engineers.

About the year 1837 railways began to engage general attention in France, and M. Flachet devoted himself to their introduction there. He was one of the principal projectors of the well-known St. Germain (atmospheric) Railway, and he has been for thirty years closely related to the Western of France Railway, to which he is now the consulting engineer. He was associated also with other leading engineers in the construction of the Southern Railway of France and the Northern Railway of Spain. Following the example of Mr. Stephenson and Mr. Fairbairn, M. Flachet was the first in France to adopt wrought iron in construction for large bridges, viaducts, and railway stations.

Apart from railway engineering, M. Flachet some years ago executed a work of much architectural and, indeed, general interest, viz., that of renewing the massive piers under the central tower of the old cathedral at Bayeux, the original piers having been found to be slowly crushing under their great superincumbent load.

In conjunction with Messrs. Petiet, Le Chatelier, Barrault, and Polonceau, M. Flachet has written various works, which have long been recognised in France as of the highest practical value, upon the manufacture of iron and the construction of locomotive engines. He has also written, apart from the co-operation of his associates, important works upon railways and steam-navigation.

M. Flachet is now, and for the seventh time, the president of the French Institution of Civil Engineers, and for the last twenty years he has been the president of the "Conférence des Chemins de Fer," an association established for the purpose of maintaining friendly relations between the Government engineers and those practising in the profession apart from governmental interference. The "Conférence" now comprises sixty members, all of whom are railway managers or chief engineers. M. Flachet is consulting engineer to the Western of France Railway Company, the Southern Railway Company, the French Transatlantic Steamship Company, and several other important undertakings.

We may be permitted to record here our own testimony that M. Flachet is one of the best beloved members of our profession in France. He is personally known to a considerable number of our English readers, and of these many have had occasion to remember his ready, generous, and high-souled assistance in their first introduction to French engineering.

THE AMERICAN NAVY.—The American navy at present consists of 238 vessels, and 50 of these, carrying 637 guns, are in squadron service. The number of vessels in commission has been reduced twelve during the present year.

BOILER OF STEAMSHIP "BUBULINA."

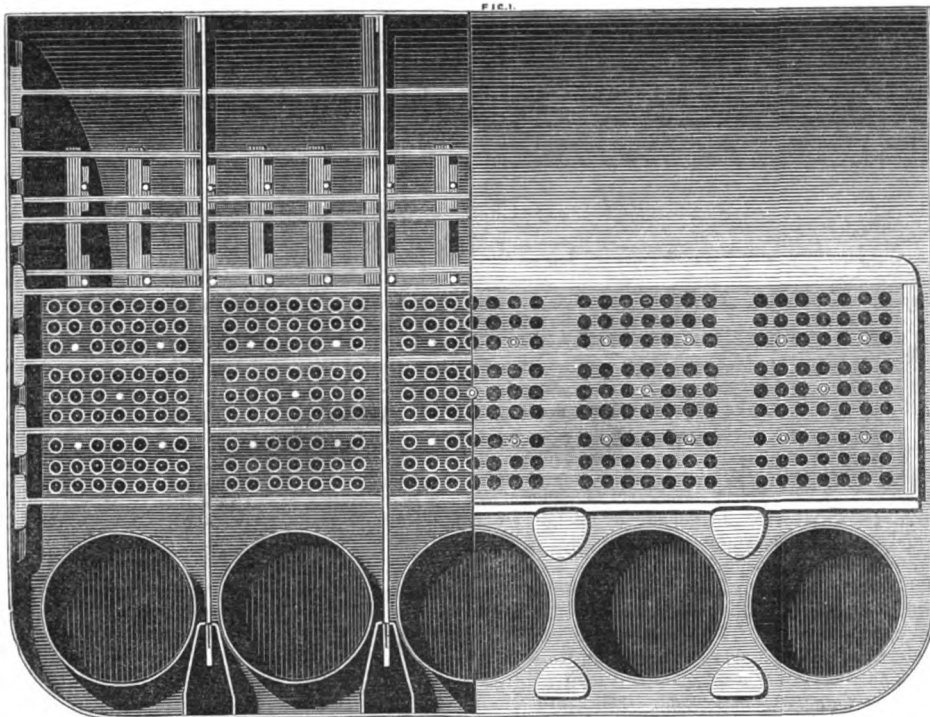


FIG. 1.

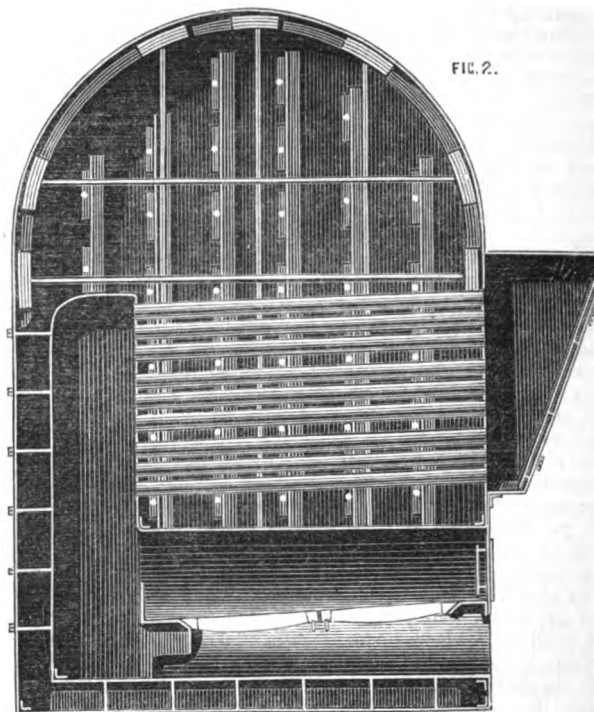


FIG. 2.

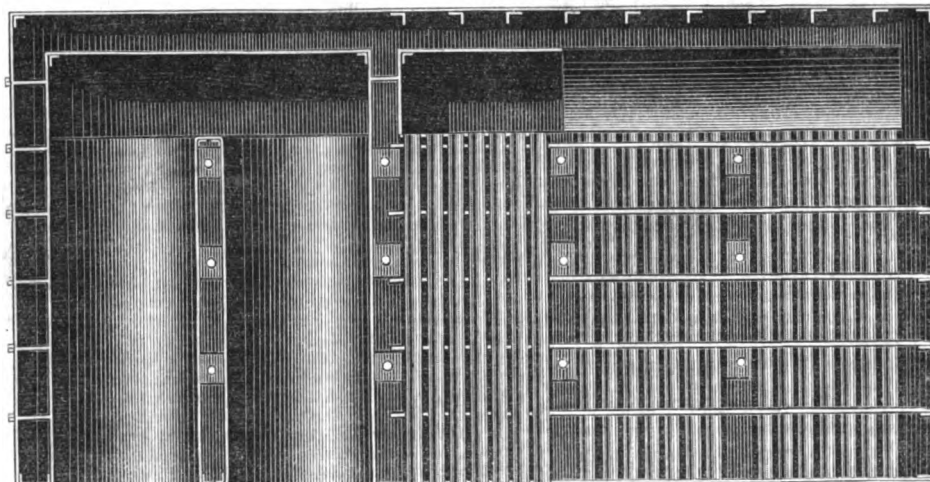


FIG. 3.

WE give, above, an engraving of one of the four boilers of the steamship *Bubulina*, recently sunk by an explosion, in the Mersey. The boilers were made by a Liverpool firm, and they are similar to others which were made about the same time for blockade-runners. The construction of the boiler will be readily understood without any special description.

THE STATE OF TRADE IN AMERICA.—The last American accounts give an unfavourable picture of the condition of the manufacturing States. The majority of the factories are not working more than three-quarters time; and the shipbuilding interests are particularly depressed. In Newburyport, Massachusetts, it is said the shipbuilding trade, which formerly constituted the chief business of that flourishing town, is now almost entirely stopped. The few vessels that were launched last year were built at a loss. "Mechanics earn poor wages, and while labour and property are less productive, the cost of living has not fallen to a corresponding degree." The repeal of the Reciprocity Treaty with Canada is now, more than ever, seen to have operated disastrously to the New England States. Canada exchanged her raw produce for New England manufactures, and it is admitted that the ruin of this trade is a greater misfortune to New England than to Canada. The prostration of the New England shipbuilding interests has been chiefly caused by the loss of the supply of cheap lumber from the almost exhaustless forests across the frontier. For the restoration of the shipbuilding trade and the general industry of New England, according to the *New York Commercial Advertiser*, prompt and judicious legislation is required.

THE AUSTRALIAN COLONIES.—The population of Victoria in June, 1866, was 632,998; of New South Wales, 420,000; of Queensland, 94,710; and of South Australia, 163,452. The population of Tasmania in 1865 was 95,201; and of New Zealand in December, 1864, 172,158. Of the population of Western Australia and Southland we have no recent returns, but we may set it down at 20,000. At the close of 1867 the population of the Australias may be approximately estimated as follows: Victoria, 645,000; New South Wales, 430,000; Queensland, 100,000; South Australia, 170,000; Tasmania, 97,000; New Zealand, 185,000; Western Australia and Southland, 20,000; total, 1,627,000. These figures refer exclusively to the British population.

THE INVENTOR OF THE NEEDLE GUN.

ON the 9th inst., Herr von Dreyse, the inventor of the needle-gun, died at his native place of Sommerda, near Erfurt. He was born in 1787, and, the son of a locksmith, worked in his father's shop until, as is the wont of artisans in this country, he left home to perfect himself in his trade. In the course of his wanderings he came to Paris, where he found employment under Colonel Pauly, a German officer, commissioned by Napoleon I. to invent a breech-loading rifle. There he stayed from 1809 to 1814. It is well known how, after his return to Prussia, he established an iron factory, and, devoting all his energy to the pursuit of the object which had been vainly attempted by his Paris teacher, at length succeeded in constructing the *zündnadelgewehr*. This was in 1836. Four years later orders were given to arm the light regiments of the Prussian infantry with his gun. Working steadily on amid the honours and riches heaped upon him, he from time to time presented his country with new inventions, some of which promise to add still greater lustre to his name. Among these, the grenade rifle, to be shortly given to some fusilier regiments, is mentioned as the most important. Its physical and moral effect upon the enemy is anticipated to exceed everything hitherto achieved in this line. The ball, weighing 88 grammes, is 53 millimetres long, hollow, and filled with a charge of powder 2½ grammes in weight. On striking, it explodes with the greatest certainty, and, dispersing its fragments 3 ft. in every direction, is reputed to do as much damage as three or four ordinary balls, and to create as much dismay as would a dozen. The ingenuity displayed in making a simple yet effective projectile is repeated in a contrivance to weaken the rebound, necessarily strong in so heavy a weapon. The calibre of the new rifle is 21 millimetres. Speaking of firearms, a few words may be bestowed upon the rifled mortars devised by the Prussian Artillery Commissioners. They are breech-loaders 6½ ft. long, and can be brought to an elevation of 75 degrees. It is asserted that, hitting their mark with as much precision as the rifled cannon, they are applicable in many cases where the latter would be of no use. If the hopes of professional people are fulfilled, their balls, flying over walls that would be impenetrable to rifled cannon, will prove incomparably more dangerous enemies to fortresses than the old mortar with its random shots, while when employed on coast defences they will fall perpendicularly on the deck of a vessel the cuirassed sides of which mock attack.—*Times*.

THE FORCHAMBAULT WORKS, FRANCE.

(From our Paris Correspondent.)

THE Forchambault Works are situated upon the Loire, 3 miles from Nevers, and belong to Messrs. Boiguer-Rambourg and Co., who own also the coal pits at Commeny, another establishment at Montluçon, ore beds near De Bourges, blast furnaces at Torteron, la Pique, &c.

At Forchambault are two distinct works, employing together about 2000 workmen. The first is the forge, which works up pigs from various furnaces belonging to the company. Here is made the well-known "fer du Berry," worked generally into rails and merchant iron of moderate section. Iron for tin plates was once made here, but not since the works at Imphy have been turned over to the Société des Acieries Jackson.

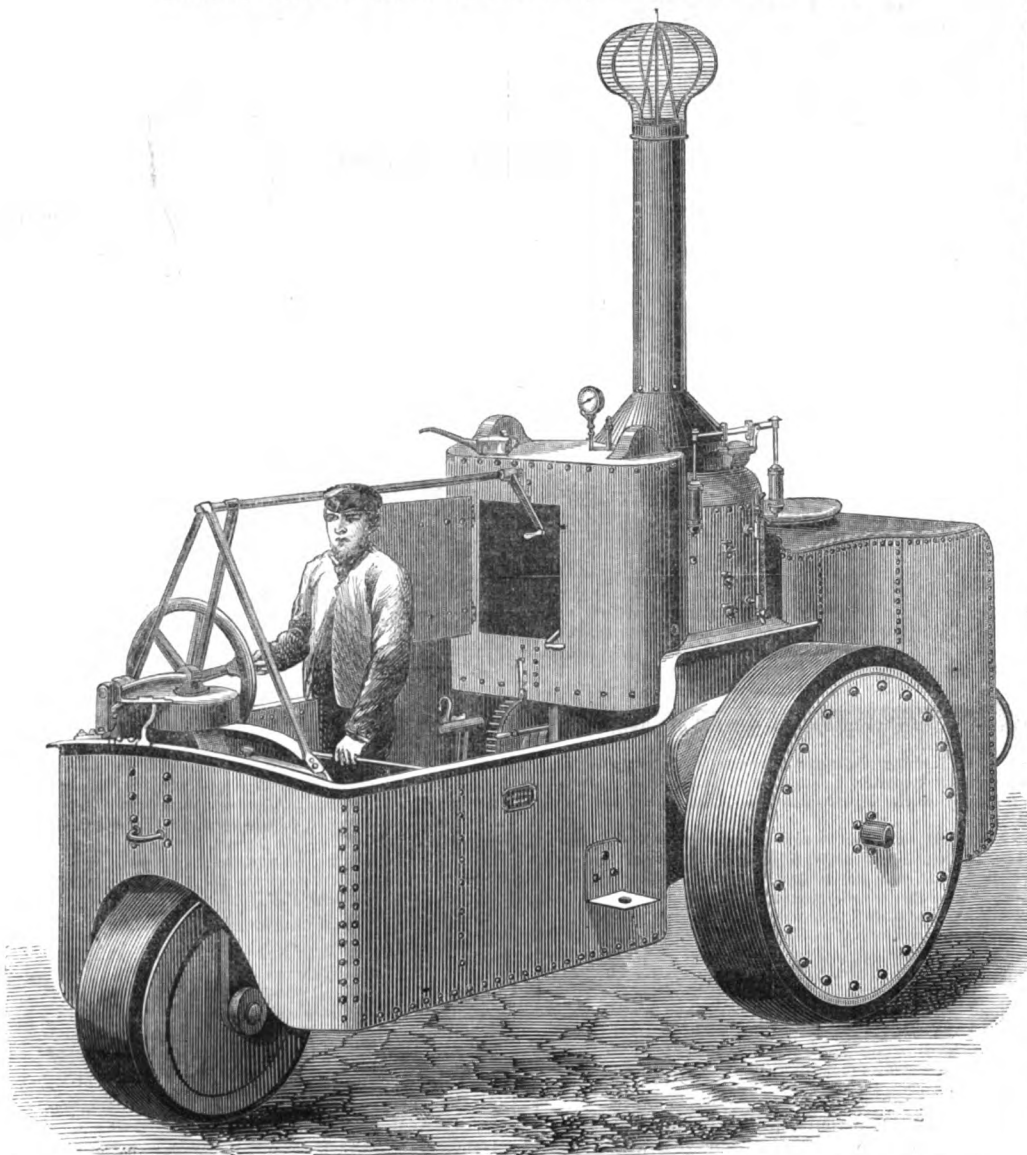
The foundry, formerly the works of Messrs. Emile Martin and Co., is now occupied in the construction of railway material, turntables, crossings, railway wheels, axles, &c. Recently a contract has been taken for the construction of 500 platform wagons for the Lyons Railway, the frames of the wagons to be wholly of iron. Large numbers of projectiles are also made in the foundry for the French artillery.

