NOTES ON THE ELECTRICAL CONSTRUCTION OF DEEP-SEA TELEGRAPH CABLES.

I.

The data available for the guidance of the telegraph engineer or manufacturer in what may be termed the electrical, in contradistinction to the mechanical, construction of submarine cables have not hitherto been collected, examined, and presented in a form calculated to render them a subject of study amongst the generality of those who are interested in the great problems of submarine telegraphy. The stock of knowledge which we have at hand to aid us, as an engineering nation, in giving to the rest of the world a solution of these problems is certainly not deficient in depth or in extent, but is insufficiently disseminated, and, owing to causes which—in spite of, and partly in consequence of, our various scientific organisations—are constantly operating to prevent the spread of science, is practically confined to a few scientific men whose talent for the application of valuable data is apparently by no means equal to their ability for abstract investigation. In this circumstance is, we believe, to be found the main cause of deep-sea telegraphy being at the present moment at a stand-still, so far as regards progress in practical results. Be this as it may, the discussion in our columns of questions relating to the electrical, as well as to the mechanical, construction of deep-sea cables may be attended with advantage; and the observations we propose to offer under this heading may perhaps initiate this discussion, whilst affording information to some who may be seeking it in this direction.

With the one exception of the last Atlantic cable, submarine wires have hitherto been insulated simply by "rule of thumb," that is to say we cannot trace the application of any accurate theoretical principle in their construction. Even in the case of the cable mentioned, a wide deviation is observed from the relative proportions of copper and gutta percha theoretically requisite to obtain the maximum of efficiency at the minimum of cost; and the reasons for this divergence from the admitted scientific principle have not, so far as we are aware, been explained. We purpose to refer to them further on.

The "thumb" rule which is now mostly prevalent is "to make the conductor as large as may be consistent with financial considerations." This, though plausible and based upon a generally safe principle, is, like most other empirical rules, deficient in definition and accuracy, and is fraught with some dangers, amongst which that to the pockets of shareholders in telegraphic enterprises is not the least important. The rule of "as large a conductor as possible" is in fact to be accepted with reserve, or at least with certain limitations. It is not many years since it was rejected *in toto* by several electricians; and the reasons which led to its rejection, and to the adoption in the case of the first Atlantic cable of what has been considered a very faulty design, are deserving of careful consideration in connection with the present subject-matter, since—though they are now known to be insufficient to lead to the conclusion that an advantage is gained by constructing a long cable with "as small a conductor as possible"—they afford the data for obtaining a golden mean between two extremes. It may here be remarked that the Atlantic cable of 1858 was probably far more defective in execution than in design, electrically speaking; and that the proper diameter for the conducting wire of a submarine cable is a question which is dependent in very great measure upon the nature and cost per lb. of the material used for the insulating sheath. The statement which has been made—that a certain ratio should be maintained between the diameter of the conducting wire and that of the insulated core—is liable to some misconception, since the most advantageous ratio varies in the case of different insulating media, and even with the variations in their price. The ratio to be considered is that of electrical efficiency to cost—one which should obviously in all cases bear the maximum value, so long as the question of mechanical efficiency does not interfere with the electrical question.

And in considering the construction of submarine cables from an electrical point of view, care should be taken not to underrate mechanical advantages. It is true that the commercial value of a cable, when the latter has been successfully laid, is generally dependent upon the rate of speed attainable in signalling through the wire; but it should be borne in mind that the main difficulty has hitherto been in depositing deep-sea cables at the bottom of the ocean in a condition of efficiency, and the greatest mistakes made in connection with such cables have been those in their mechanical construction. Nevertheless, an electrical objection, brought forward by an eminent electrician, but which, if it be not almost wholly unfounded under existing circumstances, is of small moment in comparison with the mechanical advantages in view, has been allowed to militate against the adoption of a system of constructing deep-sea cables which, whatever may be its merits and demerits, would doubtless have sufficed to obviate the disastrous failures which have again and again occurred in the attempt to lay a Transatlantic telegraph. We refer to Mr. Allan's system of placing the strength of the cable in the conductor, by forming this of a solid copper wire, surrounded with fine steel wires laid with a slight spiral. The electrical objection to this system is, that since the conducting power of steel wire is much less than that of copper, the compound conductor would expose a greater amount of surface than does a copper conductor of equal conductivity, and would, consequently, by reason of the greater inductive charge upon the surface, give, *cœteris paribus*, a lower rate of speed in signalling. Obviously this is no valid objection if, as may undoubtedly be the case, the advantage gained mechanically outweighs the electrical disadvantage; and, indeed, the former might be cheaply bought at the cost of the increased quantity of insulating material necessary to compensate for the electrical defect. But while pointing to the inexpediency of allowing comparatively slight electrical objections to interfere with more vital questions of mechanical efficiency, we may state that the "serious electrical disadvantage" in the case of Mr. Allan's cable is found, upon examination, to have no existence in fact, provided the weight of steel be considerably less than that of copper. Owing to a solid copper wire being used in this cable in place of a twisted strand of copper wires, the interstices in which are filled up with an insulating compound, it is found that the inductive charge in a given length of Allan's cable may be but very little greater than that in a similar length of cable of the ordinary construction, equal to it in conductive resistance, and in thickness of insulation. The twisted strand conductor, necessitated in consequence of a defective system of mechanical construction, is open to an electrical objection of at least equal weight to that we have referred to, but strangely enough, though involving the consideration of a radical defect instead of an advantage, the objection has in this case been but little insisted upon.

Next—in the present stage of our progress—to the question of mechanical efficiency, comes that of electrical perfection in regard to the conditions which at the minimum cost allow of the maximum rate of speed in signalling. Nor should the latter consideration be underrated by those whose attention has been mainly directed to the mechanical construction of deep-sea cables; for it is quite possible that, of two cables of equal cost and equal length, the one may allow of a rate of speed in the transmission of signals double or more than double that which is attainable in the other, or that the cost of cables equal in electrical efficiency may vary in similar ratio. And here perhaps a useful hint in relation to signalling apparatus may be given; for it is quite possible also to double the commercial value of a long submarine line by the use of improved instruments or systems for the more rapid transmission of telegraphic despatches.

By far the most important electrical question to be considered in reference to the efficiency of long submarine cables is that of inductive resistance, and it is worthy of remark that, where this question is duly regarded, perfection in regard to insulation properly speaking will, generally, be found combined with economy of construction. The rate of speed attainable in signalling does not, it is true, depend exclusively, as was once supposed, upon the inductive resistance of the insulating envelope of the cable—considered as the dielectric in an inductive circuit; since, though the quantity of electricity accumulated under a given tension as an inductive charge varies inversely as this resistance, the conductivity of the wire exerts a very important influence upon the rapidity with which this conductor can be charged and discharged in the operation of signalling. But, whatever may be the diameter of wire adopted for the conductor, it is of great importance in a pecuniary sense that the maximum ratio of inductive resistance to cost should in all cases be obtained. It will in effect be easily understood, even by those who are unacquainted with electrical science, that whilst, on the one hand, a wire can be charged and discharged more quickly as its conductivity is increased—the conductivity varying as the square of the diameter, and the surface, upon which electricity becomes accumulated, only in the simple ratio of the diameter—it can, on the other hand, be charged and discharged more quickly as the quantity of electricity distributed upon a given extent of surface is reduced by increasing the inductive resistance. But, as the increase in inductive resistance produced by augmenting the thickness of the insulating sheath cannot, with any advantage commensurate to the expense of material, be carried beyond a certain point, this thickness should practically be limited to that which at the minimum cost gives the maximum resistance. And it is necessary, therefore, that we should possess reliable theoretical data upon which, in conjunction with certain commercial data, we may calculate this particular thickness in the case of various available insulating materials. We must defer until next week the consideration of the laws embodying the first mentioned data.

But before closing the present chapter of notes, it may be useful to give a very plain definition of conductive and inductive resistance—two distinct properties which have frequently been confounded—and also two or three simple formulæ, in which are condensed the most important electrical principles applicable in the construction of submarine cables. Conductive resistance is the obstacle opposed either by a good or a bad conductor to the *passage* of electricity as a *current*; inductive resistance is that opposed by a bad conductor, or insulating substance, to the *accumulation* of electricity as a *charge*. Thus the quantity of electricity passing as a current from a source of given electromotive power will be inversely as the conductive resistance in the circuit, and the quantity of electricity accumulated as a charge will be inversely as the inductive resistance of the insulating medium or dielectric which necessarily forms part of every telegraphic circuit. Calling E the electromotive force and R the resistance, conductive or inductive, the quantity, Q, of electricity passing as a current or accumulated as a charge may, in either case, be expressed by the equation:—

$$Q = \frac{E}{R} \qquad (1).$$

In the case of *prismatic* resistances, either conductive or inductive, such as a metallic wire of equal sectional area throughout its length, or a flat plate of insulating material, the following formula (also bearing out the analogy between the conductive and the inductive circuit established by Mr. Gaugain and Mr. F. C. Webb) is applicable—l being the length of the wire, or thickness of the plate, and S the cross-sectional surface:—

$$R = \frac{l}{S} \qquad (2).$$

But, when l and S are maintained constant, the resistance (R) is found to vary in the case of different substances, and gives the measure of their *specific* conductive or inductive resistances. Calling r the specific resistance, the equation, when different substances are compared, becomes

$$R = \frac{l\,r}{S}.$$

This equation, it should be pointed out, is inapplicable to the *inductive* resistance in a submarine cable, this resistance—unlike the conductive resistance of the wire—not being prismatic but composed of a hollow cylinder of dielectric, within which is encased the conductor.

From the above equation (1) it follows also that—

$$R = \frac{E}{Q} \qquad (3)$$

an expression which would at once enable us to obtain experimentally at least an empirical formula applicable to inductive resistances in submarine telegraph circuits.

VISITS TO THE PROVINCES.

MERTHYR, AND ITS IRONWORKS.

No. I.

The mining districts of South Wales are situated in the midst of a number of valleys, stretching from the northern parts of Glamorganshire and Monmouthshire, in the north, to the Bristol Channel, in the south. The largest ironworks and collieries of Wales are, as a rule, to be found near the upper parts of these valleys, at distances of from fifteen to twenty-five miles from the sea, and separated from each other by intervening ridges of hills. Thus, there are the Vale of Neath, the Aberdare Valley, the Merthyr Valley, Rhymney Valley, Ebbw Vale, and many others, all lying nearly parallel with each other, and opening in the direction of the sea. Railways or canals, or both, run down these valleys, in many instances amalgamating with each other as they reach the more level ground in the south, and they finally terminate either in Cardiff, Swansea, or Newport, the three great shipping ports of South Wales, Cardiff being the central and most important. A little of the traffic of the iron districts also finds outlets at Neath and Briton Ferry.

The largest and richest of the Welsh ironworks are at Merthyr, which lies at the head of the Taff Vale, and is connected with Swansea by the Vale of Neath branch of the Great Western Railway, the Glamorganshire Canal and the Taff Vale Railway uniting it with the port of Cardiff. Merthyr is rapidly increasing in population, and now ranks in the census returns next to Brighton. On both sides of the town high ranges of hills cut it off from the neighbouring valleys of Aberdare and Rhymney; the sides of these hills are defaced by great heaps of refuse from the mines and works; railways and tramroads cut up the district in all directions, and rise one above the other at different levels on the sides of the mountains. Huge chimneys are seen belching forth smoke by day and fire by night; while in the buildings beneath them, swarthy beings toil amidst fires and furnaces, surrounded by ponderous masses of machinery. From the hilly nature of the country, and the large ironworks in the immediate neighbourhood of the town, Merthyr by night presents a spectacle of fiery magnificence rarely if ever equalled.

The people who labour in this black and fiery region hold their lives on a somewhat precarious tenure, the returns of the Registrar-General showing that the mortality in the Welsh iron districts is greater than anywhere else in the United Kingdom. This is partly caused by the nature of the occupations of the inhabitants, partly by the extra liability to accidents, partly by want of drainage, and partly by drunkenness and want of cleanliness in a population continually increasing by new comers, who cannot find employment in Ireland or the Welsh agricultural districts. The wealth of Merthyr is derived from the three large works in the neighbourhood: the Dowlais Ironworks, the largest in the world; the Cyfarthfa Works, the property of the Crawshay family, the "Iron Kings" of Wales; and the Plymouth and Penydarran Works, recently purchased by the Plymouth Iron Company, Mr. Richard Fothergill being the managing proprietor.