PATENT AGENTS.—The law of patents is a technical branch of law upon which there is much to be learnt before any one can feel sure of his ground. Many books have been written upon the subject, and there are, and have been, many gentlemen of very great ability who have devoted themselves almost exclusively to this branch. It is a very important branch, and one which requires much study and observation; and yet any one may set up as a patent agent, without any license, certificate, or annual payment being required. He may know nothing whatever of patent law, and may be utterly unable to give an opinion as to whether a particular invention is the proper subject of a patent; whether there is or is not "variance" between a provisional and complete specification; or whether there is or is not "novelty" in a certain invention; and yet he may take a set of chambers, paint "Patent Office," or "Bureau des Inventions," on his window, and undertake to pilot the first inventor who comes that way. Of course, questions of great difficulty are in all cases submitted to legal opinion. There is no requirement whatever made of the patent agent, who sets up to undertake the patent business of any one who may come to him, while, in the case of a solicitor, who is consulted by his client as to the best mode of disposing of his property, or as to his chances of success in a suit or action, the test of an examination has been interposed, in order to ensure his knowing his business, a fact which the client, being unlearned in the law, has no opportunity of testing. It will, of course, be understood that we are speaking in general terms, and without reference to any individual instances; we are, of course, aware that there are gentlemen of position, of eminent ability, and an intimate acquaintance with patent law, who carry on the business of patent agents. The solicitor, in addition to other requirements, has to take out a certificate, and pay an annual tax, in the shape of certificate duty, which he is told the State cannot afford to remit, and yet nothing is required of the patent agent. We cannot see why a solicitor should be taxed while a patent agent pays nothing, and we would suggest for consideration whether a considerable amount of patent litigation might not be avoided if some test were required, in order to ensure that no one should practise as a patent agent, without possessing a certain acquaintance with the subject.—*Solicitor's Journal*.

SHEFFIELD.—Both at Sheffield and Rotherham, the men engaged in the iron trade have received notice of a reduction in wages, and it is understood that the proposal will not be resisted. Most of the puddling furnaces, both at the Atlas and the Cyclops Works, are now in blast; there are, however, considerable stocks. It is stated that large orders have been received for springs and some other description of railway materials.

TRACTION ENGINE.

CONSTRUCTED BY MR. R. W. THOMSON, ENGINEER, EDINBURGH.



In our issue of the 29th ult., we gave a short notice of the road-steamer or locomotive traction engine invented and patented by Mr. R. W. Thomson, C.E., Edinburgh, in which city it had just been tried with very successful results. To-day we give an engraving of the engine, and supplement our former notice by some additional information.

Notwithstanding the great extent to which ordinary railway locomotion has gained a hold, both in our own and in other densely peopled countries, there seems to be room still left for employing steam power on many roads in those districts where the iron way has gained no access, and to which it may never gain access on account of the difficulty of making it "pay." To supply the wants of ordinary macadamised roads there is ample scope for the inventive powers of the mechanical engineer. Various persons have tried their inventiveness with more or less success, but not many have laboured with any very marked success. James Watt tried his hand at a solution of the difficulty, and a model of his steam-carriage is still preserved as a memento of his great skill and ingenuity. But efforts were made even before Watt's time; still it is only in our own day that there has been anything like a realisation of the idea. The efforts which have approached nearest to actual perfection are those which resulted in the invention of the machines which bear the names of Boydell, Blake, and Aveling and Porter. Machines made by the last-mentioned firm are in successful use in many countries for road locomotion, but they do not seem to be completely free from the charge that their wheels are apt to injure the road by the projections which are fastened on their tyres, and more especially by the reserve teeth which are called into requisition to "claw" the road when the projections of themselves supply an insufficiency of "biting" power. In Messrs. Aveling and Porter's road locomotive the tyres are of rigid inflexible metal, and although these give ample "bite" under all ordinary circumstances, still it is sometimes necessary to employ some sort of projection or tooth on the circumference of the wheel, and hence a difficulty still. Road locomotion will not be completely realised until wheel-tyres can be made which shall neither slip nor cut up the road.

Mr. Thomson's road steamer seems to be a step decidedly in advance of everything which has preceded it. As mentioned in our former brief notice of the invention, the peculiarity in it is the application of vulcanised india-rubber in lieu of the rigid unyielding iron of the ordinary wheel tyre. It is certainly a somewhat novel idea that suggested itself to Mr. Thomson, and which that gentleman has worked out; but we must wait for some time before we can pronounce upon its value without any fear of contradiction; however, the results already attained

by the road steamer, in the experimental trials to which it has been subjected, lead us to speak hopefully of it. The band of vulcanised rubber employed by Mr. Thomson for his tyres is 12 in. broad and 5 in. thick. It is true that vulcanised rubber of such a great thickness will require a friction resulting from long use to wear it away, but that it will wear there is not a shadow of doubt. The experience of every person who has used this material for erasing pencil marks amply proves the fact. In Mr. Thomson's locomotive there is the apparent impossibility of a smooth-surfaced tyre conjoined with a marvellous power of "bite." The elasticity of the machine seems equally marvellous.

Since the trials took place which we formerly referred to, the inventor of the road-steamer has had several runs with it into the country, at the rate of from eight to ten miles per hour, with a large omnibus in tow. The vulcanised rubber tyres seem to remain entirely unaffected by sharp stones, &c., and there is no symptom of wearing. Mr. Thomson intends to run the engine over to Glasgow by the road, for shipment to Java, where it is to be used for running between two towns about forty miles apart, taking in tow a large omnibus full of passengers, or trains of wagons, at the rate of speed which has already been accomplished in the trials which have been made in the neighbourhood of Edinburgh.

The engine has a 5 in. cylinder, with an 8 in. stroke, and weighs, as previously mentioned, between 4 and 5 tons. For high speeds the gearing is 3 to 1, and for very slow speeds 22 to 1.

AMERICAN PATENTS.—Eleven thousand six hundred and fifty-five patents and designs were issued in America during the year ending September 30, 1867, and at that date the balance in the Treasury to the credit of the Patent Fund was \$286,607.

EXPLOSION IN A FRENCH COAL-MINE.—An explosion of fire-damp occurred last Friday morning in a coal-mine at Blangy (Saône-et-Loire). Two galleries in which some men were at work, behind the spot where the disaster occurred, are obstructed by the rubbish, and several days will be required to clear the approaches. Eighty dead bodies have already been got out. Every effort is being made to save, if possible, the men who may be still alive. The emperor, on hearing of the disaster, forwarded a sum of 10,000*fr.* to the prefect of the department, to be distributed among the families of the victims, and has since sent one of his aides-de-camp to make a report on the catastrophe.

THE INSTITUTION OF CIVIL ENGINEERS.

JOHN FOWLER, ESQ., President, in the Chair.
December 17, 1867.

THE ANNUAL GENERAL MEETING.

THE Council in their report stated that it was a source of gratification that the interest taken in the Ordinary General Meetings by the members of all classes continued to increase. It would be remembered that a principal if not the primary motive which led to the establishment of the Institution was to afford an opportunity for the free and mutual interchange of individual observation and experience in the various branches of engineering. This object had been steadily kept in view during the fifty years which had elapsed since the foundation of the Society; and it was satisfactory to observe that the value and importance of the original communications, and of the discussions, had been fully sustained.

The premiums awarded for some of the communications brought forward last session (and which were presented after the reading of the report) included Telford Medals and Telford Premiums of Books to Messrs. J. T. Chance, M.A., and E. Byrne; a Telford Medal to the Astronomer Royal, F.R.S.; a Watt Medal to Colonel Sir W. Denison, K.C.B., R.E.; a Watt Medal and a Telford Premium of Books to Mr. John Bourne; Telford Premiums of Books to Captain W. H. Tyler and Messrs. W. H. Preece and W. A. Brooks; and the Manby Premium of Books to Mr. C. D. Fox. It was noted that Colonel Sir W. Denison, Captain Tyler, Mr. W. A. Brooks, and Mr. W. H. Preece had previously received Telford Medals from the Institution. In the adjudication of the premiums, Mr. W. H. Barlow's description of the Clifton Suspension Bridge was not taken into account, the author being a Member of Council; but the thanks of the Institution were eminently due to Mr. Barlow for his interesting communication, and for the suggestions he had made in regard to the materials to be employed, and the principals to be adopted, in bridging wide spans, which led to so useful and practical a discussion.

The record of these papers and discussions was contained in Volume xxvi. of the Minutes of Proceedings for the session 1866-67, which had been issued to the members in a complete form. The publications of the Institution were at present limited to the printing of the papers and the reports of the discussions upon them. But the members were reminded that they had been invited to contribute, not necessarily for reading at the Meetings, the details and results of any experiments or observations on subjects connected with engineering science and practice, for the purpose of forming an appendix to the Minutes of Proceedings.

It was stated that many circumstances, beyond the control of the council, had prevented a satisfactory conclusion being arrived at as to the plans that ought to be adopted for providing additional accommodation for carrying on the business of the Institution. Having regard, however, to the increase in the number of members of late years, and the fuller attendance at the meetings, it was trusted that the subject would receive the early consideration of the new Council.

The establishment of a class of Students, to be attached to the Institution, but not to form part of the corporation, in lieu of the old class of Graduates, was next touched upon; and the mode of admission to, and the privileges to be enjoyed by, this new class, as set forth in the by-laws adopted at a General Meeting of Members in June last, were detailed. Although not specifically mentioned in the rules, it was contemplated to organise supplemental meetings for the reading and discussion of papers by the students, and possibly also for the delivery to them of lectures upon special subjects. Already seventy-eight students had been enrolled, and the number was likely to be still further increased. The graduate class had ceased to have any existence in the Institution.

Having been informed that a petition had been addressed to the Queen in Council for the grant of a charter of incorporation to a "Society of Engineers," the council of the Institution unanimously arrived at the conclusion that, both in the interests of the profession and of the Institution, it was advisable to present a counter-petition against the grant of a second charter to the same profession, especially to a metropolitan society dealing, or proposing to deal, with precisely similar objects. The petition of the Institution was given at length in the report. A deputation from the council was subsequently received by the President of the Board of Trade; and after the matter had been fully considered by the Lords of Her Majesty's Council, the "Society of Engineers" was informed that their lordships could not recommend the grant of a Royal Charter of Incorporation to that Society, under a name which was liable to be confused with that of "The Institution of Civil Engineers."

During the past session, 48 members and 79 associates had been elected, while the deceases, resignations, and erasures together amounted to 33, leaving an effective increase of 94, or at the rate of 7.02 per cent. on the present number of members of all classes. There were on the books, on the 30th of November last, 18 honorary members, 589 members, and 826 associates, making a total of 1433, exclusive of students. The gross numbers, at intervals of five years, for the last quarter of a century, commencing on the 30th of November, 1842, stood thus: 525, 610, 745, 835, 1000, and 1433, the actual increase in each of the periods referred to being 85, 135, 90, 165, and 433 during the last five years.

The deceases announced during the year had been: Dr. Michael Faraday and the Earl of Rosse, honorary members; Nichol Baird, John Cass Birkinshaw, William Carpmel, James Combe, Alexander Gibb, William Gilbert Ginty, James Cramond Gunn, Robert Hawthorn, Edward Humphrys, Parkin Jeffcock, Alfred King, George May, Auguste Perdonnet, and James Cobby Street, members; John Bethell, Christopher Joseph Cato, Edward Magdalen Joseph Delaney, Frederick Samuel Homfray, Captain Mark Huish, Edward Loyel, William Jopling Nesham, Thomas Richardson, Ph.D., Lieut. - Colonel William Drummond Alexander Robertson Stuart, R.E., and Henry Stone, associates.

With respect to the sources of income, and the way that income had been disbursed, a brief summary of the statement of receipts and expenditure for the year ending the 30th of November, 1867, showed that the subscriptions and fees (exclusive of the building fund fees) had amounted to 4513*l.* 6*s.* 6*d.*;

the interest on investments on the general account to 484l. 5s. 8d.; and the miscellaneous receipts to 548l. 7s. 4d.; making together 5545l. 19s. 6d.; while the building fund fees and dividends had realised 844l. 1s. 7d.; and the trust funds, 371l. 15s. 5d.; bringing up the gross receipts to 6761l. 16s. 6d. In the same period the disbursements, including the payments on account of the arrears of the Minutes of Proceedings, had been 4850l. 8s. 8d.; and for premiums under trust, 163l. 10s. 3d.; while there had been invested on different accounts a sum of 1638l. 1s. 3d., in the purchase of Reduced Three per Cent. Annuities. The cash balances exceeded by 109l. 16s. 4d. the sums in hand at the same date last year, making up the difference between the two sides of the account, as presented in the foregoing analysis.

There had recently been transferred into the name of the corporation of "The Institution of Civil Engineers," in the bank books, 287l. 15s. Consols and 227l. 8s. Reduced Annuities, being, as it was understood, the final sums payable out of the estate of the first President, Thomas Telford, whose decease occurred in September, 1834.

By the will of the late Mrs. Locke, the Institution was bequeathed the well-known portrait by Sir Francis Grant (President of the Royal Academy) of Mr. Joseph Locke, M.P. (Past-President Inst. C.E.), and a sum of two thousand pounds, free of legacy duty. The portrait had been received, and was placed in the meeting-room; and the amount of the other legacy would be paid by the executors in due course.

The nominal value of the realised property belonging to, and under the charge of, the Institution now consisted of: I. General Funds, 12,845l. 6s. 8d.; II. Building Fund, 4287l. 14s. 7d.; and III. Trust Funds, 12,119l. 15s. 11d.; making, together with the cash balances of 583l. 0s. 10d., a total of 29,835l. 18s., as against 26,709l. 11s. 2d. at the date of the last report.

In conclusion, the Council stated that, in their opinion, and they trusted also in that of the general body, the Institution during the past session had fairly fulfilled its obligations, had been the means of imparting much valuable information, had tended to stimulate the growth of knowledge, and generally to advance the status of the profession.

The thanks of the meeting were unanimously accorded to the President for his zealous efforts in the interests of the Institution; to the Vice-Presidents and the other Members and Associates of Council, for their co-operation with the President, and their constant attendance at the meetings; to Mr. Barlow, for his paper on the Clifton Suspension Bridge; to Mr. Charles Manby, Honorary Secretary, and to Mr. James Forrest, Secretary, for the manner in which they had performed the duties of their offices; as also to the Auditors of the Accounts and the Scrutineers of the Ballot for their services.

The following gentlemen were elected to fill the several offices on the Council for the ensuing year: Charles Hutton Gregory, President; Joseph Cubitt, Thomas Elliot Harrison, Thomas Hawksley, and Charles Vignoles, Vice-Presidents; James Abernethy, William Henry Barlow, John Frederic Bateman, Joseph William Bazalgette, Nathaniel Beardmore, Frederick Joseph Bramwell, James Brunlees, George Willoughby Hemans, John Murray, and George Robert Stephenson, Members; and John Horatio Lloyd and Captain Henry Whatley Tyler, Associates.

The meeting was then adjourned until Tuesday, January 14th, 1868, when it was announced that the Monthly Ballot for Members would take place, the President would deliver an Inaugural Address, and, if time permitted, the discussion would be resumed upon the Papers on "The Victoria Bridge," by Mr. W. Wilson, and on "New Railways at Battersea, &c.," by Mr. C. D. Fox.

THE COBBLER MENDED.

TO THE EDITOR OF ENGINEERING.