A hundred years ago Merthyr was nothing but a moderate-sized village, and since that time its prosperity has kept pace with that of the neighbouring millowners, growing quietly with the times, and presenting few features of historical interest, except during the riots. In 1800 there was a riot caused by scarcity of provisions. Several houses were plundered, after which the mob dispersed without doing much harm. Another outbreak took place in 1816 of a not very serious nature, but the last one, in 1831, will long be remembered by the inhabitants. In June, 1831, the rioters entered the house of Mr. Rowland Fothergill, manager of the Aberdare Ironworks, and compelled him with menaces to sign a paper of somewhat unmeaning character, which he did, knowing that his life was in peril. After taking everything eatable to be found in the house they returned to Merthyr, where they destroyed the houses of the bailiffs of the Court of Requests, and burnt the furniture. They also burnt in the street the books of the Court of Requests, as well as the furniture of Mr. Coffin; after which they went to Cyfartha, and stopped the men engaged in the works from continuing their employment. Soon after this Mr. William Crawshay, and Messrs. Bruce and Hill, acting magistrates for Glamorganshire, went to Merthyr with a party of the 93rd Highlanders, followed by a mob of rioters. The soldiers drew up in front of the Castle Inn, whence the mob was addressed by the High Sheriff, Mr. Guest, and Mr. Wm. Crawshay, who exhorted the men to disperse quietly. It was of no use. The soldiers were attacked by the crowd, who tried to wrest their arms from them; the major and many of the men were wounded, when the soldiers placed in the windows, seeing that their comrades were threatened with destruction, fired into the street, killing three upon the spot. A desperate fight followed, in which thirteen more were killed, but in the end the soldiers succeeded in dispersing the rioters, although some of them continued firing into the Castle Inn, one of the shots narrowly missing both the High Sheriff and Mr. William Crawshay. As night came on the little party at the Castle Inn managed to reach Penydarran House, the residence of Mr. Forman, a much safer position. For several days afterwards the town and district were in a state of great excitement. The rioters surrounded a body of cavalry from Swansea, under Major Penrice, and disarmed them; but more and more military aid reached Merthyr from different parts of the country, till at last the disturbances were quelled without further bloodshed. The present Mr. R. T. Crawshay, then a child, was at the time of these riots given for safety into the hands of a workman and his wife living in a cottage on the side of the Aberdare hill, opposite Cyfartha Castle. The ringleaders among the rioters were afterwards taken prisoners, and the worst of them only, Dick Penderrin, convicted and hanged. Thus the old Iron Kings of this district ruled with a strong hand over a turbulent race. They, however, were true public benefactors, in making a district yield food and employment to thousands of men and their families which once only furnished sustenance to a few shepherds, and even before the troubled times just described, the strong attachment existing between the ironmasters and the better portion of the workmen once prevented the sale of the Cyfartha Works to Sir Benjamin Hall just as the deeds were on the point of being signed. It was only a question of five minutes. Mr. R. Crawshay chanced to go outside the office door, where some of the men from the mills who had just heard some rumours about the sale, surrounded him, and their spokesman, Dick Morgan, said, "We hear, master, you do think of selling the works. Iss indeed!" Mr. Crawshay replied, "Yes, Dick, I do." Whereupon they implored him not to sell them, saying it would be a blow to themselves and their families, and that they would not serve under any other master. Mr. Crawshay could not stand this; he re-entered the office, and told the then Mr. Hall, in language more emphatic than polite, "I won't sell the works." Upon this Mr. Hall, to use a west country expression, looked "main scrow." He replied, "You won't, won't you?" and hot words followed, calmed somewhat by the intervention of the son, Mr. William Crawshay, who chanced to be present. Both parties left the office, eager to obtain those truly British luxuries, legal advice and expenses. These were not the days of the railway or the telegraph; so both parties posted to London in hot haste, by different routes, with all the speed the horseflesh could give, in order to be first in engaging the services of Sir Samuel Romilly, who was then in the height of his fame. Mr. Crawshay sped on his way by the Brecon and Hereford road, reached London and the office of Sir Samuel Romilly; and after the interview, as he left the house of that eminent counsel, he met Sir Benjamin Hall coming in. They passed each other in the passage. The works in the end remained the property of the Crawshay family, and the words of Dick Morgan have had their effect, both on the House of Commons and the House of Peers; for the owners of the large Welsh ironworks have gained influence enough to occasionally send themselves or their representatives to both, as instanced in the one or other of the cases of Lord Llanover, Sir J. Baily, Bart., M.P., Sir J. Guest, Bart., M.P., the Right Hon. H. A. Bruce, M.P., and others.

The Glamorganshire canal, by which route alone goods were once carried from Merthyr to Cardiff, is 25 miles in length, and was opened in 1798. It has a fall of from 500ft. to 600ft., has forty locks, cost £100,000, and has a branch to Aberdare. The Taff Vale Railway, one of the best paying lines in the kingdom, also runs from Merthyr to Cardiff, and was opened in May, 1841. As it passes through a very hilly country it has plenty of heavy bridge work, and at Navigation Junction the trains have to be drawn, locomotives and all, up a steep incline by means of a stationary engine and ropes. At the present time some heavy work is being executed whereby the gradient will be rendered less steep, and the stationary engine abolished. The broad gauge afterwards reached Merthyr by the Vale of Neath line in 1852, and within the last year or two railways from Abergavenny and Brecon have been constructed to within a few miles of Merthyr, their further progress being retarded by the difficulties and expenses of the route.

In former times, as at present, Merthyr was very unhealthy, and Dr. William Kay, of Bristol, after making an official investigation of the subject, calculated that in 1851 the average age at death in Merthyr was 17½ years, being rather less than half the average length of life in the healthiest district in the kingdom. Typhus fever and cholera habitually made deadly ravages in the town, and as soon as the Public Health Act came into operation in 1850, it was found absolutely necessary to supply Merthyr and Dowlais with water. Engineers were invited to send in plans to supply water by gravitation, the choice of the source being left to the candidates. The plans of Mr. Lynd, now engineer to the Manchester Corporation, were accepted. He proposed collecting water on the mountains, below the Brecon Beacons, at about eight miles from Merthyr, and delivering it at the highest level at the top of Dowlais, whence all the rest of the town could be supplied. As these plans, however, did not altogether meet the views of the ironmasters and the wants of the town, they were reconsidered by the local authorities and ultimately rejected. The eminent engineer, Mr. Thomas Hawksley, was then employed, and he suggested the construction of the present works, which consist of the Peatewyn reservoir upon the river Taff Vechan, where it acts as a compensation reservoir for the ironmasters. It is about six miles from Merthyr, and contains when full 63,000,000 cubic feet of water, covering an area of 100 acres. The town is supplied with water direct from the river Taff Vechan above the reservoir, whence the water is delivered by 14in. pipes at Penybryn, about a mile from Merthyr, where depositing tanks, filter beds, and a covered reservoir are constructed. From this place the whole of Merthyr and Penydarran are supplied by gravitation, but for the upper part of Dowlais the water is pumped by two engines of 14-horse power each, made by the Vulcan Iron Company, Warrington, delivering it into a small covered reservoir at Dowlais. The total length of pipes of various sizes, from 14in. to 2in. in diameter, is forty-two miles. The total cost of the whole of the reservoirs and works was £82,000, raised by the Board of Health on mortgage of the rates, to be paid off, with interest, in thirty years, five of which have now expired. The yearly payment by the town on this account is £5,577. The present daily consumption of water by the town is 150,000 cubic feet, and the revenue from the water rates now amounts to about £4,000 a year, showing that the new waterworks are becoming valuable property to the town. As regards the compensation reservoir, as long as it contains 20,000,000 cubic feet, the millowners have the power, under the Waterworks Act, of drawing off the water as rapidly as they require it. When the water sinks to 20,000,000 cubic feet the minimum quantity to be discharged is (by agreement) 110 cubic feet per minute. When it sinks to 6,000,000 cubic feet, which it never has done, even in the excessively dry summers of the last two years, the minimum quantity supplied to the millowners will be reduced to 90ft. per minute. There is an escape of water from the reservoir through the fissures in the limestone rock, whereby an average quantity of 150 cubic feet per minute is discharged into the river, some of this amount, however, coming from springs. All this leakage, which varies in quantity according to the height and pressure of the water in the reservoir, is calculated in the quantity supplied to the millowners. The waterworks were constructed by Messrs. Tomlinson and Harpur, of Derby, under the direction of Mr. Samuel Harpur, now town surveyor of Merthyr. The total expenditure of the Merthyr Board of Health is covered by two rates in the year, raising about £10,500, of which one-third is paid by the ironmasters.

At present there is a break at Merthyr between lines of railway that will in future more directly unite North and South Wales. The railways striving to enter Merthyr meet with great difficulties from the mountainous nature of the ground, and general heavy expenses. The London and North-Western Railway Company propounded a scheme last session to unite the Merthyr and Abergavenny line, with the Vale of Neath Railway. For various commercial reasons this project has been abandoned. The plans included a very large and expensive viaduct, besides which the proposed line was forced to make an ascent of 700ft. in a distance, in a straight line, of a little more than two miles, an ascent which with difficulty could be overcome by gradients of about 1 in 40. The Brecon and Merthyr Railway Company is now making the link which will supply North and South Wales with more direct communication than hitherto, by means of the Cyfartha branch, which will connect the Vale of Neath and Taff Vale Railways with the Brecon and Merthyr Railway. This branch, although a short one, is a very expensive length, and requires two noble stone bridges or viaducts, upwards of 100ft. in height, and consisting respectively of fifteen and seven arches of 40ft. span, over the rivers Taff Vawr and Taff Vechan at Cefn and Pontsarn. Both bridges are built of the limestone of the district, but are not yet quite finished. The contractors for the line are Messrs. Savin and Ward, who with Messrs. Watson and Co. and Messrs. Davies and Roberts, have within the last few years been covering Wales with railways in all directions, principally at their own expense. When the Cyfarthfa branch of the Brecon and Merthyr Railway is finished it is almost certain that the London and North-Western Railway Company will obtain running powers over it, whereby trains can come direct into Merthyr from Euston-square, *via* Abergavenny.

Another great work of the future in Merthyr is the drainage of the town and district, which has not yet been commenced, notwithstanding the large population. The plans prepared by the town surveyor, and passed by the Government engineers and the Secretary of State, provide for the entire sewage of Merthyr and Dowlais, and for the disposal of the sewerage by irrigation in the surrounding country. These plans appear to be very complete, and include ten miles of oval brick sewers of from 30in. to 50in. diameter, and nineteen miles of pipe sewers of from 9in. to 12in. in diameter. Flood outlets are projected for discharging any surplus of water in times of storms and heavy rains. The works have been let to Messrs. Isaac Dixon and Co., contractors, of Liverpool, whose revised estimate amounted to £24,068, instead of £26,123 as already published in The Engineer. The sum borrowed by the town for the construction of the works is £27,000, being the amount of the surveyor's estimate, and this sum is already in the hands of the town treasurer. The drainage works will be commenced in a few days, and, by agreement, they must be completed within two years.

A new feature in the trade of Merthyr is that within the last few years the ironmasters have entered into the coal trade. Large quantities of coal are exported to all parts of the world by the Dowlais Iron Company, and Mr. R. T. Crawshay is making preparations to enter into a similar business. It is a curious fact as regards Merthyr, that although coal and iron are so plentiful on the spot, and the whole country is alive with locomotives and engines, all the best steam machinery connected with the ironworks is made at a distance and brought to Merthyr by rail. Neither are the smaller description of iron goods manufactured on the spot, and in many instances the identical iron made in Merthyr and sent to England has been traced back to Merthyr and South Wales in the shape of manufactured goods. The manufacture of nails, wheels, and axles, iron hurdles, and other iron goods in large demand in the surrounding country, is not carried on at all, or to any extent worth noticing, in the Welsh iron metropolis. Good schools have been established by the millowners, although in this respect Merthyr proper is not well supplied. The Dowlais Works, the property of the late Sir John Guest, Bart., are now in the hands of two trustees, Mr. G. T. Clark, who has given a greater impulse than anybody to the establishment of schools in the district, and the Right Hon. H. A. Bruce, M.P., who has devoted most of his time and attention in the House of Commons to the promotion of national education.

THE DUBLIN TRUNK CONNECTING RAILWAY.

A TUNNEL UNDER THE LIFFEY.

In the session of 1864 the plans of the Dublin Trunk Connecting Railway were first deposited in Parliament amid strenuous opposition, there being no less than five competing schemes, all having in view but one object—the connection of the Dublin termini of the Irish trunk railways entering that city. Two of these schemes were based on the plan of erecting a central station, whence lines should branch to the different trunk railways, but the other three each purposed to make a railway round the suburbs of the greater part of Dublin, uniting the different lines as it crossed them. The capital necessary for the central station lines was in one instance calculated at £800,000, and in the other at £1,000,000. The parliamentary committee were so satisfied with the plans submitted to them by one of the central station companies that they intimated to the Dublin Trunk Connecting Railway Company that it would be no use their taking any further steps in the matter. This took place immediately before the Easter recess. After thirty days' deliberation, however, the plans of the Dublin Trunk Connecting Railway Company were unanimously accepted by the committee, and the plan they first accepted was thrown out, more especially because the expense of carrying out the plans finally accepted would be only about £250,000, and gave the public the same accommodation as the others. Another feature was that the accepted plans brought the whole of the trade of the port of Dublin into more direct communication with the existing lines.