SIR.—The venerable Mrs. Gamp, of the engineering profession, commonly known as *The Engineer*, reviewed, last week, a cyclopedia known as *Brand's Dictionary of Literature, Science, and Art*, recently published in three octavo volumes by Messrs. Longman. Your carping contemporary objects that the scientific articles in this work—which is intended for general perusal, and has not been produced for the exclusive benefit of engineers—are written in too popular a style, and do not enter sufficiently into practical minutiae of the technical dry-as-dust order. On this head two opinions are obviously maintainable; and when elderly females aspire to be critical, we have no reason to feel astonished if they should be weakly, garrulous, and testy rather than severely just. If your contemporary had expended her toothless ire in shrill generalities, there would be nothing further to say about the matter. But unfortunately for her credit, she has, in a few instances, entered into particulars, and has administered corrections which are not merely erroneous, but absurd. Thus in the comments on the article "Screw Propeller," exception is taken to the accuracy of the statement there made that the plan of balancing the momentum of screw-engines by counterweights was introduced in 1853 by Mr. Bourne, inasmuch as "the original" engine of the Comet, now in the Patent Museum, at South Kensington, has a balance-weight fitted between the spokes of the fly-wheel; and this fact effectually disposes of Mr. Bourne's claim. Here is a specimen of discriminating criticism! Of course every apprentice boy among your readers very well knows that many old single engines had weights attached to the fly-wheel, not for the purpose and not with the effect of balancing the momentum of the moving parts, from which, in these slow-going engines, no inconvenience was ever experienced, but for the more elementary object of assisting the engine over the centre. In paddled vessels propelled by a single engine it was long a common practice to introduce a heavy cast-iron float, which should be horizontal when the engine was on the centre to carry the crank over the dead point; and in the case of engines with fly-wheels the weights were placed on the fly-wheels with the same object. But such weights, being placed at right angles with the crank, neither did nor could counterbalance the momentum, but, on the contrary, would aggravate the evil during a certain portion of the stroke. To balance the momentum of an engine, the piston and its connexions must move in one direction, while the counterweight moves in the opposite direction. But in these old engines the piston and

counterweight moved in the same direction through certain portions of the stroke. Your contemporary seems to consider a weight to be a weight to whatever purpose it may be applied, not seeing that it is as reasonable to argue that counterweights to balance the momentum of the moving parts were not novelties in 1853, because in old engines counterweights were used for the wholly different function of assisting the engine over the centre, as it would be to maintain the antiquity of counterweights because weights were applied in old safety-valves to balance the pressure of the steam! Far better to stick to inarticulate abuse. The old lady gets into a sad fog when she attempts to rectify such imaginary errors as the one I have indicated, and the only result of the effort is to let every smiling spectator see how complete is her ignorance even of the alphabet of that engineering knowledge of which she pretends to be the expounder.

I am, &c.,
AN ENGINEER.

NEW SOUTH WALES AND METROPOLITAN RAILWAYS.

TO THE EDITOR OF ENGINEERING.

SIR.—I observe in your last number a letter signed by Mr. W. Bridges Adams, evidently intended to convey the impression that he is entitled to some merit for the introduction of the plan for controlling the radiation of the axle which has been adopted in several carriages recently built for the New South Wales Railway, and has also been applied to a large number of carriages now building at the works of the Ashbury Company for the Metropolitan Railway.

In his letter, Mr. Adams appears in the attitude of the great expounder of radiation, with "railway authorities" at his feet as his humble and tardy disciples.

As the same arrangement has been in use for a considerable time past on the Metropolitan Railway, the first carriage having it being constructed from plans prepared in the offices of the company under my personal instructions and supervision, I beg you will kindly allow me space for a few words on the subject.

I am aware that your columns can be much better employed than in affording space for controversies respecting the claims of individuals for the merit of mechanical and other contrivances.

In this instance, however, it seems to me necessary that I should say something, lest silence might be construed as assenting to the statements and claims advanced by Mr. Adams.

I am quite at a loss to understand on what grounds Mr. Adams can claim as *his* plan the one in question. The general arrangement, and certainly the essential principle, of the contrivance has been in use for years past on railway rolling stock in this country, and, with all deference to Mr. Adams, I am in a position to state he has had nothing whatever to do with its introduction on the carriages of either the Metropolitan or the New South Wales Railway. He has not been consulted, and, certainly, he has not assisted, the slightest degree, in the working out of the mechanical details; and, so far as I am aware, he was ignorant that the plan was being adopted until the drawings were completed, and the contracts let to the companies employed to construct the various lots of carriages.

Although I believe I was the first to apply it to carriages (probably owing to the Metropolitan Railway being the only line on which some such arrangement is needed, on account of its specially long carriages and sharp curves), I do not consider the contrivance involves any new principle. I claim credit only for having worked out the mechanical details to so simple and effective a form as to enable the plan to be applied readily and cheaply to carriages, in such a manner as to ensure its working well without the ordinary lubrication and attention which is required in Bissell's radiating arrangement in use under locomotives.

Nothing can surpass the excellent manner in which Bissell's arrangement works. I believe I may be allowed to speak with some degree of authority on this point, as the whole of the locomotives working the Metropolitan Railway under my charge have his arrangement.

Although not a single instance of "seizing" or binding of the rubbing surfaces has occurred with these engines, I was convinced that some modification would be required to enable the same principle to be applied to carriages, because they are liable at any time to be put away in sidings for weeks together without receiving the special care and attention given to locomotives.

It was evident that, under these circumstances, large rubbing surfaces would become rusted up, and liable to stick, and so prevent free action when again brought into use. Accordingly, I determined to retain the arrangement of suspension-links at the ends of the bearing-springs which has been so long in use, not only on the Metropolitan Railway, but also on other lines, for permitting free lateral and radial play without lubrication or any undue wear of bearing parts, and which had proved itself so efficient a plan for that purpose.

I readily allow that Mr. Adams did recommend to me several contrivances, but they appeared to me to be too crude and unmechanical to be of any practical use. The plan I ultimately adopted was certainly not one of them.

I was at a loss at the time to understand why Mr. Adams was taking such a loving interest in the well-being of the rolling stock of the Metropolitan Railway, but afterwards learned that he had patented the various contrivances which he had recommended, but which were not adopted.

Mr. Adams has been at some pains so to express himself, as to give the impression that he had been consulted by me regarding the principles of radiation, as well as its practical application to individual cases. He says, for instance, "Mr. Burnett furnished me with a tracing of the frame, in order to apply to it the radial guide movement." I admit the fact; but Mr. Adams ought to have stated the whole truth, and

added that "Mr. Burnett did so, not because he wanted my advice or assistance, but in the same spirit that one often, I think, gives a street beggar a penny—to get rid of him."

I have, I am sure, trespassed too much on your space, but trust you will pardon me, as I promise not to trouble you again on this subject.

I am, Sir, your obedient Servant,
ROBERT H. BURNETT.

CANCERINE ENGINEERING.

TO THE EDITOR OF ENGINEERING.

SIR.—I am about to specify the material and pattern of rails to be laid down upon a long line of railway abroad. I have not yet, however, fully decided what that material is to be. Steel, I am told, is subject to attacks of worms, to cerebral softening, and to pimples—something, at any rate, which an eminent Irish authority from Ballycaron, Kilkenny, and whose engineering genius was nurtured and matured in a country smirky there for the repair of portable engines and thrashing-machines, calls "molecular deterioration." I, of course, allude to the well-known conductor of a well-known journal whose *dictum* is petticoat law in our profession, and whose backward progressiveness does credit to the whole Crustacean tribe. I am so much impressed with, and convinced by, his mere *ipse dixit* that I shall not trouble myself to ascertain what has been the experience of Mr. Ramsbottom, Mr. Fowler, Mr. Berkley, and a score of other first-class engineers with steel rails. Has not *all* steel in all times always shown a tendency to "molecular deterioration"? Toledo blades and table cutlery, the steel jumpers of the quartermen, steel engine tyres, piano wire, and tuning-forks? Or, if it has not yet done so, is it not now time that it should? And if not quite yet, will it not be by-and-by?

I need not say that I shall not think of specifying steel, nor wrought iron neither. The latter is, I understand, favourably spoken of in certain quarters; but it is comparatively a new material, first produced (at least, by rolling) hardly eighty years ago. It is a material of which engineers have at present no certain knowledge, and is probably liable to molecular mumbo jumbo, measles, or miscegenation. Cast iron is undoubtedly preferable in every way, being at once tougher, stronger, and more durable. But I am inclined to believe that iron in every form is more or less tainted with the congenital sin of molecular deterioration, and that wood or terra cotta would be every way safer and more lasting, as well as cheaper. Believing that there is no progress like progressing backwards, I desire to obtain, through your widely circulated journal, whatever information is available as to the strength, wear, &c., of rails of either wood, stone, or terra cotta.

I am Sir, your obedient Servant,
CARAPAX CANCER, C.E.
Crustacean-chambers, E.C.

RECIPROCATING WATER-METERS.

TO THE EDITOR OF ENGINEERING.

SIR.—The article on "Reciprocating Water-Meters," which appeared in your journal of the 6th inst., took me greatly by surprise. Myers's meter was, I had heard of, but knew very little about; to us, therefore, the article was one of considerable interest. Personally we had no wish to complain, and certainly had no intention of mixing up in any controversy which might arise upon the subject; but observing in your last issue a letter by the London and Westminster Meter Company, referring to the above article, and making rather light of our meter by saying disparaging things of it, we feel bound, in self-defence, to reply to some of the statements therein made, and hope, therefore, you will do us the favour to insert the following in your next number.

The writer of the letter in question assumes that the article referred to was written by an interested party, and has, in consequence, made very copious extracts therefrom, which he would fain have made use of in an attempt at satire, but which, in consequence of his very meagre acquaintance with our meter, must seem to those who know it better to recoil upon himself in a rather awkward manner; we, however, beg to say that in those conclusions he was mistaken, and refer him to the foot-note appended by yourself to his letter, which we hope will be deemed satisfactory.

Your correspondent raises certain objections to the meter (Chadwick and Frost's patent) manufactured by us, which are as follows, viz., that our valve is a double valve, that it is complicated, that it has four wearing surfaces, and is exposed to a disadvantageous pressure of the water; further, that in use it wears out of truth, and thus, as he alleges, the machine ceases to be a meter; and also that a little sand or mud getting into the meter would make short work of the valves and index.

Now in comparing our valve with the "affair" shown in Myers's meter, we think it cannot fairly be called complicated. Let any one of your readers just look at the two meters, and compare the paraphernalia, consisting of sheet rubber, runners, springs, rollers, inclines, &c., connected with, or forming part of, Myers's valve, employed to change the course of the water, with the simple fluid motive valve, occupying but little room, and of few parts, wherewith we effect the same purpose with almost unerring certainty, and without noise or concussion, and we believe he will be forced to the conclusion that our valve cannot be considered complicated in comparison with that employed by the London Company.

As to the alleged friction of the surfaces, that is more imaginary than real, not being by any means so serious a matter as the writer appears to think. We have had some experience in making these meters, and have learned to make them work easily; the water passes through them with but little obstruction, and thus accumulated pressure in the valve chamber is avoided. When speaking of the wear of these parts it should be recollected that the valve is at rest during the greater part of the time, and only put into motion momentarily at the termination of each stroke of the main piston, and also that the valve-ports or water-ways are so

formed that only a very short move of the valve is necessary to reverse the action of the meter, and therefore the wear of these parts is in reality very little. Should any such wear as is spoken of ever take place, it is amply provided for by the valve pistons being made of such a form and substance as to yield and adapt themselves by the fluid pressure acting upon them to any such slight alterations which may take place in the wear of the valve faces, and experience has practically demonstrated that nothing more is needed.

Mud and sand in water-meters are objectionable enough, of which fact we are fully aware, and have made provision in the shape of a copper strainer and dirt-box, formed inside the meter, to keep such out as far as possible. Should, however, dirt at times get into the meter, it does not necessarily affect the valve, which is so accurately fitted together as to prevent the dirt ever getting between its faces; and suppose occasionally a little to lodge upon the uncovered faces, it is simply pushed off by the valve when in motion; and as to the index, that is placed outside the meter, only two of the coarser wheels of the motion being exposed to the water, and which are not thereby injuriously affected.

It is a fact worth knowing that our meters are capable of going on in constant and regular use for two or three years, and frequently four and five years, without having a screw unloosed, or needing the slightest attention whatever; this, we think, proves their certainty of action and very small liability to derangement in ordinary wear. Only last week we examined a meter-valve which, up to a fortnight back, had been in continual use for nine years, and the wear in the central part of which (containing two faces) was so slight as to be imperceptible by ordinary measurement; in fact, after renewing the leathers, it was practically as good for service as the first day it left our hands, and is now at work again as before.

The writer objects to the works of our meter being enclosed in the water. We take a different view, and claim that as an advantage, and we think that mechanical men will see, that this overcomes many difficulties; for instance, attention in lubrication and packing is thus avoided, and all objectionable leakages from the piston-rod stuffing-box are obviated (the pressure being on both sides), whereas in Myers's meter we suppose the rollers, rubbing surfaces, slides, &c., will require oiling pretty frequently and copiously, or somebody would soon know about it, and occasionally the piston-rod stuffing-box will require re-packing. These may seem little matters in a single meter, but when they are hundreds at work, and these widely apart, as in country districts, the matter assumes a more serious and expensive aspect. For our meters overcoming these great objections, which are admitted by practical men to be such, we claim a decided advantage over all other positive measuring-meters.

Having explained how our meter would be affected when dirt is brought in contact with its working parts, we should now like to inquire how Myers's meter would fare under the same conditions. Supposing a little dirt to get under the rubber-valve, as is liable, at the corners and ends in particular, we imagine it will not readily get out again, and then what will become of the rubber-valve when the rolling machinery comes upon it? We rather think it will soon be something the worse for it.

Again, we think it will be readily seen that, under a high pressure, the india-rubber valve will be very liable to stretch and elongate, consequently becoming thinner beneath the foot of the rollers; leakage will be very likely, or to prevent which the rollers or runner must be held down so tightly as would cause the friction and wear and tear to be very great, and jeopardise its action altogether.

Respecting the mode of changing the valve, viz., by the use of springs and weights, such certainly are the oldest expedients with which we are acquainted for effecting such a purpose. Valves of that sort will not do now-a-days; neither rubber, weights, or springs are needed, as is practically proved by such numbers of our meters in use without them.

The last comparison made by your correspondent, viz., of price, being one quite off the subject in question, as well as incorrect, we pass over without any comment. We have no desire to say all we could say condemnatory of Myers's meter, time and experience will best show up its merits and defects; as yet it can scarcely be said to have been tried. Of our own we are enabled to speak more positively, it having been in successful use so long in various parts of the world, and notwithstanding all the fancied objections raised by your correspondent, it is, we conscientiously believe, the most mechanical and efficient instrument of its kind in use.

Your journal is widely read by the mechanical public, in whose hands we will now leave the matter, being willing to abide their decision.

As we have no desire to enter into any controversy with the above company, and shall object to do so, we hope this will end the matter.

Apologising for occupying so much of your valuable space,

We are, Sir, yours respectfully,
(For The Manchester Water-Meter Company, Limited),
HERBERT FROST, JUN.

Tipping-street, Ardwick, Manchester, Dec. 17, 1867.

THE CLEVELAND IRON TRADE.—The make of pig in the Cleveland district in November is computed at 82,667 tons, as compared with 79,468 tons in October, showing an increase in November of 3199 tons. The makers' stocks, at the close of November, were computed at 74,100 tons, as compared with 74,419 tons at the close of October, showing a decrease of 319 tons during November. Foreign shipments have been a little more brisk of late. The reduction of wages in the manufactured iron trade has been pretty generally accepted without dispute; the trade at present shows no improvement, and no rail orders of any magnitude are anticipated until the spring.