The new railway will begin with a junction with the Great Southern and Western Railway of Ireland at its terminus near the Phœnix Park. It will then be carried across the Liffey at a considerable angle by a skew girder bridge of six arches, supported on columns, each arch having 60ft. span, or about 30ft. on the square. The railway will next cross Parkgate-street on an ornamental girder bridge, and in this street there will be a station. Afterwards it will cross Aughrim and Prussia-streets, between which there will be a station for passengers, as well as a very extensive one for cattle—the Dublin cattle market being at this spot. Here a large *abattoir* will be established by a company, so that the cattle will be brought by the new railway to market, where they will be immediately under the eye of the Government inspector, and, after examination, slaughtered on the spot, and in the majority of cases at once shipped at Dublin or Kingstown as dead meat. The new line will next cross the Circular-road, and the Midland Great Western Railway of Ireland, with which it has up and down junctions. A station is to be built in the Phibsborough-road, whence the route of the railway leads across the Royal Canal and one of its branches, when it will have a junction in the Liffey branch of the Midland Great Western of Ireland. Another main street it is intended to cross is Drumcondra-hill, where a station will be built. After crossing Ballybough-road it will have another station in the North Strand, beyond which point it will cross the Dublin and Drogheda Railway, with which it communicates by up and down junctions. From this point it descends for a distance of half a mile by gradients of 1 in 70, to the river Liffey, under which there will be a tunnel, the most important piece of work on the whole line.

The total length of this tunnel is 324 yards, one length of it—95 yards—being horizontal, and the remainder having a gradient of 1 in 70. It is approached on both sides by a covered way. This is, in fact, two tunnels side by side, one for the up and the other for the down line, and the two will not be constructed together, but one always 12ft. or 13ft. before the other, so that the water, by any accident, is not likely to break into both at the same time. By making two tunnels instead of one more strength also will be given to withstand the superincumbent pressure. Each of these tunnels is 15ft. horizontal, inside measurement, and 15ft. from the rail level to the top.

Borings have been taken in the centre and on each side of the Liffey to ascertain the nature of the ground through which the tunnel will have to pass. These borings show that it will have to be built in a thick stratum of stiff blue clay, full of large limestone boulders, and it will rest upon solid limestone rock. The boring on the north side of the river commenced about 8ft. above high water mark, and passed through 15ft. of mud and loam sand, 3ft. of loam gravel, 18in. of sand and gravel, 18in. of fine sand, 1ft. of sand and silt, 1ft. of sharp sand, 9ft. of coarse gravel, 1ft. vein of clay, 3ft. strong loam sand, 1ft. 6in. sand and gravel, 17ft. 6in. blue clay and boulders, 1ft. 6in. boulder, 5ft. 6in. blue clay, 2ft. limestone rock. On the south side were—14ft. mud and loam sand, 6ft. of sharp sand, 3ft. mud, 2ft. sharp sand, 12ft. gravel, 17ft. blue clay, 4ft. rock. In the centre of the Liffey the borings gave the following:—Below the bed of the river, 5ft. clay and silt, 2ft. 6in. silt and gravel, 3ft. 6in. gravel, 6in. vein of clay, 7ft. sand and gravel, 19ft. blue clay, 3ft. boulder, 1ft. 6in. blue clay, 2ft. rock. The tunnel, then, will pass through blue clay, and rest principally upon limestone rock. The engineer, Mr. J. S. Burke, by whom the works were designed, states that the stratum is very different to the treacherous London clay, and is of a stiff character, very impervious to water.

The shafts for the tunnel have already been commenced on both sides of the Liffey, and are being pushed on with vigour. The side walls are built on a strong iron curb, constructed on the principle of some designed by Brunel when sinking the shafts for the Thames tunnel. The walls, as they are built up on this curb, are bolted to it at intervals by means of iron rods, and as the earth is dug away the curb and the walls above gradually sink by their own weight. By this plan water is prevented from coming in at the sides, nor has any yet been met at the bottom of the shafts. A depth of 20ft. is, however, all that has been reached as yet.

Most of the bridges and works on the line are to be built of stone, which is found in abundance in the cuttings. Tramways for goods traffic are to be made to the docks on the north side of the river, and on the opposite side of the Liffey is to be a station at Irishtown, and finally a junction with the Dublin and Kingstown Railway at Sandymount.

A company has been formed, and will shortly submit to Parliament its plans for constructing on the south side of the Liffey a large floating basin, covering an area of about twenty acres. It will have an entrance lock 400ft. long by 80ft. wide, through which the largest steamers will be able to enter at from an hour to an hour and a-half after low water. This dock will be close alongside the Trunk Connecting Railway, and hydraulic lifts will be erected to raise coal from the ships into the railway trucks, the imports of coal at Dublin being very large. Although a metropolitan line, the new railway will be cheaply made, because it passes through much ground in the suburbs not much covered by building operations. When completed it will be to Dublin what the North London line would be to London did it cross the Thames at each end before terminating. The greatest gradients on the Dublin Connecting Railway will be 1 in 70, the greatest curves about fifteen chains radius, the gauge 5ft. 3in.—similar to the rest of the Irish system, and the length seven miles. By means of the new line, passengers arriving at Kingstown by the Holyhead steam packets will be able at once to proceed by rail to their destinations in other parts of Ireland, and the mail service will be considerably accelerated. Very much of the traffic of the existing lines in Ireland must of necessity pass over the new railway, which will besides have a local suburban traffic, analogous to that possessed by the North London. The deep water at all times of the tide of the Kingstown and Holyhead harbours is another feature in favour of the new line, as regards its cattle and mineral traffic, and the London and North-Western Railway Company warmly support the scheme. The contractors are Messrs. J. and C. Rigby, who undertake to complete the line for £37,000 per mile. It is expected that the railway will be finished in eighteen months or two years.

Commencement of the Forth Bridge.—This gigantic undertaking may now be said to have fairly commenced, and to have commenced under unexpected favourable circumstances. The construction of a pier near the middle of the Forth has been contracted for, and the contract has been entered into at a price no less than £8,000 under the estimate of the engineer. The pier, though not of the largest dimensions of those proposed, is upon a very great scale, and the foundation will be no less than 45ft. below the surface. The contractors are Messrs. Jilks, Wilson, and Co., of Middlesbro', an opulent and enterprising firm. The contract price is about £17,000, instead of £25,000 as estimated by Mr. Bouch. The pier will be finished by May next—a result in the matter of speed in construction of the adoption of the system of founding, without piling or cofferdams. This system, which has been recently applied by Monsieur Kalebot in the Garonne, on a great scale, with perfect success, proves to be a revival of an ancient method which was used in the construction of the old bridge of Westminster. In one important particular the plan adopted by Mr. Bouch differs from the method of the French engineer. In the lower portion Mr. Bouch uses green beech instead of iron. The durability of green beech—that is, of beech with the sap in the tree, and used immediately after being cut down—when constantly immersed in a river or sea, and used in a situation in which there is no substantial alteration of dryness and moisture, has been proved by the remarkable discovery of Mr. Edwin Clarke, that such wood in the Thames exists in a condition of the most perfect soundness for an ascertained period of at least 600 years. Iron, to a certain extent, used under such circumstances is liable to corrosion. The pier, when constructed, will be tested by an enormous weight of iron rails. Our readers may form some conception of the extent of the foundation of the pier when it is stated that it will occupy a space nearly equal to one half of Westminster Hall. The formation of the pier is proceeding in the harbour of Burntisland, from which at the proper time it will be floated to its position and sunk. Our arboricultural friends will be glad to learn that a new value is given to the beech by its probable extensive application in works to which it has not been applied for centuries. It is not a little singular that while it has been to a large extent superseded by iron in beetling works and machinery, and had thereby greatly lost its value, it is now in its turn superseding iron in the construction of river works.—*Railway News.*

The Manufacture of Coke from Small Slack in Staffordshire.—*(From a Correspondent.)*—The existence of immense quantities of fine coal slack in the South Staffordshire and other mining districts in a state almost, if not quite, commercially valueless, is a fact well-known to those acquainted with the coal and iron trades of this country. The fact that most of this slack, which has hitherto been considered waste, possesses all the chemical properties of the coals from which it is derived, has also been for some years forcing itself upon the attention of those interested and stimulating their efforts to recombine it as a fuel suitable for smelting and other purposes. The extensive use of coke in iron smelting and the advantages accruing therefrom, shows that the most obvious way of utilising this slack, viz., by converting it into coke, would also be the way of giving it the greatest possible value. The difficulties in the way of coking the Staffordshire slack arise from the fact that, although possessing the valuable properties for which Staffordshire coal is noted, it does not possess sufficient bituminous matter to cause it to cake or bind in the process of coking. The most successful method in coking the Staffordshire slack is found to be by mixing with it a certain portion of bitumen, in the shape of Welsh or other bituminous slack. The greatest difficulty at present experienced is with respect to the ovens, as in those hitherto in use the heat developed in the process of manufacture is not applied with an effect or uniformity sufficient for the thorough fusion of a thick mass of slack and the production of good hard coke. The charges are found to be caked only in layers at top and bottom, the interior of the charge being imperfectly fused and waste. With a view of remedying this defect in the process, Messrs. Hinchlin and Pardoe have produced an arrangement of ovens which has been employed with much success. The principle on which they are constructed is that of causing the flame and gases from each oven in a group to enter a common system of flues passing over and under every oven in the series, thereby causing a thorough intermixture of the gases, the development of intense heat and the application of the same in a more uniform and effective manner than hitherto, the coking chambers being, as it were, enveloped in fire. It is found that the ovens will thoroughly fuse and convert into best hard coke, thick charges of Staffordshire slack with a less proportion of bitumen than is used habitually. The charges are so thoroughly fused that they are drawn *en masse*, the doors being as wide as the ovens. Any one or more of the ovens in a series can be drawn and re-charged without interfering with the others, and the charge is immediately ignited by the heat of the contiguous ovens and upper and lower flues, and, in its turn, contributes to the general effect.

HOW FORTUNES ARE MADE IN THE OIL REGIONS.

OUR contemporary, the *Railway News*, contains a very interesting article on the oil regions of Pennsylvania, from which we make the following amusing extract:—

"It is not true that all persons connected with oil production are swindlers, or that everything connected with oil territory and oil wells is a swindle. The business is as legitimate in every respect as any other, and a large proportion of the men engaged in it are of the strictest honour and probity. But in oil mining, even more than in other kinds of mining, the door is open for various kinds of fraud, and there are always sharpers enough to take advantage of every opportunity. Every step in the process of oil mining has to be narrowly watched if the stranger does not wish to be victimised. Various artifices are resorted to for the purpose of getting up 'oil excitements' in new localities. Springs that for generations have yielded pure water suddenly become 'oil springs' by the judicious application over night of some crude petroleum. Sometimes a mistake is made, and the refined product is used in the 'doctoring' to the speedy discovery of the cheat. One ingenious speculator owning a tract of ravine where no oil deposit had ever been heard of buried over night a cask of refined petroleum in the bank and broke in the sides. The hole was filled up and the turf carefully replaced. Soon the oil exuded through the bank into a small stream, was accidentally discovered, and great excitement followed. A couple of speculators secretly dug into the face of the bank, and finding an increasing drip of oil bought the land at a high figure, and commenced exploring further. The pure quality of the oil was considered a great advantage, and a phial of it was taken to the professor of chemistry at a neighbouring college for analysation. The professor held the phial to the light, shook it, and solemnly twisted the cork around previous to drawing it out. *The cork squeaked.* The professor proceeded no further with his analysis, but gave his report in these few words: 'Gentlemen, you are *sold*.' The absence of lubricating property, evidenced by the squeaking of the cork, proved that the oil had been refined. The bank was dug further into, and the 'planted' barrel discovered.

"A story is told of a Western Virginia dame who threw some crude oil into a ditch with the intention of deceiving some speculators from the East. The bait took and the land was leased at a good figure. Strange to say, the lessees struck a flowing well, greatly to the disgust of the Virginian dame, who repented not having made a better bargain with her customers. An ingenious trick in connection with oil springs has been more than once practised in places where heavy oil gathers on the surface of the water in old salt wells. To show the thickness of the oil accumulated within a given time a long stick is pushed down and comes up smeared with oil, the extent of the smearing being supposed to show the depth of oil. A moment's reflection will show that as the oil lies on the surface of the water a thickness of the sixteenth of an inch will completely smear a stick six feet long if pushed down its whole length and brought slowly up. The device is very transparent, yet, in the excited state of an oil-seeker's mind it is rarely detected.

"When wells have been sunk and found unproductive there are various ways of concealing the truth and defrauding some unsuspecting stranger into a purchase. A common method is to slyly convey some crude oil into the well by night, and then pump it up in the presence of the stranger who is to be taken in. One of the most elaborate tricks of this character was perpetrated last spring at a well near Franklin. The well proving unproductive, the engine conveniently broke down, and several days were occupied in fixing it up. In the meantime the little almost inaccessible nook in which it was located was boarded off from the too curious public. A tank holding about one hundred barrels of oil was 'planted' in the ground, with a gaspipe leading from the tank to the well hole below the 'seed-bag,' where it was secure from observation. The oil flowed down the outside of the pump tube into the bottom of the hole, and was there ready to be pumped up. All being ready, the engine was set in motion, and the pumps brought up a good stream of oil. The news of the new 'strike' rapidly spread, and a crowd gathered. There was no mistake about it, the yield was steady and good. An offer was made to purchase the well at the then current rate, four thousand dollars for every barrel of pure oil yielded in a day. The offer was accepted, and the intending buyer, to prevent tricks, determined to watch the yield all day. The result was perfectly satisfactory, the engine worked steadily and the flow increased. The rate having been settled on at twenty barrels per day, the price was fixed at eighty thousand dollars, and paid on the spot. For two days longer the well yielded steadily, and then stopped. The tubing was drawn to refix the seed-bag, when the gaspipe was pulled up and the cheat discovered. A diligent search failed to bring the original owner of the well to light. He had business somewhere else.

"Another and very common way of deceiving an intending purchaser of a well is to 'pump by head.' The well is left idle until the time set for its being 'shown off.' Then the engines are set to work, and the accumulated oil is pumped up in a thick stream. As soon as signs of exhaustion appear the engine breaks down, and the 'test' ends. Oil well engines are perpetually breaking down. It is true this frequently happens with good wells, but with doubtful wells they break down at most opportune times to save the credit of the well.

"It is exceedingly difficult to get at the facts in relation to the yield of a well. Exaggeration is the rule, and from 25 to 50 per cent. should be deducted from nearly every statement as to the yield of a well. When first 'struck,' it is the usual practice to telegraph by one or other of the lines that cobweb the entire oil region that a one hundred, two hundred, or even an eight hundred barrel well has been struck, and, it is thought, will go even higher. Should it prove, as is likely, a failure, nothing more is heard by telegraph, and visitors are told 'she has not been tubed yet,' or that the engine has broken down. Should the well flow, or yield fairly by pumping, the product is systematically exaggerated, partly from intention and partly from the impossibility of ascertaining the exact amount, and the desire not to have the report err on the wrong side. The United States Revenue tax of one dollar per barrel on the actual yield has lately tended to moderate this exaggeration.

"A variation of the swindle based on 'planting' oil in a dry well was perpetrated in Michigan a few months since. An experimental well having struck nothing but water the proprietor purchased several barrels of crude oil in Canada, and had them sent to Detroit. Two barrels were diverted on their way, and carted in the night to the well, where the oil was thrown into the hole. Next day the pumping re-commenced, and a gush of valuable oil was the result. The engine broke down in a short time, was refitted, and another gush of oil followed. The news was spread by telegraph—such news always are—it was 'a hundred barrel well,' and crowds rushed to the spot to see the flow of oil. The well owner became exasperated by the crowd of visitors, and boarded up his well, admitting no one; but the eager listeners could hear the plashing of oil, and witnessed the preparations for shipping it to market. They rushed off to purchase or lease the surrounding lands, but found they had all been taken up by a stranger, who re-sold or re-leased them at an enormous profit. At last the fraud was revealed by the discovery of the destination of the two barrels diverted from the original route of shipment, an exposure followed, and the owner of the well disappeared. The purchaser of the surrounding lands also disappeared, and, for the first time, it dawned on the minds of the public that the two were acting in concert."

THE ISTHMUS OF PANAMA.—(*From our Correspondent.*)—The project of an inter-oceanic canal through the Isthmus of Panama appears to be again revived. At present, however, the overtures made in certain quarters do not appear to have proved very successful.

THE ALGONQUIN AND WINOOSKI.—The following correspondence on the subject of the Algonquin and Winooski trial has appeared in the *New York Semi-Weekly Times*:—"New York, Wednesday, October 4th, 1865.—Hon. Gideon Welles, Secretary of the Navy.—Sir,—I enclose the report of my engineer in reply to the published report of yours on the dock trial of the Algonquin. If its statements are true you and the public are grossly deceived by your report; if false, I am grossly deceived. The consequences are too important to the country and to me to permit the issue to pass unsettled. The records are in your possession, not mine; I request that they be examined, and one report or the other be proved. If your engineer's report is incorrect I presume you will not ask me to submit again to such treatment. The board of experts can easily settle it by inspection of the logs. If I had anticipated that my efforts to present to the United States more economical and better machinery would have been met with such opposition and obstruction as I have experienced I should not have undertaken the thankless service. The facts here presented by me, if true, must satisfy you that a trial at the dock for the purpose of forming an opinion as to the probable performance of a steamer when under way is wholly fallacious. A method which permits an official report to be made purporting to be the truth, which deprives one of the steamers of some hundreds of revolutions actually made by her, and of a large amount of coal actually saved by her, must of necessity be unfit and unfair. I now expect, as my right, that the Algonquin be permitted to exhibit her economy according to the plan of her construction, when using the power necessary for ordinary cruising speed. If the statements of my engineer, on whom I rely, are true, and I implicitly believe them, the facts are of the greatest importance to our country. On the 25th of August you sent me an official letter from the Bureau of Steam Engineering, in which your engineer-in-chief uses these words:—'My wishes from the first were to have a careful trial at the dock for economy of fuel, as that is really the foundation of your whole claims, and then a trial for a mere test of speed if you desire it.' This admits the truth. Economy of fuel is really the foundation of my claims. But no opportunity has yet been afforded me to show the economy which I wish to present, and every effort has been made to prevent the exhibition of that economy. It is absurd to pretend that a vessel prepared to go eight knots an hour, with 900 lb. of coal, should be compelled to burn 1,600 lb. per hour in order to show her economy! I feel that I have not been fairly dealt with, and I now appeal to you to decide whether or not I shall have the opportunity to show the economy of the Algonquin at eight knots per hour under way, or if you will not permit the trial to be made under way, then at the dock, each vessel receiving 900 lb. of coal an hour, and let the report state all the revolutions and account for all the coal delivered.—P. S. FORBES." —"Report of Mr. Dickerson to Mr. Forbes of the trial and its results.—New York, Wednesday, Sept. 27th, 1865.—Paul S. Forbes, Esq.—Dear Sir,—I have read the report of Mr. Isherwood's three engineers, Messrs. Danby, Fithian, and Kellogg, dated September 26th, addressed to the Secretary of the Navy, and published on the morning of the 27th. In this report it is alleged that, so far as the comparison went, the Winooski was in truth 231 revolutions ahead of the Algonquin, and it is claimed that she was her equal in economy. The report is a fraud upon you and upon the public; its object is to prevent the exhibition of the Algonquin's great economy. I predicted to you that this would be attempted when the accident to the Algonquin happened. The logs of the vessels kept by United States' engineers show the truth—which is, that at four o'clock on Friday both vessels, being under steam from a previous fire, began to receive 1,600 lb. an hour for a 96 hours' run. Up to eleven o'clock on Sunday night, the last count before the stoppage of the Algonquin, each vessel had received exactly the same amount of coal, viz., 88,000 lb. With this coal the Algonquin, at eleven o'clock, had made 47,454 revolutions, the Winooski 47,362, or 92 less (this count being subject to a trifling correction of two or three minutes for variation of clocks). Out of her coal the Algonquin had saved and piled up on the dock more than 2,500 lb. of coal, or enough to run her an hour and a half longer. The Winooski had saved nothing. If the vessels had been under way the Algonquin would have been 92 revolutions ahead in distance, and no juggle of arithmetic could have put her astern, or prevented her saved coal from carrying her sixteen nautical miles further ahead when she should burn it. The fraud by which at the dock the saved coal is annihilated, and the Algonquin is dragged astern, was perpetrated by suppressing from the account the first four hours of the log, during which four hours the Algonquin made about 300 revolutions more than the Winooski, and the Winooski took 3,000 lb. of coal more than the Algonquin, in violation of the regulations of the trial, and without notice to me. During the first twenty-eight hours of the run the Algonquin saved coal and piled it up on the dock. At eight o'clock on Saturday night she began to burn 1,600 lb. an hour, the Winooski doing the same; and for twenty-seven subsequent hours both vessels used the same hourly allowance. If any less time than the 96 hours is to be taken as a criterion, it should be that time during which both vessels were burning hourly the same amount of coal, *i.e.*, these twenty-seven hours. During these hours the Algonquin made upwards of 1,000 turns more than the Winooski, and was gaining at the same rate when she was stopped by the accident, and could have continued to do it indefinitely, notwithstanding the fact that her fresh-water supply condenser does not work at the dock, as you notified the navy department when you protested; and notwithstanding the fact that our wheels adapted to expansion and economy had been removed against your protest; and, more than all, notwithstanding the fact that we were required to burn about twice as much coal per hour as was necessary to drive the Algonquin eight knots an hour, and thereby were deprived of all opportunity to show the great economy of the Algonquin at this best ordinary cruising speed, and in disregard of the order of the Secretary of the Navy, which requires 'the trial to determine the relative economy of the power with each machinery operated to the best advantage for that purpose.' If you have any rights now is the time to assert them. You cannot expect any better treatment in the future than you have had in the past at the hands of those who, by a stroke of the pen, have annihilated your 2,500 lb. of saved coal and 300 of your revolutions actually made. The engine of the Algonquin is constructed to drive her eight knots an hour—a fast cruising speed, with an economy which cannot be equalled by any other war steamer in the United States; 900 lb. of coal an hour are sufficient for that purpose. I am prepared to prove this assertion by the demonstration of fact, and if I must I will show at the dock, disabled in condenser and wheels as she is, that my assertion must be true. Let the Winooski and the Algonquin have each 900 lb. of coal per hour (both having working boiler pressure to begin with), and the Algonquin will beat her forty per cent. in economy for ninety-six or any other number of hours. That the Algonquin can do this I pledge myself to you and to the public, and I rely upon your obtaining the opportunity. Further, the Algonquin and Winooski under way, and both carrying the same number of tons weight, in addition to their machinery, the Algonquin will go as fast as the Winooski, and as far, notwithstanding the fact that the Winooski has twenty-seven per cent. larger engine, fifty per cent. more grates, and nearly three times as large boilers. It should be known to the public that the Winooski is contending against the Algonquin by the use of the Algonquin's principles. She uses an independent cut-off, and expands her steam three times at one end of the cylinder, and twice at the other. You asked that the cut-off of the Winooski should be set at six-tenths, the point beyond which Mr. Isherwood says there is no economy. This request was refused by Mr. Isherwood. None of the naval vessels proper built under Mr. Isherwood's theory have any independent cut-off. The economy of the Winooski, cutting-off as she does, is sixty per cent. greater than that of the naval vessels without an independent cut-off. The gratuitous accusation of complexity made by Mr. Isherwood's engineers is answered by the fact that valve gear of precisely the same construction has been running with great success for a long time in many steamers, among them the Moro Castle, and no one of them, to my knowledge, ever failed.—EDWD. N. DICKERSON."

NOTES AND MEMORANDA.

THE density of Jupiter is 1·37 times that of water.

WE had no copper coinage in this country until 1610.

THE temperature of the lime light is estimated at 2,000 deg. C.

FLORINS were first coined at Florence, and guilders were silver *gilt*.

ATHELSTAN, in 928, first established an uniform system of coinage in England.

A PERSON at the equator is carried round with a velocity of 1,000 miles per hour.

IN 1604, nearly 3,000 oz. of Welsh bullion were minted at one time in the Tower.

THE roaring of the volcano of Coseguina was heard at San Salvador, a distance of 1,000 miles.

THE first engine erected in London by Watt, was for a Mr. Goodwynne, who used it for brewing purposes.

A CANNON BALL, moving at the rate of 500 miles an hour, would take 91,000 years to travel from Saturn to the sun.

M. SAVART discovered that the human ear can appreciate a sound of only the 24,000th part of a second duration.

THE ancient silver penny was marked in the form of a cross, and thus was easily broken into a half-penny and farthing.

THE cow eats 276 plants and rejects 218; the goat, 449 and 126; the sheep, 387 and 341; the horse, 262 and 212; the hog, 72 and 171.

FOR every pound of water vapourised by the sun's heat at the equator, a quantity of heat has been expended sufficient to raise 5 lb. of cast iron to its melting point.

THE most ancient clock with wheels and balances mentioned in history, was constructed in England, by Richard Wallingford, Abbot of St. Alban's, who lived in 1326.

IN the reign of Edward I. 1,600 lb. weight of silver was obtained, in the course of three years, from a mine in Devonshire which had been discovered in the beginning of this reign.