TRAMWAYS IN LIVERPOOL.—A Liverpool tramway company is seeking for powers to lay down no fewer than twelve lines of tramway in Liverpool and the neighbourhood. The lines, if carried out, will extend altogether over between twenty-five and thirty miles.

DRAUGHTSWOMEN.

TO THE EDITOR OF ENGINEERING.

SIR,—Will you permit me to offer a few words on the letter signed "J. J. Birckel," contained in your last issue?

In reference to the employment of women in making tracings, I quite agree with your own editorial remarks, and from experience can endorse the statement, "that they work with superior accuracy and industry, as compared with the well-known class of apprentices," &c.

Mr. Birckel does not bring forward any valid arguments in support of his views, and I can only account for his objection on the ground that he is desirous of obtaining the situation of tracer to some establishment, and thus feels himself much aggrieved. It is a well-known fact to most draughtsmen that tracing is a great bugbear in all drawing-offices, and is invariably done with a grudge.

His views as to the educational influences of tracing are, to say the least, very much overdrawn.

In reference to the wooden partitions in the office, which were the cause of such an awful picture rising before Mr. Birckel's eyes, your own correspondent who wrote the article in question was in error, and he will, I doubt, not explain the matter, so that this horrid vision shall cease from troubling our nervous friend.

To the false and calumnious charges upon the character of Mr. Dubs, with which the letter is so freely interspersed, even in its modified form, I think it is unnecessary for me to enter. Mr. Dubs is well known in the engineering world as an upright and honourable man; therefore, such charges can only recoil upon the head of his detractor. I think, Sir, I only express the opinion of all right-minded and honourable men when I say that such language as contained in Mr. Birckel's letter merits only their scorn and execration, and which I doubt not it will receive at their hands.

Hoping that you will give insertion to these few remarks in your next number, if possible,

I remain, Sir, yours respectfully,
Glasgow, December 16, 1867. AN ENGLISHMAN.

P.S.—I enclose you my card.

TO THE EDITOR OF ENGINEERING.

SIR,—One paragraph in Mr. Birckel's letter of the 13th inst. I feel bound to take notice of. He boldly declares that Mr. Dubs is jealous, lest his young men should learn too much. I have no hesitation in saying that there is not the slightest foundation for such a statement. I have served under Mr. Dubs for many years, and gratefully acknowledge the interest he has invariably shown in my progress, and others in a similar position, I have no doubt, hold the same opinions. Mr. B. is as far from the truth as anything can possibly be; and nothing gives Mr. Dubs greater pleasure than to see his young men get on well and improve in professional knowledge.

Regarding what Mr. Birckel says about tracings, the scale on which these are used in the Glasgow Locomotive Works renders it necessary that a very large number of them should be made.

The making of these is at all times an irksome duty, which no one knows better than Mr. Birckel himself; and the apprentices feel grateful to Mr. Dubs that, by the employment of girls, he has relieved them of at least part of this, and thus helped them to get other work which will improve their knowledge far better than tracing.

The unwarrantable attack on Mr. Dubs's private character I pass by, considering the party who made it too contemptible for further notice. I may add, that it is difficult to account for its insertion in such a paper as *ENGINEERING*.

I remain, Sir, yours respectfully,
30, Camden-street, Glasgow. A. W. GORDON.

"A NOVEL MODE OF ADVERTISING TOOLS."

TO THE EDITOR OF ENGINEERING.

SIR,—Your correspondent, S. R., in his communication entitled "A Novel Mode of Advertising Tools," published in your edition of November 16, has made suggestions for which he should apologise, if he has any regard for that "justice" he invokes.

Although he forbears to mention names, no one who has read the articles to which he refers can doubt but that his insinuations are levelled at our house.

We know you will be gratified to have our authority for saying we had no knowledge whatever of the articles referred to, until we saw them in several papers, which our friends abroad had the kindness to send us.

Our agent has never paid for them, because such payments have never appeared in his accounts; and he has not promised to pay for them, because he has never incurred any expense whatever without our express authority, and this subject he has never mentioned; and, finally, he did not write them, because such a procedure would neither have been with our authorisation nor in accordance with his own ideas of propriety. In fact, so far as we are concerned, the insinuations of S. R. are without foundation, and we have every reason to suppose the articles published by "Own Correspondent" were written in good faith.

From our knowledge of British engineers, we believe there is not one who has "his head screwed on the right way," but will be pained at such outrageous imputations as those we have commented upon.

Yours truly,
W. M. SELLERS AND CO.
Philadelphia, U.S., Nov. 25, 1867.

ENGINEERING CONSTABLES.—The backslums of Westminster are notoriously infected with Fenianism, we are therefore pleased to find that the engineers, solicitors, and parliamentary agents of that district have turned out in force in answer to the call of the magistrates for special constables. Several hundred pairs of sharp eyes will be kept skinned, and plenty of truncheons will be at hand, and as the "boys" are accustomed to act together, we doubt not they will be "cyc-witnesses" of any "shindy" in that neighbourhood.

TELEGRAPHS IN ITALY.

(From our Milan Correspondent.)

In 1865, the total length of telegraphs in Italy was 13,986 kilometres, using 28,185 kilometres of wires, exclusive of 3013 kilometres belonging to railway companies.

The telegraphic stations belonging to the Government were 478, using 899 instruments, of which 8 were Hughes's, 470 Morse instruments, 18 Wheatstone's system, and 3 on Bréguet's system, worked by 33,670 galvanic batteries.

The telegraphic stations belonging to the railway companies were 185 in number.

The charge for messages not exceeding twenty words, sent to a distance of 100 kilometres, is 1.20 francs. Beyond this distance, to any part of the kingdom, 2.40 francs is charged.

The total number of messages received and transmitted during 1865 was 4,233,671, of which 942,037 were on Government service, 293,115 on service connected with the telegraphic administration, 2,294,656 private telegrams throughout the kingdom, 703,870 international dispatches, including those passing through Italy.

The receipts on inland telegrams was 3,472,688f. 06c. (138,908l.), and on international dispatches to 719,329f. 72c. (28,773l.). The total length of telegraphic lines, to the 1st January, 1866, throughout the whole kingdom, including the Venetian provinces, was 15,513 kilometres, using 34,083 kilometres of wires, not including 6076 kilometres belonging to railway companies. The number of telegraph stations belonging to the State was 499, using 944 instruments; those of the railway companies were 320 in number.

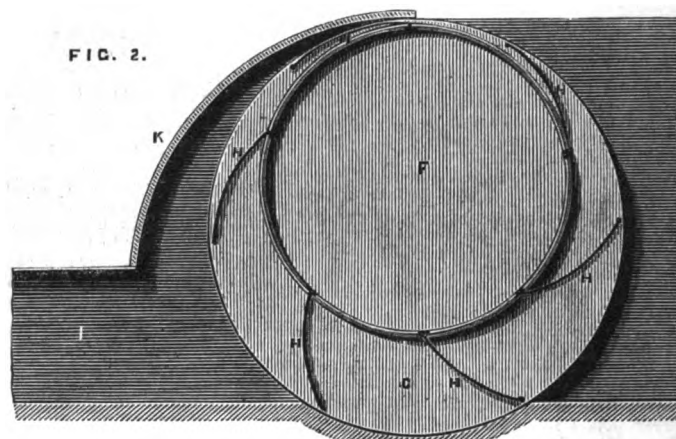
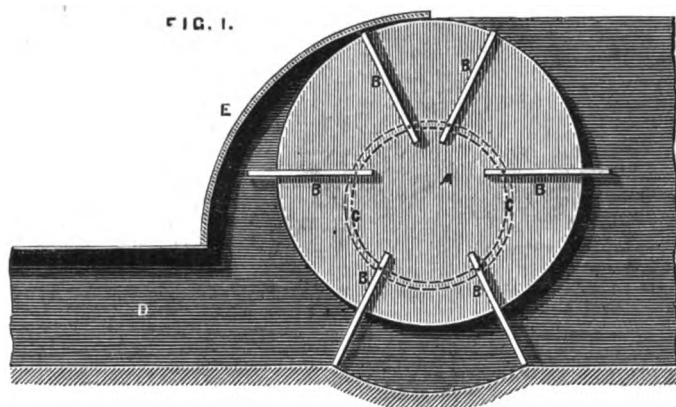
JOINT STOCK MISMANAGEMENT.—A singular illustration of the results of joint-stock mismanagement is furnished in the fact that consignments of coal are actually being made from Sydney to Singapore, while the Labuan collieries, which are only three days distant from Singapore, and contain an inexhaustible quantity of a superior kind, besides possessing facilities for cheap labour, have been unable to return a shilling to their shareholders, and are now, with the assistance of the Court of Chancery, thrown into hopeless insolvency after expending about half a million of capital.

GOVERNMENT PURCHASES.—According to a parliamentary return just issued it appears that a sum of 88,638l. was paid in the two years 1865 and 1866 by the Department of the Secretary of State for India for "cables, anchors, and mooring chains." Appended to this statement is the following admission;—"No contracts, specifications, or schedules of prices regarding such supplies are in existence, and public competition was not invited."

LONDON AND NORTH-WESTERN RAILWAY.—This company has been making good progress, of late, with a great bridge over the Mersey at Runcorn. The sixth and last of the great girders will soon be placed, and traffic is expected to be commenced over the bridge in June.

COATBRIDGE TRADE REPORT.—The improvement in the malleable iron trade continues, and a more hopeful feeling has prevailed during the past fortnight than at any time this year. Some of the principal firms are very busy. The ship-plate manufacturers have all at once become very actively employed. In one instance, the men have been "double-shifted" during the past week, and the orders on hand for long heavy angle-iron will keep them fully employed for some time. At Mossend there is a brisk demand for "bull-ear" and heavy ship iron for the Clyde yards. At Motherwell Ironworks notice of a reduction of wages was said to have been issued; but from inquiries which have been made it seems that such is not the case. Rail and nailrod iron has not been in great demand of late; and at the establishments chiefly employed in the manufacture of those materials the hands are still but partially employed. Buyers everywhere show a decided indisposition to enter into contracts for future delivery, as all apparently wait for a reduction in prices. Stocks are light, however; so that, when a revival does occur in those branches, it must be very decided. In the casting and engineering branches a slight improvement is spoken of. In some instances, employers who were slack a month ago are now tolerably well off for orders. At the various boiler-works business has seldom been so slack as at the present moment, not more than half the usual amount of work being done; and the number of "tramps" is increasing. Messrs. Russell, at Motherwell Ironworks, are somewhat better off for orders; but even there slackness is felt. Trade in the district about Uddingstone is also in a very indifferent state; but, undoubtedly, more business is being done in that locality than there was a fortnight ago. The reports from the Tubeworks are better, and at the Coatbridge Tinworks (Limited) all hands are fully employed. With respect to the oil trade, there are signs of improvement. In the course of the last week, a number of the retorts at the Nackerly Works, which have been out for nearly a twelvemonth, were "fired up," and it is said that they will be in full operation during the coming year. The additional railway accommodation just opened up in that district by the Caledonian Company will give them every convenience in forwarding their produce to the Clyde. In some of the minor metal branches more is being done; but, generally speaking, slackness is yet felt, and a considerable number of tradesmen still remain idle. The price of pig iron remains pretty firm; and as the furnaces "blown out" last year at Gartsherrie, Summerlee, Langloan, Carnbroe, Calder, Calderbank, Chapelhall, Omoa, and Cultness are being repaired, it is evident that a revival in trade is anticipated. The coal trade continues very dull, and the number of workmen partially employed is increasing. Stocks are accumulating at the sale-pits; and some of the masters have lately given notice to their men that the works could not be continued going, unless they consented to work at the prices which existed previous to the last advance. In some instances the men have consented to do this; in others they have turned out on strike. The ironmasters are now getting the coal-fields more into their own hands; consequently, the demand on the sale-pits are not so heavy as in past years. The Lanarkshire miners have become notorious for the frequency of the struggles which have taken place between them and their employers.

A PROPOSED SUBWAY UNDER THE THAMES.



TO THE EDITOR OF ENGINEERING.

SIR,—Without making any reference to the plan proposed by Mr. Peter Barlow for constructing and working a subway under the Thames from Tower-hill to Pickle Herring-street, I may be permitted to state that there can be no doubt whatever but that a subway for passengers and goods in the above position, if cheaply constructed, and expeditiously and efficiently worked, would prove a great public advantage, and also highly remunerative to the promoters. I beg to propose the following plan, to be worked partly by gravity and partly by atmospheric power:

The station on the north side of the river would be placed near the north-west corner of Trinity-square, and in connexion with the proposed station of the Underground Railway; and the station on the south side would be at Tooley-street. The station on the north side of the river would be some 30 or 40 ft. higher than the station on the south side, and it is therefore probable that the momentum acquired in descending from the higher station on the north would land the train at the lower station on the south side of the Thames.

The return train from Tooley-street to the City would run down the descending gradient, and run some distance up the ascending gradient on the opposite side, and before the train came to a stand, the atmospheric apparatus would be set in motion to extract the air from the front of the train, and the atmospheric pressure behind the train would propel it to the station.

The application of mechanical power will in this case require to be exerted only over little more than one-third of the length of the line every alternate trip.

If a centrifugal fan were used for the purpose of extracting the air from the tunnel, the very high velocity at which the fan has to be driven would be very inconvenient where the power is intermittent; but the fan which I have patented (Figs. 1 and 2) acts tangentially, and the motion would be slow and well adapted to the proposed case. The engine could be employed for other purposes when not driving the fan.

Yours very truly,
11, Cowley-street, Westminster, ALEX. DOULL.
December 12, 1867.

THOMSON'S IMPROVED STEAM-BOILER.

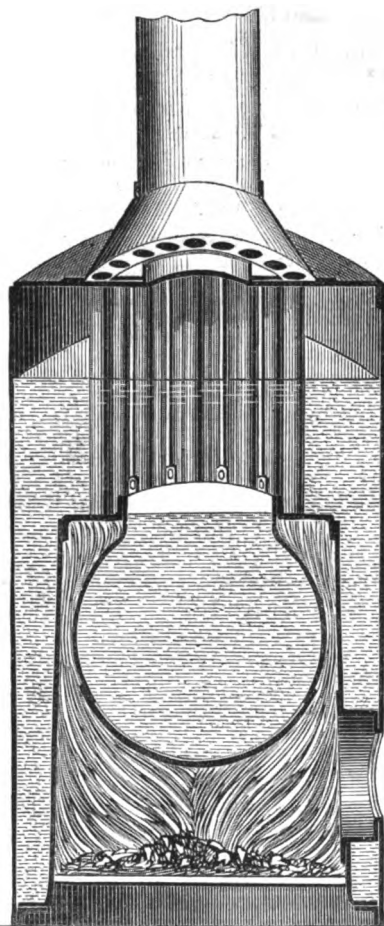
THE notice which we gave in *ENGINEERING*, three weeks ago of Mr. R. W. Thomson's new locomotive for common roads concluded by simply making incidental mention of another speciality besides the vulcanised india-rubber tyres possessed by the engine in question: we mentioned that it was fitted with one of Thomson's patent vertical boilers. As we are now able to place before our readers an engraving of a vertical section of the "pot" boiler, by which name it is already popularly designated and known, we may take the opportunity of saying a few words regarding the thing itself.

Taking it for granted that the vertical form of boiler is the one which most commends itself, when one of the smaller class of steam-boilers is wanted, on account of the great economy of space which is possible from its use, the cheapness of first cost, &c., we need not stay to refer to the various disadvantages—such as small heating-surface, tendency to prime, liability to burn and crack, &c.—which attend the use of many of the vertical boilers hitherto devised, and more or less extensively adopted, but pass on to speak of what seem to be good features in the construction of the boiler recently invented and patented by Mr. R. W. Thomson, C.E., Edinburgh.

The annexed engraving is a sectional view, in which all the specially meritorious points of construction may be observed. The "pot," or spherical generator, is placed so as to receive the full blast of the flames, which, actually blowing directly on it, impinge with great force on its lower surface, and then, without losing their velocity, are deflected against the sides of the furnace. The annular space is so narrow and contracted that the flames and heated gases are necessarily made to pass through it in a thin film, and brought into actual contact both with the sides of the firebox and the surface of the spherical generator. They are thus enabled and compelled to give up to the heating surfaces most of the heat which they possess, and by the time the hot gases reach the tube-plate they have cooled down so much that they cannot burn it. The shape and position of the steam-generator are admirably fitted for receiving and

transmitting to the water within the full effect of the fire without, while, at the same time, there is left for the tube-plate and tubes only a moderate amount of work to do.

The rapid circulation of water over the internal surface, and the quick rush of flame and hot gases over the external surfaces of a steam boiler, are alike essential and important for the rapid generation of steam. The inventor of the "pot" boiler claims for his invention that no coating or layer of steam can possibly accumulate or stagnate upon or against the internal surface of the boiler, and that an accumulation of soot upon the exterior of the boiler—which is not much less prejudicial than an internal coating of steam—is equally impossible. He believes that the generator presents itself to the action of the fire under the very best conditions for doing the maximum of work with the minimum injury to itself.



The lower part of the sphere is close to the burning fuel, and is therefore most favourably situated for receiving both the immense heat which radiates from the burning fuel and the direct impact of the flames. Neither soot nor ash can settle on the exterior of the generator, to diminish the heating action, while internally the water rushes round with such a velocity that the steam is cleared away as quickly as it is generated. The spherical form gives to the boiler the greatest possible amount of strength; stays can, therefore, be dispensed with. The whirling of the water in the steam-generator effectually prevents the settlement of mud or any other sediment within it. All such solid matter which the water may originally hold in suspension is tossed out of the generator, and finds a resting-place only in the water-space below the level of the firebars, from whence it can be removed, from time to time, through hand mud-holes. It has been found, from actual trials, that the lower surface of the generator maintains a cleaner surface, internally and externally,

than any other part of the boiler, and, therefore, it is not only in the highest degree efficient as a steam-generating surface, but is exempt from all risk of burning.

One great obstacle to the use of the old kinds of vertical boilers is the difficulty of clearing out the hard deposits of carbonate of lime, common salt, or other mineral matters which may be held in suspension mechanically or in actual solution. In Thomson's "pot" boiler the facilities offered in this respect seem to leave nothing to be desired. The opening of the manhole exposes to view the whole interior of the tubes, tube-plates, and central generator. They can all be seen, and cleaned, and repaired without any difficulty, and without pulling any part of the boiler to pieces. Such persons as generate steam from water containing either dissolved or suspended mineral substances will fully realise the importance of this facility.

For working ships' winches, or for evaporating salt water for the use of the crew and passengers, Thomson's patent boiler seems to possess several advantages. It has the good points of tubular boilers, without possessing many of their disadvantages. It has the simplicity, durability, and facility for cleaning out and repairing of bulky boilers without tubes, while, at the same time, it occupies less room, and raises more steam, than the very best tubular boilers—surface for surface—whether those boilers are vertical or of the ordinary locomotive shape.

The "pot" boiler employed on the road-steamer elsewhere described has a diameter of 2 ft. 6 in., by 5 ft. high; the total heating surface is 40 ft.; and the area of the firegrate is 3.14 ft. Mr. Thomson states that carefully conducted comparative experiments show that, with a given quantity of coal, the "pot" boiler evaporates 24 or 25 per cent. more water than the ordinary vertical tubular boiler, and from 11 to 13 per cent. more than the horizontal tubular boiler. We anticipate that many persons who wish a small boiler will be glad, when these dull times pass away, to make practical acquaintance with the "pot" boiler invented by Mr. Thomson.

ROAD ROLLERS.

TO THE EDITOR OF ENGINEERING.

SIR,—May I claim a small space in your valuable and wide-spread journal on the above subject?

There is not the least doubt but that a roller of some sort is advantageous in quickly bringing a newly formed roadway into a good and solid shape, especially so when that roadway is formed of hard granite.

There seems lately to have been a mania for steam-rollers. Now, Sir, I wish to ask whether a steam-roller is really better than a horse one. There is the greater outlay in the first instance, and it must cost more to keep it in repair, even supposing the working cost to be about the same.

Could you tell me, or any of your correspondents, what the average working cost is of the roller used at Westminster? I hear it is about 5 tons weight, and drawn by four horses. In Paris, I believe, horse and steam rollers are used. I should be thankful for the like information with regard to the difference in the cost of working those.

Is there not a danger from these heavy steam-rollers of destroying a great percentage of the stones? Messrs. Moreland's, for instance, 25 tons weight, surely that is too heavy. I cannot help thinking that a light roller taken over the road six times is better than a heavy one taken over once.

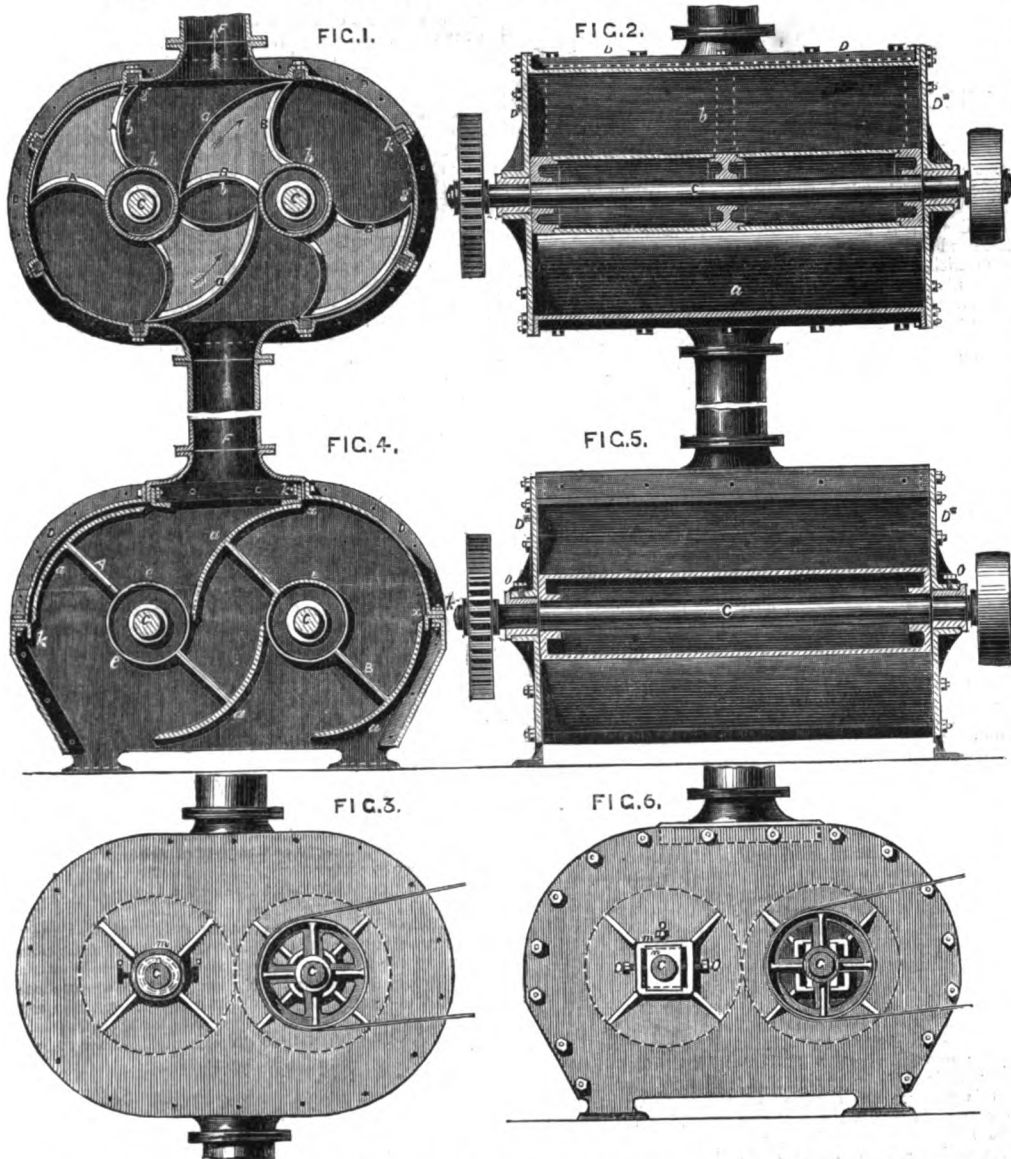
The subject is before the vestry I am connected with, and I feel sure the horse roller is in favour. Certain it is that something is needed in the metropolis for consolidating the roadways, as it is most trying both to horses and carriage springs.

A little information on the subject will, I feel sure, not be wasted, and will be of much service to,

Yours, &c.,
80, Hemingford-road, N., ASSISTANT SURVEYOR.
Dec. 9, 1867.

SOUTH YORKSHIRE.—The men at Milton and Elsecar have received notice from Messrs. Dawes of a reduction of wages to the extent of 10 per cent., to commence from the 21st inst. It is believed that this reduction will be acceded to. About an average tonnage of steam coal is being forwarded to Lancashire by the Manchester, Sheffield, and Lincolnshire Railway. The demand for steam qualities is quiet, and at several of the collieries stacking is taking place.

ROOTS'S BLOWER FOR CUPOLAS, &c.



In America, rotary blowing-engines, or "blowers," are largely used, instead of fans, for supplying blast to smiths' fires, cupolas, &c., it being found that these machines utilise a greater proportion of the power applied to drive them than fans do. Amongst the "blowers" thus employed are those made by Messrs. P. H. and F. M. Roots, of Connersville, Indiana, which are very largely adopted. Of the form of blower generally made by Messrs. Roots we gave an illustrated account in our second volume (page 269), and we now publish engravings showing some improvements in this blower, which have been recently patented by Messrs. Roots in this country.

The chief object of these improvements is to enable the machines to be made at a cheaper rate, and for this purpose the construction of the casing of the machine has been modified. Instead of making the interior of the case or blowing-chamber true in the lathe, so that the rotating "abutments" may fit sufficiently close to prevent the passage of air between them and the inner surface of the case, the case is fitted with packing-strips. The use of these strips involves a change in the form of the "abutments" themselves, or the pistons which they carry, it being requisite that each abutment shall span so much of the space between the packing-strips as to offer an effectual obstruction to the passage of the air or other fluid past it.

In the accompanying engravings, Fig. 1 is a section of one of these improved blowers, taken at right angles to the shafts of the abutments; Fig. 2 is a section taken at right angles to Fig. 1; and Fig. 3 is a side view; Fig. 4 is a longitudinal section of an arrangement, wherein the abutments are of a form suitable for acting upon dense fluids, such as water; Fig. 5 is a corresponding transverse section, and Fig. 6 is a side view.

In Fig. 1, A, B, represent two double-acting abutments mounted on shafts, C C, which have their bearings in bosses cast with the side-plates, D*, of the case, D; these abutments have each two pistons, *a a*, and two intervening recesses, *b b*. The method by which the pistons and recesses are constructed is as follows: Two points, which are the centres of the rotary shafts, C C, are taken at any desired distance apart, according to the size of the machine, and around each of these centres two circles are described, each of the larger circles being of such a diameter as to just touch the smaller circle around the other centre. On the periphery of each circle formed with the larger radius two arcs are taken, each consisting of about 90°, and on opposite sides of the circle. From the extremities of these arcs, *g g*, *g g*, curved lines, *g h*, are drawn to the periphery of the circle, *e e*, so that in revolving the points, *g g*, may pass without friction. When dense fluids are to be acted upon, considerable space should be allowed between the points, *g g*, of the pistons and the concave portions of the piston indicated by the lines, *g h g h*. The form of pistons shown in Fig. 4 may be used

when water or non-elastic fluids are acted upon without lessening the volume discharged at each revolution, but more or less loss, according to the pressure, would be sustained if air or gaseous fluids were acted upon by that form of piston. It is not absolutely essential that the coating abutments should be alike: for instance, the pistons of one abutment may consist of arcs of 120°, and its recesses of 60°, in which case the pistons of the corresponding abutment must consist of arcs of 60°, and the recesses of arcs of 120°. The abutments shown in Fig. 1 are constructed with a metallic crosshead.

At Fig. 1 the crossheads are shown as covered with sheet metal, which may be secured by rivets or bolts. Crossheads, as thus represented, may also, for many purposes, be advantageously covered with wood, instead of with sheet metal. The shafts, C C, to which the abutments are keyed, are geared together by suitable cog-wheels, as shown at Figs. 3 and 6. It is evident from the position of the abutments in Fig. 1 that, when made to revolve simultaneously, the contact will be preserved during their entire revolution. The case, D D, as shown in section at Fig. 1, is constructed of two semi-cylindrical shells of equal dimensions. Fitted into recesses cast in these semi-cylindrical shells, in lines parallel with their axes, are the packing strips, *k k*, which are placed at suitable distances apart according to the length of the arcs of the pistons. The case is thus rendered practically air-tight, although the parts between the strips may not fit accurately to the surface of the pistons. These strips may not be secured by bolts or set screws, as shown, or in any convenient manner; they are made adjustable, so as to be brought in contact with, or in close proximity to, the peripheries of the rotating pistons. Strips in like manner may be inserted in the case opposite the ends of the abutments to render them tight in that direction. These strips may be made of wood or metal, and, if desired, may be faced with leather or other suitable material.

An arrangement is shown in Fig. 4 where the strips, *k*, are formed of angle-iron made fast by bolts at the case couplings. The case may be made of cast iron or sheet metal, or of wood with staves for the cylindrical part, especially where large volumes of blast are required. It is not essential that the parts of the case surrounding the abutments should consist of half-cylinders. Each part may be made to consist of a little more than a quarter of a cylinder, as shown at Fig. 4, where the segmental form ceases at *x x*. The case may, if desired, be inverted so as to discharge the air at the bottom, or turned so as to discharge at the side.

By *m m*, Figs. 3 and 6, are represented the bosses cast on the side plates, D, and *n n* are the tubular boxes for receiving the ends of the shafts, C C. The bosses are suitably recessed to receive the tubular boxes or bearings and permit of their lateral

adjustment therein. The bearings may be in one piece, as shown at Fig. 3, or cut in two halves lengthwise. These bearings are kept in position by set screws, *o o*, or keys, which will allow for the accurate adjustment of the abutments with respect to each other. A rectangular or square recess may be made or cast in the end plates to receive boxes of corresponding form, as shown at Fig. 5, which are likewise kept in position by set screws or keys, and susceptible of lateral adjustment. The boxes or bearings may also be made by simply coring out a sufficiently large recess in casting the bosses in the end plates, and the tubular bearings for the shafts may be formed by pouring in molten zinc or any suitable metal or alloy around an accurately fitted temporary metal core or mandril corresponding in diameter with the shaft, being first placed in proper position for the fluid metal to flow around. By these means the bearings may be very economically renewed when necessary.

The operation of the engine is as follows: When the abutments, A B, are made to rotate in the direction of the arrows, the air, or water, or whatever fluid is acted upon, will be carried forward as the pistons approach each other and, forced through the discharge pipe, F. And as the connexion is kept up between the abutments during their entire rotation, there can be no back escape. The volume discharged at each rotation is equal to the area of one entire cylinder of the diameter and length of the abutments, deducting therefrom the area of the centre cylinder. By reversing the operation and acting upon the pistons by means of steam or water, the device becomes a rotary steam-engine or a pressure water-wheel. Messrs. Roots's blowers are being made in this country by Messrs. Thwaites and Carbutt, of Bradford.

THE MONITOR QUESTION.

TO THE EDITOR OF ENGINEERING.