THE first balloon ascent, in Scotland, was made by M. Vincent Lunardi, in November and December, 1785. He twice ascended from Heriot's Hospital-gardens, in Edinburgh.

THE Cardiganshire mines yielded, in the time of Charles I., 80 oz. of silver in every ton of lead, and part of the king's army was paid with this silver, which was minted at Shrewsbury.

1,000 parts of wheat yield 740 parts of starch; of barley, 790; of rye and oats, 640; of peas, 500; of beans, 420; of potatoes, 160 to 200; of beet, parsnips, carrots, &c., under 75; grasses, from 65 to 20.

IF the orbit of the moon, which measures 474,000 miles in diameter, were filled by a sun, such a sun might be placed within the actual sun, leaving between their surfaces a distance of 200,000 miles.

THE first known account of an air gun is in the "*Elemens d'Artillerie*," of David Rivaut, who was preceptor to Louis XIII. He ascribes the invention to Marin, of Lisieux, who presented one to Henry IV. of France.

IT is calculated that, for every million of pounds of raw silk produced in France, 250 million pounds weight of leaves are consumed, and that 5 million trees, of the average age of thirty years, are stripped to furnish them.

SIR HUGH MYDDLETON is said to have cleared £2,000 per month from the silver obtained from his lead mines in Cardiganshire, and to have been enabled thereby to undertake the great work of bringing the New River from Ware to London.

IF the whole earth's orbit, measuring nearly 200 millions of miles in diameter, were filled with a sun, that sun, seen from Saturn, would be only about twenty-four times greater in its apparent diameter than is the actual sun seen from the earth.

THERE were issued by the British Government, between the years 1803 and 1816, 3,227,716 muskets, 118,103 carbines, 27,895 rifles, and 203,266 pistols. In 1815 there were, at one time, 1,000 muskets per diem manufactured in Birmingham.

MOST of the great glaciers in the Alps have, in summer, a central velocity of two feet a day. There are two points on the Mer de Glace, opposite the Montonvert, which have a daily motion of thirty inches in summer, and in winter have been found to move at half this rate.

THE wood of trees which have grown on mountains, under the same conditions, is more compact than that grown in plains; the wood of closely-grown trees is more compact than that of isolated trees; and the compactness appears to increase in proportion to the dryness of the soil.

A MINT for the coinage of Welsh silver was established previous to the reign of Charles I., at Aberystwith. The indenture was granted to Thomas Bushel for the coinage of half-crowns, shillings, sixpences, twopences, and pennies, all of which were to be stamped with the ostrich feathers on both sides.

THE English silver penny of Edward III. was ordered to weigh thirty-two wheat grains from the middle of the ear; twenty of these pennies were to weigh an ounce, and twelve ounces a pound; eight pounds were to be equivalent in weight to a gallon of wine, eight such gallons to a bushel of wheat, and eight bushels a quarter.

WERE Jupiter to fall into the sun it would evolve by the shock as much heat as the sun would in 32,240 years; and were its rotation stopped by means of a brake, the heat of rotation would be equal to the solar emission for a period of 14 years 144 days. Were the sun itself stopped in the same manner the emission of heat would equal 116 years 6 days expenditure.

THE first invention of the process of procuring alum by artificial means is not known, but it appears to have originated in the East soon after the twelfth century. In the fifteenth century there were alum works at Constantinople. The first alum works in England were established at Whitby, by Sir Thomas Chaloner, who was excommunicated by Pope Pius II. for so doing, His Holiness having assumed the right of exclusively supplying Europe.

MR. SMYTH stated that we dig annually 84 millions of tons of coal from our pits. The combustion of a single pound of coal, supposing it to take place in a minute, would be equivalent to the work of 300 horses; and if we suppose 108 millions of horses working day and night, with unimpaired strength, for a year, their united energies would enable them to perform an amount of work just equivalent to that which the annual produce of our coal-fields would be able to accomplish.

TIDES are affected by the state of the atmosphere. At Brest the height of high water varies inversely as the height of the barometer, and rises more than eight inches for a fall of half an inch of the barometer. At Liverpool a fall of one-tenth of an inch of the barometer corresponds to a rise of the Mersey of about an inch; and at the London Docks a fall of one-tenth of an inch corresponds to a rise in the Thames of about seven-tenths of an inch.

ACCORDING to Professor Tyndall 474,439,680,000,000 of waves of light enter the eye in a second of time to produce the impression of red colour. To produce the impression of violet a still greater number of impulses is necessary; it would take 57,500 waves of violet to fill an inch, and the number of shocks required to produce the impression of this colour, amounts to 699 millions per second. The other colours of the spectrum rise gradually in pitch from the red to the violet.

WEBSTER, in his "History of Metals," published in 1671, makes mention of two places in the West Riding of Yorkshire, where formerly good argentiferous lead ore had been procured. One of the places was Bronghite Moor, in the parish of Slaidburn; the ore held about the value of 67 lb. of silver in the ton; the other place was Skelhornfield, in the parish of Gisburn; it had formerly belonged to a person of the name of Pudsey, who is supposed to have coined it, as there were many shillings in that county which the common people called Pudsey shillings.

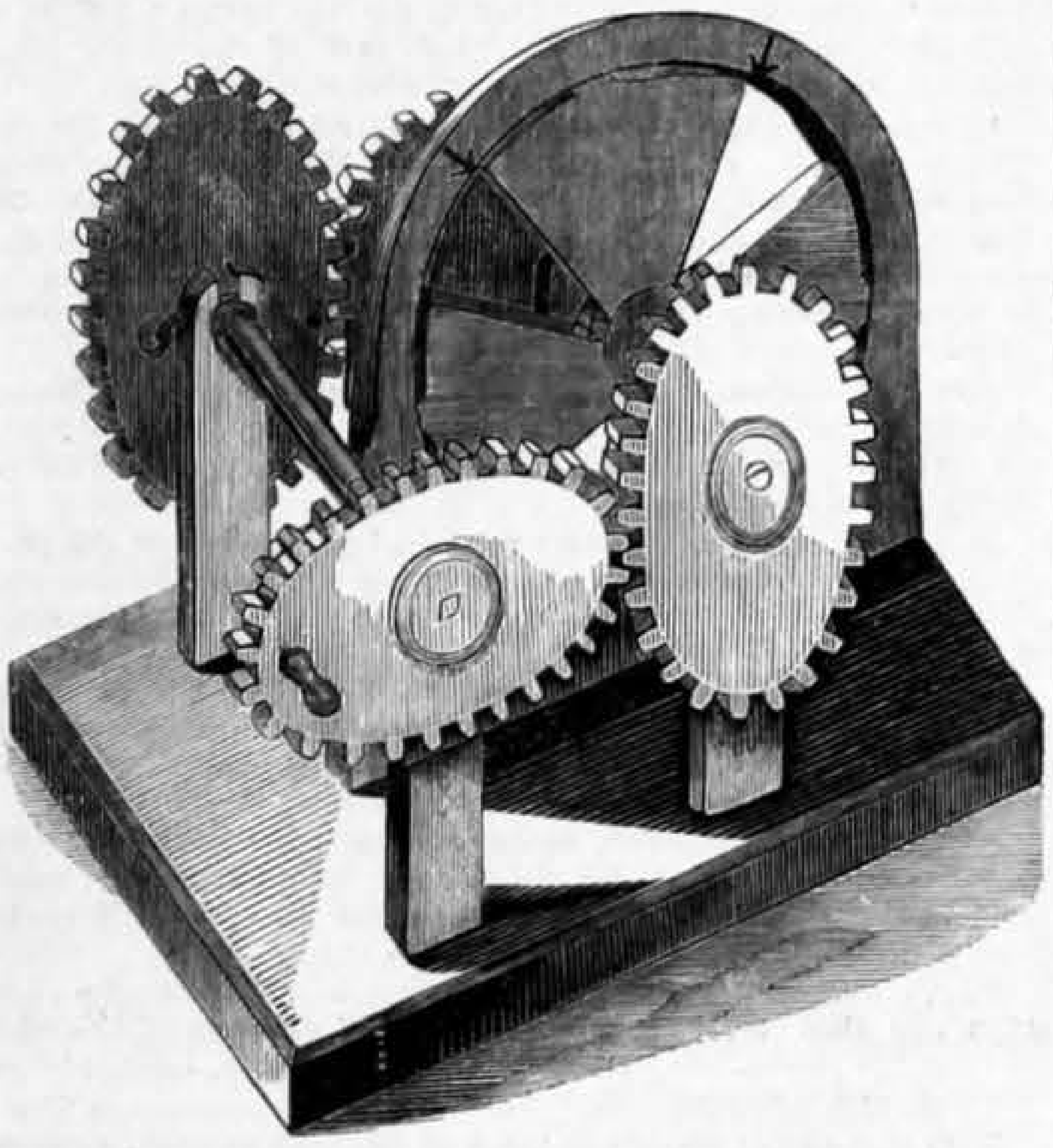
DESCRIPTION OF A ROTARY STEAM ENGINE.*

By R. W. Thomson, C.E., F.R.S.E., Edinburgh.

In bringing before your notice a new steam engine, I feel that the moment I state that it is a rotary engine to which I wish to draw your attention a strong prejudice will at once be excited against it. It must be confessed that the innumerable failures of engines of this kind almost justify practical engineers in the belief, which has become pretty general amongst them, that a good rotary engine is an impossibility. I will not occupy your time in describing any of the attempts hitherto made to construct rotary engines, nor will I explain the causes of their universal failure. I will state as shortly as possible the essential differences between this engine of mine and all its predecessors.

All the rotary engines hitherto proposed, with a few exceptions which need not be noticed, have been constructed with a cylinder having a body of some shape or other, revolving in it eccentrically. The revolving body, or piston, generally touches the inside of the cylinder at one side, and being smaller than the cylinder it leaves space on the opposite side in which the steam does its work. To enable the steam to act on the revolving part of the engine, a steam stop or abutment is necessary, and herein lies the fatal obstacle to all the rotary engines hitherto brought under the notice of the public. This steam stop or abutment must get out of the way at every revolution of the engine. As one of the principal advantages of the rotary engine over the reciprocating form of steam engine lies in the much greater speed of the former, it is essential that the steam abutment moves out and in with a rapidity greatly exceeding that imposed on any part of a reciprocating engine.

Great mechanical ingenuity has been displayed by many inventors in trying to overcome the difficulties of the steam abutment and its rapid movements. Sometimes the stop is a fixture, but this only throws the movement on the vane or piston. They must pass each other, and it matters very little which gives way to the other, whether the stop or the vane on which the steam presses has to give way; the mechanical difficulties arising from the extreme rapidity of movement are quite fatal.



No perfection of workmanship would keep in a steam-tight state any kind of rotary engine having either a movable steam abutment or a movable vane or piston, that is to say, having, in addition to their revolving movement, another movement towards and from the centre round which they are revolving.

I believe that this double movement of the parts of rotary engines, viz., a simultaneous movement round an axis, and a reciprocating movement towards and from that axis has been the bane of all rotary engines without any exception. They have all had this fatal compound movement of parts within the steam-tight portion of the machine.

There is also an insurmountable difficulty in the packing of all rotary engines in which the axis of the moving part of the engine is eccentric to the cylinder in which it is revolving, arising from the fact that the convex curve of the packing strips and the concave curve of the inside of the cylinder cannot possibly coincide unless the packing is allowed to rock on its seat, and that is practically impossible; the result is that the packing strips bear only along a line against the inside of the cylinder, and the wear necessarily becomes so excessive that they soon cease to be steam-tight.

In the engine I now bring before you all the difficulties arising out of the use of a steam stop or abutment are got rid of, simply because I dispense with the steam stop or abutment entirely; and, further, I get rid of the difficulty of keeping the packing steam-tight, from the fact that the packing strips have the same curvature as the inside of the cylinder, and they bear equally and steadily against it in the same way as packing of an ordinary piston does. I have laid on the table two sheets of drawings, with a printed description of my rotary engine, but as its movements are very difficult to comprehend I have had those two wooden models made so as to exhibit its movements. They are simply moving diagrams, and I think they will enable you to form a clear idea of the principle of my engine.