SIR,—I am sorry I cannot so far gratify your correspondent, Mr. W. Watt, of Washington City, as to prefer his testimony regarding a matter of fact in the construction of the monitors to that of Ericsson, the author of the system, and by whom the particular monitors about which controversy has arisen were constructed. Ericsson is a man of European reputation. Whether we acquiesce in all his opinions or not, we, at least, receive them with respectful attention; and any statement of fact which he may send us, vouched by his own knowledge, we accept as a matter of course. When, therefore, he tells us that some monitor built under his direction was constructed in a particular manner, what European engineer can refuse to believe him? or what can signify the contradictions of Mr. W. Watt, of Washington City, in such a matter? Ericsson we know; but who is Mr. W. Watt? For aught we can tell, he may be an engineering Mr. Harris, and, however sad the confession, it is nevertheless the fact that, until this controversy arose, I did not know that there was any such person in existence. Nor is this ignorance limited to myself, as American engineers of eminence, whom I have spoken with, have been equally unconscious of the dawn of this modest authority, whose obscure dictum is to supersede all evidence such as heretofore we have considered sufficiency. If Mr. Watt believed that Ericsson or myself had made any erroneous statement of fact, his business was to have *proved* the error. It was upon him that this onus devolved, and if, instead of affording the necessary proof, he has contented himself with the mere reiteration of unsupported assertions, he must be prepared to encounter the incredulity he has earned.

I am glad to learn from Mr. Watt's last letter that the only point in which he now disagrees with me is in regard to thickness of the armour-plating existing on the hulls of the large monitors, and which he charges me with "persistently misrepresenting." He says that his information comes from a higher source than mine, namely, from "the official records of the Navy Department," and that the resisting powers of the monitors have been unduly exalted in the public eye by "disreputable deceptions practised to secure the public approbation." To put an end to this discreditable state of things, he sends you a diagram showing the correct distribution of the armour-plating of the Dictator according to his conception of it. "The information," he says, "contained in this diagram has never been published," and unless it can be disproved, Ericsson and myself, Mr. Watt says, "will stand convicted of practising a gross deception on the public." In answer to this heavy arraignment I have only humbly to state that the diagram which Mr. Watt says has never been published, and which he believes will come upon us with all the force of a new revelation, was published in this country some time since, that it was produced among other diagrams when my paper on ships of war was read, now nearly a year ago, before the Institution of Civil Engineers, and that you will find it reproduced in plate 9, page 28, of the minutes of the proceedings of the Institution of Civil Engineers lately distributed. I have no reason to doubt that Mr. Watt obtained his diagram from the Navy Department in America, from whence also the diagram produced at the Institution was probably derived. But I denied its accuracy then, as I do now, simply because it is inconsistent with the drawing that Ericsson had sent to me. Very probably a project of armour diminishing in steps was lodged in the Navy Department, and there is much to recommend such a project, since it is plain that the armour, instead of terminating abruptly at a certain point below the water-line, ought in reality to get thinner and thinner as it gets protected by a greater and greater depth of water. But although this plan may have been proposed in the case of the Dictator, and a design embodying this idea may have been lodged in the Navy Department, it does not by any means follow that the vessel was built on this principle; and Ericsson, who ought to know the fact better than any other person, shows by his plans of the actual mode of construction that she was not. In no case, however, can any discrepancy relative to such a detail affect our views of the soundness or otherwise of the monitor system of ironclad vessels. If with a given height of side above the water we wish to make the armour a little thicker or a little deeper, all we have to do is to make the vessel a little larger, there being no natural limit in the system which hinders one depth of armour from being adopted

more than another. I did suppose from Mr. Watt's previous letters, that he dissented altogether from the soundness of the monitor system. But if he has abandoned all his other objections, is it worth while to display so much heat respecting discrepant accounts of some point of detail in a particular vessel, and which can in no way affect the main issue which-soever account is the correct one? Why strain at the gnat after having swallowed the camel? and, above all, why strain with so much vituperation? No doubt people, when beaten in controversy, generally lose their tempers, and in this phenomenon of human frailty I am willing to find extenuation of the rude language in which Mr. Watt has indulged, and upon which you have animadverted. But strong words are only poor substitutes for strong reasons; and if in cooler moments Mr. Watt should drift towards the conclusion at which I have arrived, that the testimony of a design raked out of the Navy Office affords no warrant whatever for contradicting the statement of its author—not that there was no such plan, but that it was not literally followed—that the wilful concealments alleged to have been practised in this country are wholly imaginary, the fact being that a duplicate of Mr. Watt's illustrative diagram was published and commented upon in this country long before Mr. Watt favoured us with his present elucidations, and that after all the point in dispute is of very subordinate importance, and can in no wise affect our estimate of the value of the monitor system—I am at a loss to conjecture wherein can be found the justification of such choice phrases as "persistent misrepresentations," "disreputable deceptions," and others of a like kind, which Mr. Watt has drawn from the most fiery depths of his indignation? The truth, I take it, is that these tall heroics are merely the language of a farce that is being played out in your pages. Ericsson and Mr. Isherwood I am told have fallen out; and it is said that Mr. Watt, of Washington City—whose existence in the flesh I neither deny nor assert—is virtually only a *nomine umbra*, through which Mr. Isherwood may more conveniently direct his shafts against his opponent. Hence the animus displayed, and which may have some spring far removed from the intrinsic qualities of the monitor system. But we are here in England, who have nothing to do with such feuds, to suffer ourselves to be drawn into them on the inducements of a mock controversy raised on a fictitious issue? Mr. Isherwood's name is well known among us, and any opinion or statement coming from him is sure to meet with courteous attention in this country. But to earn this respect it must come to us at first hand, and must concern itself only with those technical considerations which his own talent and candour may indicate as essential.

I am, &c.,

JOHN BOURNE.

London, December 18, 1867.

ABERDEEN HARBOUR.

TO THE EDITOR OF ENGINEERING.

SIR,—Having observed your notice of the works proposed for the improvement of Aberdeen harbour, in the last number of "ENGINEERING," I beg to send you the following remarks on the proposed works.

I consider the object sought to be the widening and deepening of the entrance, and the protection of the harbour from the easterly swell.

It is proposed to extend the north pier, and construct a breakwater on the south side, to the seaward of the present one. The present width of the channel is about 540 ft. opposite the present breakwater, and 330 ft. opposite the south pier. The terminus of the proposed breakwater is about 1060 ft. east of the extended north pier, and about 550 ft. south of the line of its direction.

Now, as it is proposed to remove the present breakwater and south pier, it appears to me, that the harbour by having about two-thirds greater width of entrance, a much heavier easterly sea will roll in than at present, and which swell will be greatly augmented by the proposed increased depth of water.

The swell at present frequently prevents the dock-gates being shut. By the proposed works, a still greater swell may be expected against the gates.

I think the new breakwater will afford little or no protection from north-easterly seas, from its being placed so far to the seaward; the seas from this direction will roll into the harbour, when unprotected by the present inner works.

It is proposed to dredge away the shoal inside the south breakwater, which I believe will be a waste of money. My views coincide with those of Smeaton, who said that "his proposed north pier at Aberdeen would not stop the continual driving of the matter coastwise from the north, but after the back of the pier is filled with sand, &c., it will then go round the pier-head," but he hoped "that it would get round the point of Girdle Ness without getting into the harbour's mouth."

My great objection to the proposed breakwater is that, being 1000 ft. to the seaward of the extremity of the north pier, it will intercept this drift in its passage round Girdle Ness Point to a much greater extent than is done by the present breakwater, which is not outside the line of the present north pier; and on the removal of the works on the south side the waves in on-shore gales will bring it up the harbour, and deposit it where they lose their transporting power from the increased shelter inside, where it will remain till removed by the scour of the ebb tide, or by artificial means.

There is also the danger that a north-east gale after the continuance of fine weather will draw down the light portions of the sand and gravel from the more exposed portion of this beach on to the bar—an action similar to that which forms the remarkably shaped indent in the beach behind the present breakwater.

Instead of the proposed breakwater, I would suggest that the extended north pier be carried, say, 100 ft. to the south, not only for the purpose of sheltering the harbour, but also for concentrating the power of the ebb before passing the bar. This increased shelter on the north would allow the

projections on the south to be set back so as to give a greater width of channel where required.

All I say as to the proposed improvements inside the harbour is, do not encroach on your tidal space, as you will want it all to scour the bar.

I am, Sir, your obedient Servant,
J. W.

THE ELECTRICAL ANTI-INCRUSTATOR.

TO THE EDITOR OF ENGINEERING.

SIR,—Your correspondent of last week, "H. P.," is somewhat "behind time," it would seem, in questioning the existence of electrical tension in a boiler supplied with Baker's anti-incrustator. If "H. P." had been wise, and had taken the trouble to make himself acquainted with all that has been published on this subject before he launched into criticism, he would have been aware that repeated experiments have incontestably established that a difference of electrical potential exists between Baker's star and the plates of a boiler, when steam is issuing, or, as he terms it, that "the metallic star does draw electricity from the steam," and that the intensity of this electricity increases with the increased pressure in the boiler.

In attacking Mr. Sabine's theory, which he asserts to "rest but on a slender foundation," "H. P." does not seem to be quite clear as to what his theory really is. The "slender foundation" in question happens to form no part of the "foundation" at all; it consists, your correspondent says, in the remark that "the application of this apparatus converts a boiler into an hydro-electrical machine,"* whereas, the electricity being once admitted to exist, its source is quite immaterial to the theory. The actions of Armstrong's machine and the one which is formed of a boiler by the application of the anti-incrustator may be different. Faraday gave a theory for the former which has been unhesitatingly accepted by scientific men. This theory is that the minute aqueous particles produced by the partial condensation of the steam rubbing against the wooden lining of the nozzles, become electrified. No one, Sir, can have a greater reverence for the august name of Faraday than I have; but Faraday was human, and, however improbable it may be, it is still well within the limits of possibility that even he may have been mistaken. Let us see what takes place in the nozzles of Armstrong's machine when the steam is issuing from them against the conductor. First of all, the steam is partially condensed, because the nozzles have a temperature lower than that of boiling water, and their interiors become covered with a film of water. Then, the minute particles of water which follow rub against this film, and not against the wooden lining at all. So that, in truth, the friction is not that of water against wood, but of water against water. Now that wood as a lining should have been found to give better results than metal I take to be a simple phenomenon of conduction, wood being a tolerable insulator.

But all this, be it as it may, is no "foundation" whatever, not even a "slender foundation," for any theory which has been started, to account for the removal of the incrustation, as your correspondent, "H. P.," thinks. The question simply is this, "Given an electrical tension in the boiler, how can this produce the observed effects?" In weighing the two principal theories against each other, I am disposed to doubt the correctness of that which originated with Mr. Sabine, and to adhere to that of the decomposition of water underneath the incrustation. The objection raised by Mr. Sabine to this theory is that "the quantity of electricity developed being very little, and the decomposing surface very large, the current in each point may be regarded as infinitely small." Now, against this, I would suggest the possibility of *time replacing intensity*. Suppose, for example, a current of a certain strength to be able, in one hour, to develop hydrogen gas sufficient to blow off the incrustation, would the result not be effectively the same, had the current only the one-thousandth part of this intensity, but lasted a thousand hours? I think it would.

But we are at present groping in the dark, because the experiments upon the way in which the electricity acts are too few and unsatisfactory to be taken as the basis of an argument. I therefore hope that, instead of letter-writing and further speculation, we proceed to make a few careful experiments, but not quite those suggested by "H. P."

Yours truly,

December 17, 1867.

X. X. X.

TO THE EDITOR OF ENGINEERING.

SIR,—I read in your issue of the 6th instant the very able and interesting letter of Mr. Robert Sabine respecting the "Electrical Anti-incrustator," another of those discoveries or inventions which, like the Injector, surprises by their practical results taking place before any theory has been deduced of how these results should or could occur. Probably many other discoveries will be made contingent with inquiries into this problematical phenomenon of the anti-incrustator; and if a little indulgence be permitted your correspondents, these results may be facilitated. Viewing the operation of this useful instrument somewhat differently to Mr. Sabine, will you please to permit a statement of these views?

I fully accept his idea that "the application of this apparatus effectually converts a boiler into an hydro-electrical machine," the steam being positively charged, and the water and its contents, in suspension, being negatively so. This being the case, how or in what manner should we say that incrustations are formed at first? Before the application of heat, the boiler, with its liquid contents and the solid matters suspended therein, are in a neutral state electrically. When heat is applied, the larger portion thereof passes through the metal, and is absorbed by the fluid within, until this fluid becomes sufficiently heated to generate steam. Another por-

* I do not understand Mr. Sabine to refer to Armstrong's construction especially.

tion, however, is distributed throughout the metallic parts and radiated or transmitted to the air or contiguous bodies. Now this portion of heat, though less in volume, is of higher intensity, and must therefore induce on the boiler surface a positive electrical condition, and the solid matters suspended in the water, being negative in relation thereto, would thus be caused to adhere to the metallic plates; and the firmness of the incrustation, as well as its rate of formation, will be regulated, with the same amount and character of suspended matter, by the difference in temperature of the boiler and that of its liquid contents. On the formation of steam another electrical action takes place, the steam becoming positively charged therewith; and it might be supposed at first sight that the electricity contained in this portion of the boiler would be carried down its metallic sides into the water space as quickly as it was formed by the development of steam, and thus neutralise the electrical condition above and beneath. But does not the intensity of heat which is applied to the boiler, by inducing a mere positive electrical state in the metal, interfere with this, and render an equal intensity necessary to neutralise it? If so, Mr. Baker's instrument, by collecting and distributing the electric fluid through a superior medium, is better enabled to effect this neutral action.

The development of electrical action must also be increased when steam is liberated from the boiler by condensation through contact, by mechanical duty on a piston, passing through restricted orifices, or by increased velocity of discharge; so that the point at which steam leaves the boiler should be the one most suitable for the efficient action of the conducting instrument.

Now, Sir, in the above views I am not certain that I have said much more than might be inferred from Mr. Sabine's communication. For he says, "Supposing, now, a current to be established between the metal of the boiler and the water through the steam, which in its formation may carry off sufficient of one kind of electricity to leave the water charged with the other kind, this might cause the suspended particles to have a tendency to leave the boiler sides for the centre." And he also mentions another explanation why incrustation should not form, viz.: that the suspended particles might, the instant they touched the sides of the boiler, become charged with the same kind of electricity, and be therefore repelled therefrom. But these two views do not seem to be quite consistent with the same kind of conditions, for in the one the matters in suspension are attracted to the centre, and in the other they are first attracted to the metal and then repelled from it. And at the close of his letter he seems more disposed to endorse the latter explanation, but considers it unsatisfactory as a means of accounting for the breaking up of incrustations already formed, and which incrustations, he considers, would act as a dielectric between the metal and the water.

Now, if the electric fluid, as I have suggested, first passes through or from the steam to the star conductor, and thence by wires to the boiler sides, and if on the interior surface thereof thick incrustations have formed, which operate as a dielectric, would the amount or intensity of fluid thus conveyed not accumulate through the presence of the incrustation until it was pierced through and the necessary circuit established?

I am, Sir,

Yours very respectfully,

Hunalet, Leeds, Dec. 14, 1867. JOHN RAMSBOTTOM.

TO THE EDITOR OF ENGINEERING.

SIR,—I am rather astonished to find nearly every other week in that excellent publication of yours, *ENGINEERING*, notices of some description or another in reference to Baker's patent anti-incrustator. My astonishment is that you have not as yet had some communication from parties who have proved them to be a complete failure.

I have had much to do with them, and have witnessed the effect of their (so-called) action in new and old boilers; and, in spite of all magnetism, the scale has accumulated in thick layers all over the boiler, requiring the use of a hammer to release it. The scale, when taken off, has varied in thickness from $\frac{1}{4}$ in. to $\frac{1}{2}$ in.