You will observe that the pistons or vanes revolve round an axis which coincides with the axis of the cylinder in which they revolve. In this model there are two double pistons. The steam is admitted between them on opposite points, and at first sight it may appear that the steam would force the two pistons with an equal power in opposite directions—indeed, several makers of steam engines to whom I have shown this engine are quite unable to comprehend why it goes at all. They see that the pistons or vanes are all of the same area, and that the steam, when admitted between them, will necessarily press one backward with as great a force as it presses the other forward. They are unable to see wherein the power of the engine lies from overlooking the fact that the vanes do not travel with equal speed. The number of pounds of pressure is equal in forcing one vane forward to that keeping the other from following it, but the following vane does not travel so far as the leading vane does. It is obvious that if two vanes or pistons have an area of, say 10in., each acted on by steam of 100 lb. pressure per square inch, the total pressure on each vane will be $10 \times 100 = 1{,}000$ lb., and that if one vane moves through a space of 8in. while the other moves through a space of only 4in., the first will exert twice as much power as the second. Now this is what happens in the movement of my engine. The leading vane always travels further than that following it, and the difference of travel is the available power of the engine. I have got rid of the insuperable difficulty of a steam stop or abutment by using two pistons, one of which, while travelling slowly, forms an abutment until the other piston overtakes it, when an interchange of functions takes place. It is impossible to get the working vane or piston past the abutment without removing the latter out of the way, and this involves an amount of mechanical complication that has been fatal to a great many rotary engines. In my engine the difficulties arising from the use of a steam stop do not exist, because I do not use a stop at all. The pistons themselves are made to move with a varying velocity, in such a manner that the one piston which is moving slowest acts as a steam stop to the one moving faster. Each piston in turn lags behind a little, so as to let the other run away, and then the slow moving vane increases its speed while the other lessens its velocity, until the fast moving one is overtaken, and then it runs away again; and so they go on chasing each other round, always in the same direction, but with a systematic variation in their velocities which results in their approaching and receding from each other twice in each revolution through an angle of 45 deg. This variation in the velocities is most simply produced by the use of toothed wheels of an elliptic form, as in this model or moving diagram now on the table. I need not occupy your time by reading the description of the mode of forming the curves on which those wheels are constructed.

In this other model two single pistons only are used, and the variation in their velocities is produced without the use of toothed wheels. It is effected by connecting the axis of the pistons by means of cranks and short connecting rods to a wheel, the axis of which is eccentric to the axis of the cylinder.

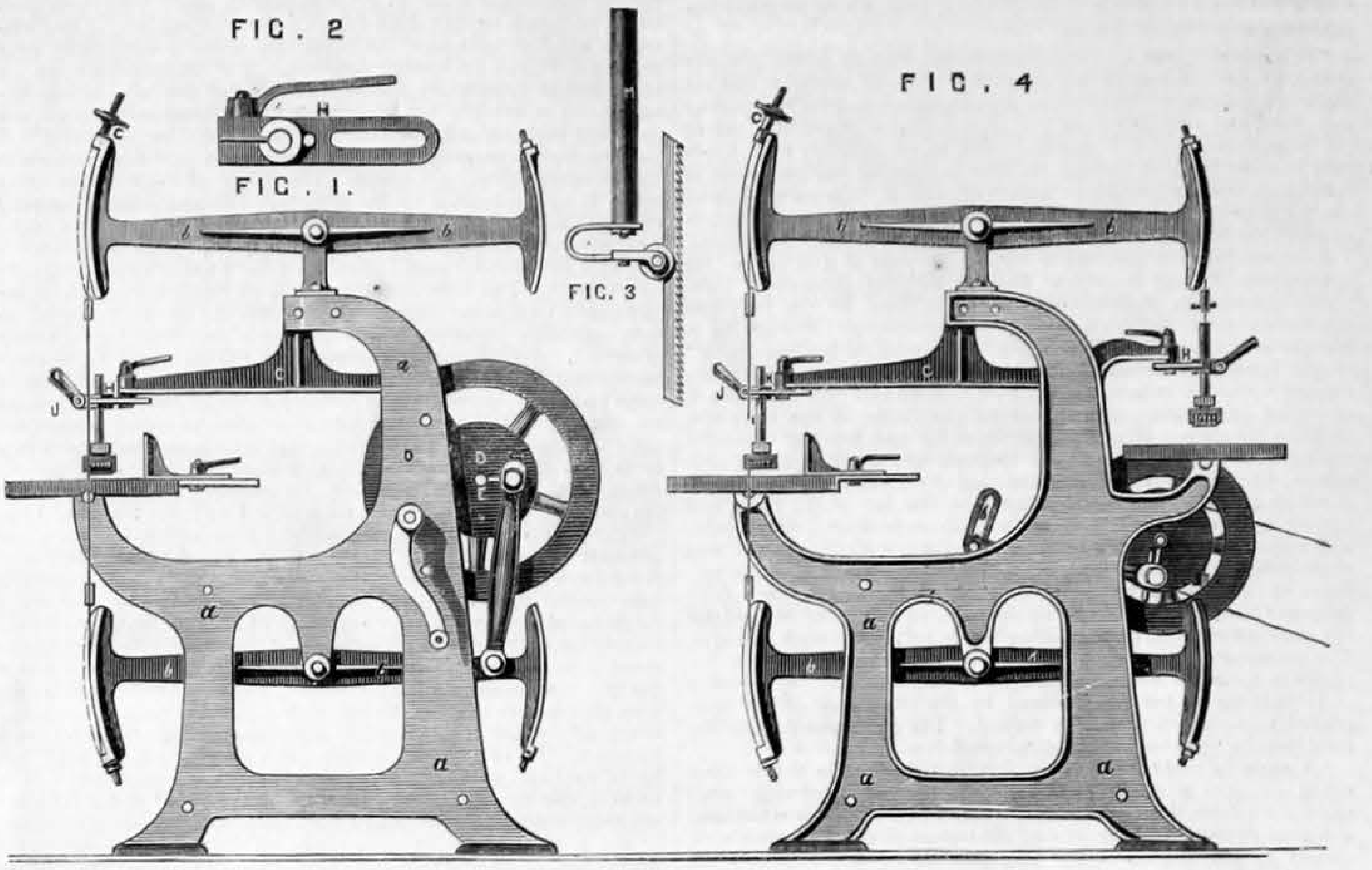
The principle of the engine is the same, but the mode of making the pistons vary in their velocities is different. There are other modes of producing this variation of velocity, but it is sufficient to describe the two modes represented by the models on the table. It will not fail to be observed that the model with the elliptic toothed wheels is perfectly balanced in all its moving parts, and that not by adding balance weights to any part of the machine. It is perfectly symmetrical, and is in itself so completely balanced that however high its velocity it has no tendency to shake. This engine has no valves nor eccentric gear of any kind. It possesses peculiar facilities for reversing; all that is required is simply to change the steam from the one port to the other, when the engine will at once reverse its action. It can also be arranged to work expansively without anything more than leaving the leading edges of the pistons full so as to cut off the steam at any part of the stroke desired. We cannot, however, get a variable expansion without some further appliances, which, however, are far less complicated than those required in the ordinary reciprocating steam engines.

The numerous advantages of this rotary engine need not be insisted on, and the experience we have had in the few engines already made justify me in believing that for many purposes it will supersede the ordinary form of steam engine. For cranes, hoists, and all similar purposes, for driving, thrashing, and other machines requiring a high velocity, for screw propulsion, and finally for locomotives, it possesses special fitness.

This engine, when manufactured under the same advantages as those under which the common engine is now produced, will be turned out at a cost not half the cost of an ordinary engine. I have here in Birmingham a portable engine, which will be in operation during this and the following days, at the works of Messrs. Street, where those of you desirous to see it at work will have the opportunity of doing so. Gas exhausters constructed on this principle act with an efficiency exceeding that of any of the machines hitherto in use for gas exhausting. One has been in operation at the Edinburgh and Leith Gas Works for some time. It goes with much less power, and discharges a much greater percentage of gas than any of the machines hitherto used for that work.

* Read before the British Association.

MATHERS' SAWING MACHINERY.



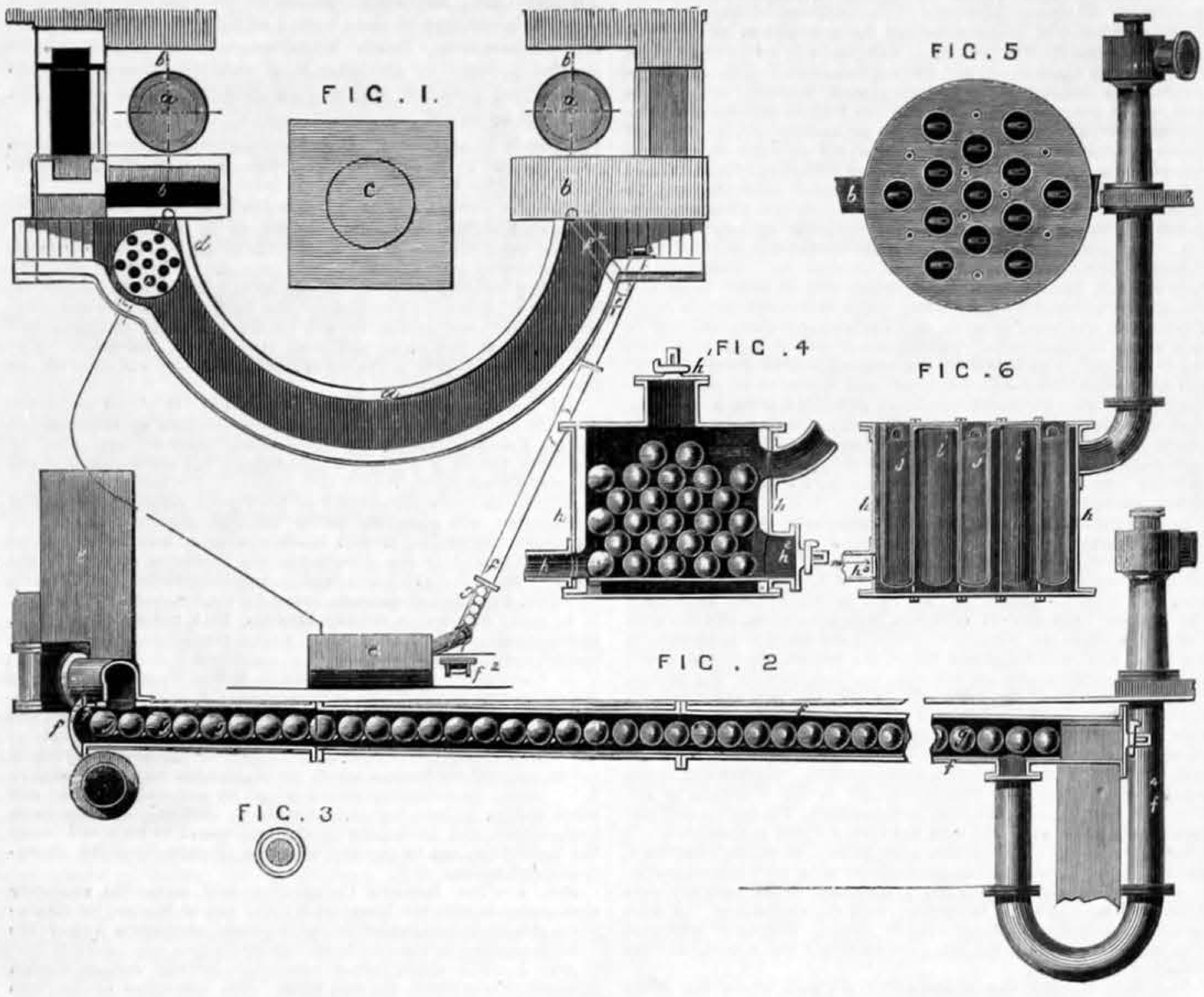
MATHERS' IMPROVEMENTS IN SAWING MACHINERY.

This invention, patented by Robert Mathers, Leeds, has for its object improvements in sawing machinery. For these purposes the ends of a narrow saw are fixed to the ends of two flexible bands which respectively are attached to two levers having curved ends corresponding with the radii from the centres of the axes on which the levers vibrate. The upper (or it may be either) of these bands is capable of adjustment in order that the saw may be kept at the proper tension. The back ends of the levers are formed with similar curves, and they are connected together by a metal band, by preference of steel, the tension on which is capable of being adjusted. The upper part of the framing which supports the carriage or bearing of the upper lever comes forward or overhangs the lower part, so that the largest space may be obtained for the table and for the work placed thereon when using a given length of lever. The saw, as heretofore, works through the table, and the work is held down on the table by means of a presser rod having at its lower end a presser, consisting of a series of discs with rounded edges on an axis, a space being left between the central discs to admit of the saw working between them. The presser rod is carried by an arm fixed to the framing, and the socket of the rod is made capable of adjustment at the end of the arm which carries it. Motion is communicated to the levers by means of a connecting rod, one end of which is pin-jointed to one of the levers and the other end is connected to a crank pin which is arranged to slide to and from the shaft or axis on which the face plate or disc is affixed. On the shaft or axis which carries the disc or plate is a fly wheel, and the shaft or axis receives motion from a steam engine or other power or by a crank handle worked by manual power, in which case gearing or chain and chain wheels is or are applied between the crank handle and the fly wheel shaft. In some machines the ends of the levers are connected by two saws and straps, and two tables for work are used.

Fig. 1 in the accompanying engraving shows a side elevation of a machine having these improvements applied thereto, which machine works with only one saw which is kept stretched between the front ends of the two levers *b*, *b*, the axes of which turn in bearings carried by the framing *a*, *a*, the other ends of the two levers are connected by a flexible band which is by preference of steel. The curved front ends of the levers *b*, *b*, have flanges, as shown by dotted lines. The tension of the saw is capable of being adjusted as shown, and there is a spiral spring at *c* to impart elasticity; D, D, show the pitch lines of two spur wheels which are used when the machine is intended to be worked by hand, but when a machine is to be driven by steam or other power a fast and loose pulley are applied on the shaft E; on the shaft E is a stud plate, the stud or crank pin of which is capable of being adjusted to and from the shaft E. Motion is given to the lower one of the two levers *b*, *b*, by means of a connecting rod L, and the upper lever receives its motion from the lower one by the saw and the metal; G is a projecting arm which is supported by and is fixed at its back end of the framing of the machine; M is a presser rod, which is carried by the front end of the arm G, and its position is capable of adjustment as shown at Figs. 2 and 3, where the parts are drawn on a larger scale. At the lower end of the presser rod M is a bent spring, which carries a horizontal axis on which are several circular discs which press on the upper surface of the work which is on the table. The presser rod is held by and adjusted in the holder H, and is retained in position by the screw and handle *g*. The holder H is secured to the front end of the arm G, and is adjusted by a similar screw and handle to those just described; the saw works between two of the discs, as shown in Fig. 3. When desired, a machine is, according to this invention, arranged to work with two saws, one at each end of the two levers *b*, *b*, as is shown in the side elevation, Fig. 4; in this arrangement it is convenient to connect one end of the connecting-rod to a slotted arm b^1 on the lower lever *b* as is shown. The parts of this machine being marked with the same letters of reference as are used to indicate the same parts in the machine as shown in Figs. 1, 2, and 3, and as such parts are combined and worked in like manner to what has been already explained, no further description will be necessary.

Marine Engineering in the States.—The Naval Bureau of steam engineering in the States is determined not to get on too fast under Mr. Isherwood's rule. Few engineers of eminence in this country would think of putting full powered geared engines into a ship of 3,000 tons burthen. They do strange things in America, however, as will be seen from the following description of a new American ironclad, extracted from a New York contemporary:—"Neshaminy, screw, 17, was to be launched at the Philadelphia Yard on Thursday. She is a sister ship to the Ammonoosuc, and was built from drawings furnished by the Bureau of Construction. She is one of the sharpest propeller war vessels in the world, and if there is anything in the model, she has all the qualities of the fleetest ship ever built. If she fails in speed it will be the fault of her engines. This vessel, with those of her class, have been designed and constructed with a view of making speed the paramount object. The dimensions of the Neshaminy are as follow:—Length between perpendiculars, 335ft.; over all, 354ft.; extreme beam, 44ft. 6in.; length of hold, 22ft. 10½in.; tonnage, old measure, 3,212; new measure, 2,019; displacement in tons, 3,998; space occupied by boilers and engines, 172ft.; coal capacity on back deck, 475 tons, and 525 tons in the hold. Her armament will consist of 16 broadside guns 10 and 11-in. calibre, and one rifle pivot on the forecastle. The engines of the Neshaminy are being constructed and compiled by John Roach and Son, at the Etna Ironworks in New York. They are designed by Mr. Isherwood, and consist of a pair of geared engines of 100-in. cylinders and 48in. stroke of piston, geared to the propeller shaft in the proportion of about two to one. They will have double ported slide valves, cutting off at two-thirds of the stroke or less, as required, by the well-known link motion. She will have one of Sewell's surface condensers, containing 7,168 seamless brass tubes. The pistons are intended by the designer to make 45 double strokes per minute, with a maximum pressure of 40 pounds of steam. She will have eight main and four superheating boilers, all horizontal tubular, having a total grate surface of 1,128 square feet; total water heating surface 28,300 square feet, and a total steam superheating surface of 2,848 square feet. She has the largest pair of geared engines for driving the propeller in the world, and they are without precedent. The total length of the gear-wheels from outside to outside is about 13ft., making 9ft. length of teeth. The propeller shaft which carries the pinions is supported by three bearings, cast on the top of the engine frames. These bearings are each 4ft. long. The engine shaft which carries the large gear wheels is supported by four bearings, each 4ft. long also. The bilge pumps and the application of the injection for freeing the dip (bilge?) in case of leak are of the most perfect and reliable kind. The screw propeller will be four-bladed, fixed and disconnected at will by means of a disengaging clutch. It will be 18ft. diameter, and 25ft. pitch. With 45 revolutions of the main shaft it will be seen that the propeller shaft will have about 90, which, with a fair allowance for slip, say 15 per cent., will, it is calculated, give a speed of upwards of 18 knots. It remains to be seen, however, whether this number of revolutions can be attained. It may be remarked here that Mr. Isherwood, in his letter to the Secretary of the Navy on these sloops, states that the maximum speed will be 15 knots. The construction of the machinery is superintended by chief engineer John H. Long, U.S.N. Mr. W. L. Hanscom, naval constructor, late of the Boston Yard, superintends the launch." Mr. Isherwood is evidently of opinion that the only thing necessary to speed is to make the screw run fast enough, and this, of course, is merely a question of gearing. While he was about it he should have run the screw three times as fast as the engines, and so made 22 knots or thereabouts.

RAMSBOTTOM'S MANUFACTURE OF STEEL AND IRON.



This invention, patented by Mr. J. Ramsbottom, engineer, Crewe, is applicable to the manufacture of steel and iron by the atmospheric process commonly known as the Bessemer process, and as described in the specification of letters patent granted to Henry Bessemer on the 12th February, 1856, No. 356, and it consists in certain improved apparatus for heating atmospheric air or other gases before they are forced through the liquid metal in the converting vessel. The apparatus for heating the air or other gases may be constructed as shown at Figs. 1, 2, and 3, in the accompanying engraving.

Fig. 1 is a plan of part of an apparatus for converting iron into steel according to the Bessemer process above referred to.

a, a are sections of the converting vessels, which oscillate on the centres indicated by the dotted lines *b, b*; *c* is the foundation plate of the crane for supporting the ladle by which the molten metal is poured into moulds ranged around the semicircular wall *d*; *e* is the chest containing the valves for regulating the blast, and *f* is the series of pipes for conveying the blast or compressed air forward to the converting vessel. This pipe the patentee now proposes to make of about twice the area of the pipes hitherto employed, in order that it may afford room for the heated spheres *g*, which are supported on rails f^1, fixed in the pipes, as shown best in Figs. 2 and 3. Each end of the pipe *f* is closed with a lid, and the lower end, or that near the converting vessel, is provided with a stop block to prevent the spheres injuring the lid f^3. This end of the pipe *f* is connected to the trunnion of the converting vessel by the syphon pipe f^4. During the melting of the metal for conversion, the spheres are being heated by the waste heat from the melting furnace, or in a suitable oven provided for the purpose, and just before the metal is run into the converter the spheres are run from the oven upon suitable ways to the end f^2 of the pipe *f*, and are thence passed forward into the pipe *f*, the lid f^3 having been previously secured to the other end of the pipe; the lid f^2 is then secured, and the blast, in passing through the pipe *f*, becomes heated to the required extent before entering the converter. The relation between the heating surface and the quantity of heat contained in the spheres may be varied at pleasure, either by altering the diameter of the spheres or by making them hollow. When the blowing is completed the lid f^3 is removed, and the spheres are allowed to run out, or are blown out of the pipe *f* into a box, in which they are taken to the oven to be re-heated for further use. It is evident that the same spheres may be used for heating the blast of any convenient number of converters. The pipe *f* may be lined with fire-bricks or other non-conducting substances, so as to prevent loss from radiation and reduce the disturbances arising from expansion and also the reduction in the strength of the pipe from excessive heat, when the temperature of the air is required to be very high.

Fig. 4 represents a modification of the improved heating apparatus. *h* is a vessel lined with fire-brick or other non-conducting substance. At the top of the vessel is a manhole provided with the lid h^1, and at the bottom is the opening h^2; h^3 is the pipe for admitting the blast to the vessel *h*, and h^4 is the pipe in communication with the trunnion of the converter. The spheres similar to those shown in the pipe *f* having been heated, are allowed to drop into the vessel *h*, the lining of the lower portion of which is protected by a metal plate or by pieces of broken fire-brick, or tap cinder, or other suitable material. The blast becomes heated in passing through the spaces between the spheres.

In Figs. 5 and 6 the blast is heated in passing between the metal tubes *i*, which are secured by flanges or otherwise to the top of the vessel *h*. The tubes *i* are heated by the heaters *j*, which are lowered into the tubes previous to or during the time that the blast is being admitted to the vessel *h*. The top and bottom of the vessel are held together by vertical stays to resist the internal pressure of the blast, or the tubes may serve as stays by connecting the lower ends to the bottom of the vessel. In this case the heat is conducted through the metal of the tubes, and the heating surface is therefore less effective than when the heat is applied direct as before described. To compensate for this the surface of the tubes is made proportionately greater. It is preferred to make the cylindrical tubes *i* of cast iron, as the pressure is external, and this metal is comparatively strong to resist compression when heated.

The modes above described of constructing the improved heating apparatus are only given as illustrations of the mode of heating air under considerable pressure, and may be considerably modified, as, for instance, more than one line of spheres may be placed in the pipe *f* above described, or more than one pipe with spheres or other heaters may be used, or the heaters may be cylindrical or of any other form that can be conveniently introduced; or in the apparatus shown in Figs. 4, 5, and 6, ingots from a previous cast may be used as heaters, either by being placed in the vessel *h*, Fig. 4, or in the tubes *i* in Figs. 5 and 6.

This invention also consists in forcing into the converter, along with the atmospheric air or other gases, carburetted hydrogen gas, or ordinary illuminating gas, in about the proportion of one part of the carburetted hydrogen gas to thirty parts of atmospheric air, to eliminate sulphur and phosphorus from the converted metal; the object being also to render available certain descriptions of iron which, owing to the presence of these elements, cannot now be treated by the Bessemer process.

The patentee does not limit himself to any fixed proportions of carburetted hydrogen gas to atmospheric air, as these must vary according to the quality of the steel and iron under operation. It is, however, evident that the proportion of carburetted hydrogen gas to the atmospheric air must not too nearly approach the point at which the mixture is explosive, such point being one of carburetted hydrogen gas to seven or eight of atmospheric air.

The introduction of carburetted hydrogen gas along with atmospheric air has the effect of eliminating the greater part of the sulphur or phosphorus which the metal contains in the shape of sulphuretted or phosphoretted hydrogen.

It is to be understood that hydrogen gas alone, or mixed with carburetted hydrogen gas, may be used for the purpose and in the manner above described.

RECENT RESEARCHES IN ELECTRICITY.

During the present year much of the time of the Academy of Sciences at Paris has been occupied in the attempt to discover both the causes and cure of the cholera and silkworm disease. At the same time, in the course of that period, much that is new in electrical science has had its share of attention. The production of thermo-electric currents and the electrical properties of mineral waters have been noticed, but these present few features of practical value. M. Martin has brought forward a curious theory as to what electricity really is, and how it is connected with the other imponderable bodies, heat and light. M. de la Rive also has communicated to the Society some new experiments of his own respecting the passage of electricity through metallic vapours, and M. du Moncel has made known a new and extraordinary method of constructing electro-magnets, a method which promises to be of commercial value.

Electricity is usually considered as an immaterial force. The new theory of M. Em. Martin is that—1. The two electricities are not forces, but simple bodies endowed with chemical properties, in virtue of which they enter into combinations with simple ponderable bodies. 2. The two electricities of the galvanic battery are not engendered by physical action, but by chemical action of the ponderous bodies holding them in combination, which bodies, by uniting with each other, put the electricities at liberty. 3. That these same electricities, conveyed by conductors and passing through the voltameter, take direct participation in the action produced, and enter into chemical combination with the elements which they separate. M. Martin says that there is nothing vague or uncertain in this theory. The electricity entering the voltameter by one wire has a greater affinity for the hydrogen of the water, and the one entering by the other wire has a greater affinity for the oxygen. Chemical decomposition consequently takes place, and hydrogen and oxygen gases are produced, each combined with a definite quantity of electricity. Thus the decomposition of water by electricity, which all the world has practised for sixty-five years, is explained in the most simple manner.