But the worse feature of all is that the points (which are spoken of as possessing such extraordinary powers of magnetism) become fairly corroded to such an extent that they have not the power left in them to disturb a common sewing-needle; and all this after a trial of about three months. I am speaking here of the latest improvements, viz., gilded points.

In proof of what I have said, I could mention the names of highly respectable cotton manufacturers who have had them fitted in their boilers, and, after proving their inefficiency, have returned them to the maker.

Now, this is all known to those who are trying to sell them, and I think it nothing but right that you and the public should be made acquainted with the swindle which is being practised.

Yours respectfully,

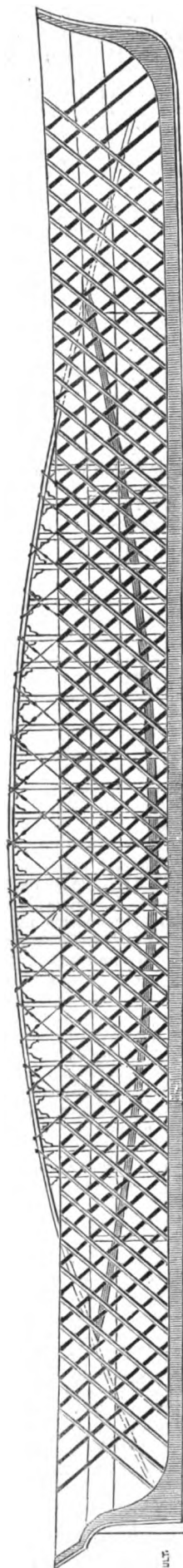
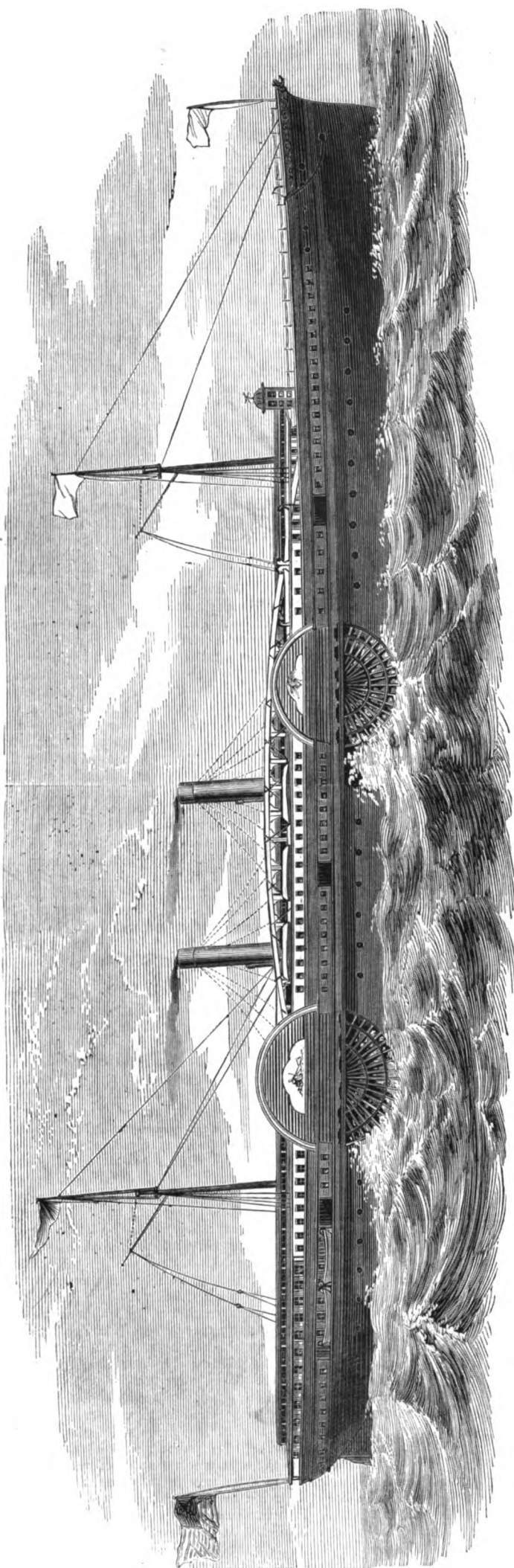
BOILER.

N.B. In all the failures, the persons authorised have seen them, and have stated that the method of fixing was correct.

RIFLE versus BAYONET.—The recent report of the Surgeon-General of the American army shows that during the civil war cold steel played but little part. In three years there were reported on the Federal side only 143 bayonet wounds and 105 sabre cuts. Gunpowder does the work, and modern artillery and long-range rifles gives little chance for bayonet or cavalry charges.

SMALL ARMS FOR THE RUSSIAN ARMY.—The needle-gun now definitely adopted by the Russian War Office is of the Prussian pattern; but the needle being somewhat shorter and thicker, the rapidity of the firing is said to be slightly increased. If Russian accounts are trustworthy, an ordinary soldier will easily accomplish eight discharges in a minute, while a skilled hand is stated to have no difficulty in reaching up to 14. There are not many new rifles being made, the old ones admitting of adaptation.

THE RANDALL FOUR-WHEELED STEAMSHIP.



We give illustrations of the four-wheeled steamship proposed by Captain Henry Randall, of the United States, and of which our correspondent, Mr. Campbell Ross, writes as "the ship of the future." We express no opinion of our own, and content ourselves with observing that the peculiarity, if any, consists in the use of two pairs of paddle-wheels, the hinder pair being larger than the forward pair. The hull is strengthened by the form of truss shown, and it is to be of moderately light draught, and to have a flat floor. Captain Randall's scheme has been for the last eight or nine years before the American public, and an influential company was once formed in Philadelphia to build and work a line of steamers of this construction, but the undertaking fell through.

NITRO-GLYCERINE.

Is the course of the inquest on the late Mr. John Mawson, who was killed by the recent disastrous explosion at Newcastle, Mr. Isaac Lowthian Bell gave the following interesting evidence respecting the properties of nitro-glycerine. Mr. Bell said: "The existence of nitro-glycerine had been known to chymists for twenty years, but it was only in the year 1864 that it was brought into public notice as a substitute for gunpowder, con-

sequently all our practical acquaintance with its effects had been gathered within the last three years. The elements of nitro-glycerine separate with immeasurable velocity, and hence the violence of the explosion, which has been calculated to be ten times that of gunpowder. Nitro-glycerine, particularly if impure, was liable to spontaneous decomposition at ordinary temperatures. The gases given off, if confined to the vessel containing the nitro-glycerine, exercise pressure on the remaining liquid; and a vessel containing nitro-glycerine under such pressure was found by Kopp to be liable to explosion under the least shock or slightest movement. Again, if this substance were brought from a cool place and exposed to a temperature of from 68 to 75 degrees Fahrenheit, decomposition took place, pressure ensued, and on removing the vessels containing it explosion might be the consequence. A continuous exposure to a temperature of 46 degrees caused nitro-glycerine to crystallise, and the resulting solid matter was liable to explosion on the slightest disturbance. Nitro-glycerine when exposed to a temperature sufficient to cause ebullition was very prone to explode. It was alleged that the presence of good spirit deprived nitro-glycerine of its explosive qualities. To separate the good spirit from the nitro-glycerine, water was added and the nitro-glycerine resumed its explosive

character. If, as he was informed, the 'blasting oil' manufactured by Nobel, of Hamburg, was diluted with wood spirit, it would appear from the evidence they had heard that day that cold-congelation—was capable of separating the nitro-glycerine from the accompanying wood spirit. He had a copy of the instructions with respect to the use of Nobel's nitro-glycerine which were issued by the manufacturer of the nitro-glycerine now under consideration, and were intended for those who had to use the substance. The instructions state that the nitro-glycerine 'can be stored for an indefinite time without loss in weight or deterioration in quality.' Such an intimation was likely to mislead persons in the habit of using it, because the nitro-glycerine used in commerce was more or less liable to spontaneous decomposition and to explode. The instructions stated that 'the peculiar property of the blasting oil not to explode by mere contact with fire rendered its carriage, storing, and handling very safe, even when in an explosive state.' So far from that statement being true, the compound was liable to explode if brought into contact with heat. And so far from being safe in transit, it was liable, from its specific gravity (which is 1.6), to explode from mere movement, and was consequently a very dangerous compound for a railway company to carry. The quantity of nitro-glycerine contained in the thirty canisters

originally brought to the town would have been equal to 4½ tons of gunpowder, and it was stored where percussion, motion, or a moderate temperature might have caused its explosion. Such a quantity of pure nitro-glycerine would have been sufficient to have blown down 115,000 tons of solid rock. Nitro-glycerine was, in fact, gun-cotton, glycerine being used as a medium instead of cotton. In the opinion of the witness, the explosion was caused by the crystallised nitro-glycerine exploding spontaneously, occasioned by some of the pieces moving or slipping. The pieces might slip one on the other, and the pieces exploding in one canister would explode the rest. He believed it was not made in Britain as an article of commerce."

THE UNITED STATES NAVY.—The Secretary of the United States Navy reports that the United States navy consists of 238 vessels, carrying 1899 guns. At present in use there are 103 vessels, carrying 898 guns, and manned by 11,900 men. During the past year the naval fleet has been reduced by 40 vessels and 480 guns. Nearly all the vessels in the navy are propelled by steam, 49 of them are armour-plated, and six armour-plated vessels are now being built.

IRON AND STEEL MANUFACTURE IN 1867.

In ancient Greece, in those classic days when the history of that small country was virtually the history of civilisation, one institution of vast importance and of unparalleled influence upon the national progress of the time stood foremost in the mind of every historian, and impressed itself so strongly upon the course of events that it governed the chronological subdivision of all historical records. We refer to the Olympic festivities, the national exhibitions for arts and sciences. In modern history, when civilisation again is recognised as the aim and ambition of the majority of all nations, international exhibitions are the Olympic festivities for a nation of nations, for that vast fraternity of mankind for which the word Christianity is insufficiently comprehensive, and which can be recognised in its integrity by no other term but that of "the civilised world." In that sense we are entitled to say that the year 1867 closes an Olympiad in modern history of civilisation, and in attempting to review the past progress of any one branch of science, art, or industry, we consider it all the more difficult to separate this one year from the preceding number of the same group, the more prominently this group itself rises, with sharp and clearly defined outlines, upon the background of a more distant past. This is the case with regard to iron and steel manufacture in a higher degree, perhaps, than with any other branch of industry. We prefer, therefore, in tracing the history of iron and steel manufacture in 1867 to drop all minute subdivisions of single years, and to record the history of the whole quintennium as one great but indivisible fact, such as has been presented to our eyes during this past year.

The space of time which in this manner rises before us comprises the first five years of a new era in iron and steel manufacture. The Exhibition of 1862 inaugurated the "age of steel," by bringing before the universal public as an accomplished fact and a practical reality that gigantic innovation, the Bessemer process, which during the comparatively short period which we are now reviewing has changed the industrial and commercial position of every European country, and is now irresistibly sweeping away the old-established iron industry of some manufacturing districts, and, indeed, the whole primitive mode of iron manufacture all over the world. The influence of Mr. Bessemer's great invention reaches down into the very mines of ironstone and of coal. One great thought has changed the least appreciated kinds of British iron ores into the first qualities of ironstone in Europe. The British hematites are now in greater demand than any class of iron ore had been at any previous period. The population of the Ulverstone district, and particularly that of Barrow-in-Furness and its neighbourhood, continues to rise at a marvellous rate which exceeds all previous examples in European history. In spite of the recent panic, and the general depression of trade, blast-furnaces are rising in this country wherever hematite ore is accessible. Within this last year the Wigan Coal and Iron Company have commenced and partly finished five new blast-furnaces each 80 ft. in height and 24 ft. at the boshes, and when we look back over the whole group of five years we have to record the erection of almost all the furnaces now existing in the Lancashire district. The value of ironstone has risen as compared with that of coal for the manufacture of iron; the preponderance of those works which owe their high standing in the iron trade to the abundance and purity of their coal (as, for instance, the great ironworks of Yorkshire and of Staffordshire) is gradually sinking, and is making room for the ascendancy of the steel-producing localities. A great revolution thus silently but irresistibly working its way naturally produces some temporary distress in certain places. The iron trade is stagnant, puddler's wages decrease, and ironmasters' profits disappear. Irritation manifests itself in different ways, and the recent ridiculous attempts of "the trade" to create prejudice against the value and durability of steel are some of the indications of this spirit of the times. It will assist the ironmasters in no better way to fight against the laws of nature and of political economy than strikes will assist their men in bringing back the old standard of wages in a declining branch of manufacture. The change being unavoidable, we can only wish it to take place quickly. The industry of the nation will vastly gain, although some special districts may suffer a momentary and perhaps not irreparable loss. The iron manufacture of the European Continent has felt a similar effect, and has undergone the same and proportionately even greater

changes. Sweden and Austria, the countries richest in pure iron ores and poorest in mineral fuel, are indebted to Mr. Bessemer for the revival of a prosperous and rapidly rising iron industry out of the very ruins of a prostrate and bankrupt iron trade. The district around Siegen, in Rhenish Prussia, the well-known locality from which the spiegeleisen is drawn, is a Continental Barrow-in-Furness on a smaller scale. The Cöln Müsen Company have erected five or six new blast-furnaces for the manufacture of Bessemer pigs out of spiegeleisen; the Charlottenhütte and several of the neighbouring ironworks have successfully changed their fuel from charcoal to coke, without impairing the quality of their spiegeleisen, and have thereby materially increased their productive power. A railway, Ruhr-Sieg-Bahn, has been opened for connecting the Siegen district with the important iron and steel manufacturing district of which Essen is the centre, and an exchange of coal, coke, and iron ore takes place between these two localities similar to that existing between Ulverstone and Wigan, in Lancashire. The blast-furnaces in the coal district of the Ruhr river, such as the Hörde Ironworks, Messrs. Jacobi, Haniel and Huyssen, and Krupp's blast-furnaces, near Coblentz, draw part of their supply of ores from the Siegen district, while another part—a good red hematite—is drawn from the duchy of Nassau, and sent down in barges through the river Lahn on to the Rhine. All that makes the high qualities of pig iron expensive in Rhenish Prussia, and British hematite pigs are in great demand there. The Georgs Marienhütte, in Hanover, has started an additional blast-furnace during the present year. These works are at this moment the best source for high qualities of grey-coke iron on the Continent, and, we believe, the only German ironworks which can occasionally undersell British hematite pigs in an English market. The George Marienhütte has only five blast-furnaces in all, and its entire make of iron is not sufficient to supply even a part of the demands of German steel-makers; there is, therefore, very little export of that iron from Germany. Another important iron district is rapidly rising in Germany, at the banks of the river Saar, close to the French and Belgian frontier. This is a Continental Cleveland. The coal beds of the Saar valley are very rich, and produce an excellent coking coal, the coal-masters having intelligence enough to wash the pyrites out of the natural product of their mines. The iron ore is an argillaceous stone lying in enormous beds upon the surface of the ground; it contains about 33 per cent. of iron, and requires no flux for smelting. The principal deposits of this ore are in the duchy of Luxembourg and all along the upper course of the Saar river. The French and Prussian Governments have within the last five years conjointly completed the canalisation of the river Saar as far down as Saarbrücken, where the principal coal mines are situated. Some parts of the canal are actually cut through the ironstone beds, and the ore can be sent down upon the slopes into the canal barges by simple gravitation. New blast furnaces are about to be erected along the banks of the canal, and several of the existing ironworks, which, like the Burbacher Hütte, have their furnaces close to the river already, required only the erection of a suitable hoist for bringing the ore up to the charging platform of their furnaces, to avail themselves of these advantages. The ore is not calcined, and the iron produced from it is mostly white forge iron. It contains a considerable amount of phosphorus, and can be employed for inferior qualities of bar iron only. Some ironworks which properly belong to this district belong to Belgium, others to France, as all the three countries meet in that point, and the frontiers have been fixed by treaties without any reference to natural boundary lines. The iron manufacture in the rest of France stands upon a comparatively less favourable natural basis. The iron ores of France are almost without exception of a very inferior kind. The Creusot Works draw supplies of pure ores from Algiers; Messrs. Petin, Gaudet and Co., from Sardinia; other ironmasters from Elba, and some, we believe, even from England whenever high qualities of iron or steel are to be produced. For the lowest and cheapest brands the fuel, again, in most places is too dear, and so the French ironmasters are behind the Swedish, Austrian, and English with regard to quality, and behind the Belgian, Prussian, and our own in respect to cost price of cheap iron. In spite of these difficulties, the iron industry of France has made great commercial progress during the period now before our view, a progress, however, which has been considerably overrated by many visitors to the late Paris Exhibition, who have been dazzled by the brilliant *mis-en-scène* of that grand display. The United States of America are turning from importation of iron to

the manufacture of this material. This is a somewhat premature step, unnaturally stimulated by an unreasonable tariff of import duties. A country like America has more profitable channels for the development of its natural resources than the sinking of that large amount of accumulated capital required for iron-mining, and the slow returns which characterise this steady and conservative branch of industry. To cripple the whole effective power of that great nation whose characteristic element and mainspring of existence is rapidity of industrial progress—to increase and even to double the price of iron and steel in such a country by artificial means—must be considered as the height of political insanity. The protective tariff will create a parasitic industry in localities unsuited by nature for its development, it will create a vested interest in these sickly glass-house plants which cannot now, and will not in future, maintain themselves unprotected and in a natural state of affairs, and the end of it will sooner or later be such a commercial and industrial calamity as will astonish even our strong-nerved cousins across the Atlantic.

So much for the commercial charges effected by the Bessemer process. The technical and scientific changes are greater still. To begin with the colliery, the practice of coal-washing has been introduced into some English works for the purification of the coal and coke from sulphur. We refer most particularly to the Kirkless Hall Ironworks of the Wigan Coal and Iron Company. All the coal-dust for the coke required in the blast-furnaces of these works is purified from surplus by washing, and is so made suitable for smelting hematite iron for the Bessemer process. Coal-washing, however, is not as yet sufficiently known and appreciated in this country. Continental collieries are far in advance in this respect, and a great deal could be learned and *must* be learned from them by our coal-masters before long. The collection of waste gases from furnaces working with coke has arrived at a high degree of perfection. The Cleveland district has led the way in that line, as it is leading the way of scientific economy in every respect. It is this successful economy which has enabled the Cleveland ironmasters and some of their followers to secure what we would call the place of commercial antipodes to the steel-masters, the only safe position during the present industrial storm. In blast-furnaces, working with raw coal, waste gases are rarely collected, and an enormous waste of fuel is the consequence. In this respect Scotch blast-furnace practice is now in a state of suicidal prodigality which nothing but the keen competition of the Cleveland iron is likely to arrest in the future. In iron-smelting there is no important successful invention on record within the period now under our review. The general tendency is an increase of heights and capacities of blast-furnaces, and an increase of the temperature and pressure of the blast. The highest temperatures of blast are obtained by the regenerative hot-blast stoves patented by Mr. Siemens, which are gradually gaining ground in the Cleveland district. Mr. Siemens has patented, but not as yet successfully carried out, a new mode of iron-smelting or steel-manufacture direct from the ore. Another clever metallurgist, Mr. William Henderson, of Glasgow, has also secured patents for a new mode of reducing iron ores, but this process too has yet to pass through the first stages of experiment. For melting pig iron in the foundry and in the Bessemer steel works the Woodward steam-jet cupola has come into extensive use. Experience has shown that the objections originally raised against its waste of steam are mere prejudices, and that this cupola works fully as economically as any other well-constructed furnace of the kind. For melting the charges for the Bessemer converter the cupola has been adopted, first at the Mersey Steel Works, and since then at the Bolton Steel Works at Barrow, at the Manchester Steel and Railway Plant Works—in all cases with very good qualitative and economical results. The manufacture of ferro-manganese lately carried on at the Phoenix Foundry, Glasgow, under Mr. Henderson's patent, has been, we believe, prematurely discontinued as an unprofitable branch. This, after the previous complete success in a technical point of view, is the only instance of a retrogressive movement in iron metallurgy which we have to record. The scientific advancement of iron metallurgy in general, which we consider as one of the greatest moral results of the Bessemer process, has in rapid succession brought into existence a considerable number of other methods for purifying and decarburising iron, some of which are practically successful. Messrs. Emile Martin and Pierre Martin, of Paris, have succeeded in using the bed of a Siemens furnace as a crucible for melting pig iron and wrought

iron or steel scrap, and in making steel in this manner. This process is gaining ground on the Continent, the Creusot Works, M. Verdic, and some others being amongst M. Martin's licensees. The old Uchatius process, consisting in melting pig iron with iron ore of great purity, has also been revived; and the Paris Exhibition has produced specimens of Uchatius steel from Sweden, where this process has been carried on commercially for many years past. Mr. Robert Mushet has started a steel works at Coleford, Forest of Dean, for the manufacture of titanic steel. The influence of titanium upon steel and steel manufacture is comparatively little known as yet; but to judge from the records of Dr. Fairbairn's tests of steel, laid before the British Association in the present year, the steel of the Titanic Iron and Steel Company seems to be distinguished by an extraordinary amount of cohesive strength. The specimens of titanic steel tested by transverse strains have given some of the highest figures in Dr. Fairbairn's table, both with regard to the value of the modulus of elasticity and to the value of the unit of working strength. We do not know whether it be the titanium, but we are quite certain it is Mr. Mushet's great skill as a metallurgist to which such results are due.

An important innovation of very recent origin is the successful application of the atmospheric blast for the decarburisation of common brands of pig iron in the puddling furnace—a process patented by Mr. William Richardson, of Glasgow. The characteristic of the Richardson process is the combination of the Bessemer process with the common operation of puddling and balling. The results obtained with this operation at the Parkhead forge, in Glasgow, are very satisfactory, and particularly the improved quality of the products is an object of great importance. Mechanical puddling has not advanced; and the paper read by Mr. Menclaus at the Paris meeting of the Institution of Mechanical Engineers recorded the fact that this able pioneer of machine puddling has abandoned his invention as a failure. The Wilson furnace is doing well. The Siemens furnace has within the last few years risen from the position of a scientific piece of over-refinement to that of the most important and most valuable means for economy of fuel in the generation of high temperatures, and one of the most appreciated parts of our modern metallurgical plant. Mr. Siemens's patent is about to expire; and if ever there was a just case for an extension of a patent, we believe the case of Mr. Siemens to be fully as deserving. The manufacture of steel castings and of malleable iron castings is progressing gradually, and under the veil of secrets of manufacture. The Bocham Company, in Prussia, and Messrs. Vickers, in Sheffield, are the most eminent craftsmen of this art. Messrs. MacHaffie, Forsyth, and Co., of Glasgow, have also gradually acquired great skill and a good name for their malleable castings; and whatever we may think of their secrets, we are ready to bear testimony to the high quality of their productions. In the forge, Mr. Ramsbottom's duplex hammer, Mr. Whitworth's hydraulic press for liquid steel, and the hydraulic forging-presses in general are working their way slowly and silently. The rolling-mills with vertical side rolls, or so-called universal rolling-mills, are gaining ground for the manufacture of T-irons and other complicated sections.

The effects of the late Paris Exhibition make themselves felt in a general desire for superior scientific education of managers and men in the ironworks of this country. This is a very desirable state of affairs; and if it has been brought about by an exaggerated fear of the impending decline of British iron manufactures, we do not regret the effect, although we cannot acknowledge the existence of the imaginary cause.

THE ATLAS WORKS, GLASGOW.

If we could collect all the products of some of our great engineering works, and pile them up upon the ground area covered by these establishments, we should perhaps, in some instances, have to raise mountains higher than Mont Blanc or Chimborazo. The Atlas Works, Glasgow, the establishment of Messrs. Rowan and Co., is one of the works which, under such a supposition, would show off to extraordinary advantage. Situated in the centre of a densely populated town, and surrounded on all sides by neighbouring manufactories, its ground area, considerable as it is, bears an unusually small proportion to its power of production. The multifarious and varied plant is therefore clustered together, we are tempted to say, upon no space with a wonderful ingenuity, still giving free access and perfect facility of transport of the dif-

ferent articles to each special machine and through the different departments of the works. The Atlas Works, although fitted out as a general engineering and millwright's establishment, are principally employed as a forge for the manufacture of railway wheels and axles. In this specialty Messrs. Rowan and Co. have obtained a great repute, not only in their own locality or district, but all over England, and in several Continental countries, particularly in Russia. The railway wheels are generally made and finished in complete sets with their axles and tyres, and the manufacture of all parts of these wheels is carried on on the spot in all its stages. The iron axles are piled and forged from scrap bars in the usual way, the steam hammers for this purpose being on Condie's principle. The largest of these hammers, with a 5 ton head, and steam on both sides of the piston, is constructed on Mr. Rowan's improved and patented plan, which we illustrate on page 563 in our last number. It works with unusual rapidity for its size and length of stroke, an advantage due to the ample width of the steam-passages provided by this arrangement. The wrought-iron spokes are made and put together in a similar way to that we have described before this on several occasions, but the mode of bending the spokes is different from that usually adopted in Staffordshire and elsewhere. The shape of each spoke is such as to leave the central boss in a proper radial line; the spokes are all welded up, and have a triangular piece welded in between them to form the rim. The bending-machine for these spokes is of an original and very convenient construction, of which we hope to give some details on a future occasion. Mr. Rowan was amongst the first constructors of vertical tyre mills, which have now come into almost universal use. The very first designer of a vertical tyre mill, we believe, was Mr. Bodmer; and Messrs. P. R. Jackson, of Manchester, are understood to have been his successors in that line. Mr. Rowan's tyre mill is a very powerful and substantially constructed machine; it works with great speed, and gives an excellent finish to the tyres. A second mill of a similar construction is now partly finished, and about to be completed at an early date, and the two tyre mills are then to work together as "breaking down" and "finishing" mills respectively, so that each tyre will pass through both mills in the course of its manufacture. The manufacture of wooden disc wheels is carried on in a special workshop, fitted out with some very ingeniously contrived machines for finishing all the work by means of saws. These machine-saws cut with such nicety and precision, both in the straight radial lines and in the circular curves, as to make it unnecessary to use any plane or turning tool for finishing the surfaces, which are perfectly clean and smooth when they leave the saw.

Messrs. Rowan and Co. were amongst the first licensees of Mr. Bessemer, and the Atlas Works are at present the only Bessemer steel works in Scotland. The Bessemer process was started by Mr. Rowan for the manufacture of steel tyres and axles, which are now, to a great measure, replacing iron upon all railway lines with the most perfect success. In the course of his early practice, Mr. Rowan succeeded in making some very good castings of mixtures of steel and iron, a very promising manufacture which has, however, been suspended for some time past, partly from the absence of a sufficient experience in graduating the "temper," of these mixtures, and partly from the pressure of other business. The first cause we understand to be rapidly disappearing, and experiments with a whole series of compounds graduated in numerous steps, so as to produce a kind of scale for the "temper" is about to be made very shortly. This will enable Messrs. Rowan and Co. to guarantee the tensile and compressive strength of their malleable iron or steel castings in future, and will, we believe, supply a great desideratum in present engineering practice, which, up to this day, is in vain looking out for the supply of castings of great strength and tenacity at a reasonable price.

LIEBIG'S MEAT EXTRACT.

For a very long time past Baron Liebig, the celebrated German chemist, has, in many of his writings, advocated the production of what he first pointed out to be the essence of meat, i.e., the nitrogenous compound which forms the principal and most valuable nutritive element of animal flesh, and which in the latter is admixed with fat and other organic compounds of small or no nutritive value. Baron Liebig first produced this meat extract in his own laboratory, and demonstrated its qualities. In his letters on chemistry he calls this substance a panacea for exhausted and convalescent persons, and he demonstrates, if we re-

member rightly, that so small a quantity of this substance as can be taken up upon the point of a knife contains more nutritive matter than a pint of the strongest beer. This extract, moreover, if entirely freed from all the foreign organic matter with which it is combined in fresh meat, can be kept exposed to the atmosphere for a considerable length of time without any danger of its decomposition or deterioration; it requires nothing but dissolution in hot water to form what is usually known as beef-tea in the household and kitchen, and one teaspoonful of that essence will produce half a pint of beef tea of greater strength and concentration than most people would find palatable. Baron Liebig also pointed out that the fact of meat being practically valueless in some countries which are too distant from the more densely populated localities to permit the direct transport of meat, in whatever form, to those latter places, it would be a very suitable and lucrative business to start factories for the extraction of fresh meat at those distant places, and to transport only the concentrated essence, which, in a very small bulk and weight, contains everything that is valuable in the meat, to the countries where it is most in demand. This suggestion was some years ago taken up by M. Giebert, an enterprising gentleman born in Germany, who went to South America and established works for the extraction of meat on Liebig's principle in a locality which was eminently suited for that purpose on account of its almost unlimited supply of fresh meat. At a later date, after having successfully commenced this extraction, and proved it to be a commercial as well as a practical reality, M. Giebert returned to Europe and started a limited-liability company under the title, "Liebig's Meat Extract Company (Limited)," with its principal offices in London; its chemical controlling laboratory in Germany, under Baron Liebig's personal supervision; and with an enormous extent of landed property and very large works in the Argentine Republic, at two places, called Tray Bentos and Gualaguaycha. The extraction of the meat is carried out on a scale which will enable the company to turn out one million pounds of meat-extract annually. The machinery and plant has been designed by M. Giebert in all its principal details and elements, and it has been executed by the well-known engineering firm of Messrs. P. and W. Maclellan, in Glasgow, who have in their turn given out a part of the work to Messrs. Blair and Gray, of the Clydesdale Ironworks, a comparatively young and rapidly rising Glasgow firm. The whole machinery is stated to have a value of about 45,000*l.*, and it was sent out to South America a short time back. The machinery was erected and put in operation on the spot by Mr. Hall, of the firm of P. and W. Maclellan, who has just returned from South America to Glasgow with the most favourable report about the whole concern. The meat-extract produced by this company bears Baron Liebig's own guarantee, since sample lots of every week's produce are regularly sent to the baron's laboratory, and are all analysed by a chemist specially engaged for this purpose. This is a very valuable point in consideration, since confidence in the purity and good quality of an article of the kind is one of the first conditions for its sale and utility. The next important question is the price. This is less satisfactory at this present moment. The extract is sold in England in jars containing 1 lb., at a price of 12*s.* or 13*s.* In abstract consideration of the fact that 1 lb. of that essence represents perhaps a quarter of a hundredweight of the best meat, this is not a very high figure; yet the practical fact that the extract is sold principally by apothecaries, instead of being an article of every day's commerce and use in the grocers' shop, shows the verdict of the public on the point of price. We understand that there is no necessity for maintaining this high price of the product, and the company could make ample profits by selling the extract at 4*s.* or 5*s.* per pound, when its sale would naturally rise to an almost incalculable amount. This cause has induced several parties to start rival establishments, and it is more than probable that competition will very soon bring down the price of this extremely useful and valuable article, which modern science has brought within the reach of the inhabitants of densely populated countries, who are in this manner enabled to feed themselves upon the luxuriant fauna of uninhabited prairies thousand of miles away. This is a great triumph of science of engineering and commercial enterprise, one whose full bearing and future importance we are as yet unable fully to realise or estimate, but for which many future generations will thankfully remember the name of Mr. Giebert, and that great name amongst the greatest, the celebrated name of Baron Liebig, the father of organic chemistry.