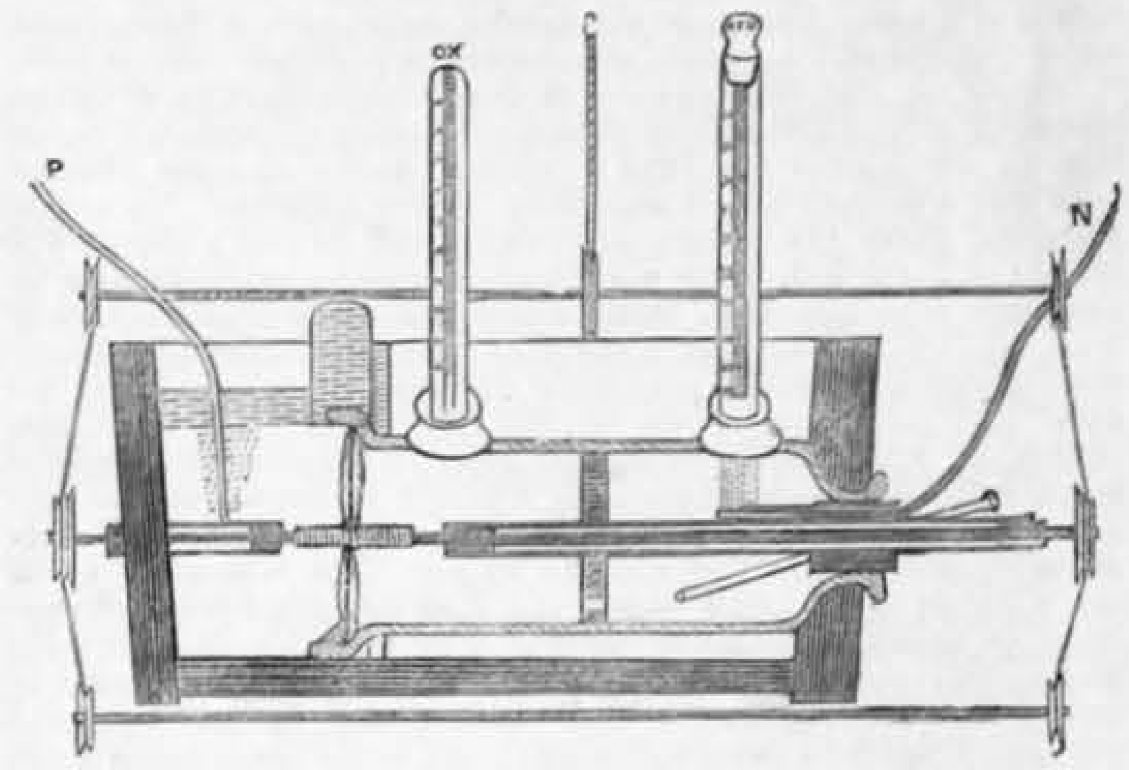
With equal simplicity and clearness M. Martin says that the electricities must be separated from each other before they will decompose any liquid through which they pass. To bring the two electricities into electro-chemical formulæ he gives negative electricity the symbol El, and positive electricity the symbol Et. It follows then that the formula for hydrogen is HEl, and that of oxygen OEt. When these two electricities unite with each other they, according to M. Martin, form caloric C*, and light L*, the liberated oxygen and hydrogen uniting to form water. The decomposition thus produced is represented by the following formula:—

$$\text{HEl} + \text{OEt} = \text{HO} + \text{El} + \text{Et}.$$

So also, if the currents be allowed to unite in a helical wire, the union of El with Et will produce an equivalent of caloric equal C*. While in the combustion which takes place when one atom of hydrogen gas is united to one atom of oxygen gas, the same atom of caloric C is produced. Thus the two electricities unite with each other, as well as ponderable bodies in fixed unchangeable proportions, in the former case forming light and heat.

It follows from this that oxygen, fluorine, chlorine, bromine, iodine, and nitrogen are compounds with negative electricity. Also that hydrogen, carbon, boron, phosphorus, arsenic, sulphur, selenium, silicium, and all the metals have positive electricity entering into their composition. The separate members of these two groups, in uniting with one of the opposite order, part with their electricities, which unite to form heat. At the end of the last century, says M. Martin, fire was considered a chemical phenomenon; and Lavoisier made a great step in demonstrating the part taken by ponderable agents in its production. Five years later Davy sought to discover the cause of the caloric produced, and even found the true cause, the union of the two electricities, but he had no data on which to establish his theory.

Simple and clever as this theory is it was mooted in England fifteen years ago by Mr. Charles Chalmers, but attracted little attention. This gentleman did not follow the idea with nearly so much energy as M. Martin, nor did he introduce the electricities into chemical formulæ, but performed some singular practical experiments in proof of his assertions. In fact, he obtained hydrogen from water without oxygen, and oxygen without hydrogen, by the aid of electricity, as shown in the engraving.



A glass jar filled with water is laid upon its side in a wooden trough. This trough is divided into two parts by a water-tight compartment. One of the compartments is filled with water, and the other, holding the jar, is empty. The bottom of the jar, which projects beyond the partition of the trough, is a plate of platina, A, B, five inches in diameter, the margin of which is imbedded in cement, so that it is absolutely water-tight, and the water in the jar has not the slightest communication with the water in the trough. The neck of the jar, with a large cork inserted, is fixed in one end of the trough, and the upper part of the jar has two tubulures, into which are inserted the tubes for collecting the gases. A diaphragm of cork divides the glass vessel into two parts to prevent the gas given off in one part from going into the other. Through the centre of the jar a spindle passes, by the turning of which a wiper is made to sweep the platina plate of any bubbles of gas that may adhere to it. This spindle is a glass rod encased in a glass tube, which fits an aperture in the centre of the diaphragm, as well as the other cork. The outside surface of the platina plate has air bubbles swept off in a similar manner. The negative wire of the battery was introduced into the glass jar, and the positive wire into the trough filled with water slightly acidulated.

With this apparatus gas, of course, was given off as usual by the two wires whenever the current passed; also from the platina plate polarised by induction. But by gradually reducing the power of the battery the electricity on the large surface of the platina can be so attenuated and become so low in intensity and quantity at any one point as to cease to decompose the water, although gases will still be given off by the wires. By this means pure hydrogen, says Mr. Chalmers, may be obtained from the water in the jar, and *no* oxygen. He also performed other highly curious experiments, which were published in 1851, all pointing to the same conclusion as that recently formed from entirely different data by M. Martin in Paris. This apparent discovery of a great elementary scientific law deserves further investigation. It is evident the truth or error of Mr. Chalmers' experiment rests upon the amount of gas absorbed by the water.

M. A. de la Rive, the author of the most complete work on electricity extant, has communicated further interesting facts to the Academy of Sciences at Paris. He says that in pursuing his researches on the propagation of electricity in highly rarefied elastic fluids, he was induced to try also the vapours of several metals. The apparatus he used consisted of a glass bulb of very large size, having four tubulures and mounted on a stand. Two of the tubes placed at the extremities of the horizontal diameter of the globe were plugged with leather, through which passed the metal slips, to which the metal or carbon electrodes for producing the voltaic arc were fixed. A powerful battery, consisting of sixty or eighty of Bunsen's cells, was used. The two tubes fixed at the extremities of the vertical diameter allowed the passage of two rods of brass terminated by metallic balls, between which, in the meantime, discharges from a Ruhmkorff's coil were allowed to play. The air was then exhausted from the globe and well-dried nitrogen admitted, rarefied to two or three millimetres of pressure, the discharge from the coil being still allowed to pass and its intensity measured.

After being assured of the constancy of this intensity, the horizontal metallic points were brought near to each other in order to produce the voltaic arc which, in this experiment, acts solely as the source of heat. After this had been produced for several minutes, all at once the discharge from the coils was greatly increased; at the same instant the colour of the latter flame, which had been previously of a deep rose hue, became of quite another tint, which varied according to the description of metal employed as the electrodes of the voltaic circuit. These colours lasted several minutes after the voltaic circuit was broken.

Electrodes of silver, copper, aluminum, zinc, cadmium, magnesium, and carbon were used, and all these substances were vapourised by the high temperature. With terminals of silver and zinc, a blue flame was produced, deeper with the zinc than with the silver; with terminals of copper, aluminum, cadmium, and magnesium, the colour was a deep green with the copper, brownish green with the cadmium, bright green with magnesium, and light green with aluminum; with carbon terminals the colour was a bright blue, which was fainter when the current was broken, such as would be caused by the formation of a little carburetted hydrogen. These effects are more visible in the upper than the lower part of the globe, and are brighter in metallic vapours than in rarefied gases.

As regards the increase in the intensity of the jet, this is greater in the vapours of silver and copper. The galvanometer deflects rapidly from 30 deg. to 60 deg., at the moment when the discharge from the coils, by its change of colour, shows that its passage is assisted by the vapours of these metals. The increase in intensity with the vapour of zinc, cadmium, and magnesium was only 10 deg. or 20 deg., but with aluminum it was rather greater. He employed also terminals of iron and platina. With the first he observed a slight change in the colour of the discharge, and a slight increase in its intensity; with the second no effect was obtained, except an appreciable increase in the conducting power of the rarefied nitrogen, due simply to the higher temperature, proving most conclusively the vapours of the different metals alone produced the former results.

M. de la Rive has published another fact discovered in his researches. When alloys of different metals are used as electrodes, they are decomposed by the high temperature produced. A plate of coke was used as a negative electrode, and that of an alloy of two metals as the positive—the last being melted and sublimed by the heat. Alloys of copper and zinc, copper and pewter, copper and aluminium, platina and silver, iron and antimony, were all decomposed at these high temperatures, and many of the particles of their constituent metals found upon the coke.

A paper of great practical value was also read before the same society by M. du Moncel. He stated that an electro-magnet on his principle consists of a cylinder of soft iron, covered with a wire helix. Up to the present time it was thought to be indispensable to obtain powerful results by using insulated wire for this purpose. It was afterwards found that this insulation was not of such value as generally supposed, and he had used bare wire for electro-magnets, which had given extraordinary results which he would not have believed had he not seen them. Not only did bare wire give as good results, but the effects were in some instances more than doubled, and had the immense advantage of only giving a feeble induced current in return. To obtain the best results the different layers of bare wire should be separated from each other by a layer of paper.

This discovery, he says, is of considerable commercial value in telegraphy. First, there is considerable economy in the manufacture of electro-magnets in using bare wire instead of the expensive wire insulated with silk. Secondly, more powerful results are obtained, so that smaller magnets may be used and more rapid results obtained. Lastly, by the partial suppression of the induced current sparks at the points of contact are abolished. He adds:—"To give an idea of the power of these electro-magnets it will be sufficient to state that an electro-magnet having for its core a bar of iron 4½ centimetres long, and 7 millimetres in diameter, covered with only a single layer of bare wire, having altogether 103 turns, sustained under the influence of two small Bunsen's elements a weight of 3 kil. 900, while the same electro-magnet, covered with the same wire insulated, lifted under the same conditions only 2 kil. 400. It is true that in the latter case the greater diameter of the covered wire would only allow 77 turns to be wound on the core." M. du Moncel next varied the battery power and description of magnet, but obtained the same results. To discover the effect of better metallic contact between the different layers of wire he substituted tinfoil for the paper first used, and this at once very considerably reduced the power of the magnet. On separating again the different layers with paper, and connecting the wires of each layer by means of separate pieces of wire laid over them at right angles, he found the attractive power of the magnet as great as ever. In these experiments M. du Moncel used the copper wire of commerce, and was thrown somewhat out in his conclusions when he discovered that they varied 75 per cent. in conducting power. He afterwards carefully avoided this source of error, and verified his first conclusion that electro-magnets covered with bare wires are more powerful than those of the usual construction.

These facts differ so greatly from all preconceived ideas, and have such a practical bearing on the prime cost of all telegraphic instruments, that the experiments of M. du Moncel require verification in England before we can accept them as being in any sense conclusive.

NEW STATION FOR THE GREAT EASTERN.

Great things are already accomplished or projected by the principal railway companies in the way of providing new or enlarged station accommodation at their London termini. The South-Eastern has got to the West-end at Charing Cross, and its City station at Cannon-street is nearly completed. The London, Chatham, and Dover, now delivers its passengers either at the Victoria station, West-end, or at Ludgate, City, as they may prefer. The London and North-Western and North London have almost finished their fine joint station in Broad-street; the Metropolitan is pushing on the works of its new stations in Charles-street and at Aldersgate and Finsbury, which will in a week or two be available to the public. The Great Western, the Great Northern, and the London, Chatham, and Dover, will have their own lines running into these stations of the Metropolitan. The Midland, which has already a portion of a vast goods station in active operation at Agar Town, has also matured the plans for a magnificent passenger station to front Euston-road at its junction with St. Pancras-road. Concerning most of these projects, we have already given particulars in former numbers of The Engineer. We propose now to supply information regarding the new passenger station of the Great Eastern in Liverpool-street.

The City extension of the Great Eastern will be a little over a mile in length. It will leave the main line at Tap-street and will cross Bishopsgate-street to the north of Worship-street, and will pass on to Liverpool-street, where the new terminal station will be erected in the immediate neighbourhood of the Broad-street station of the London and North-Western and the North London. Although the outer casing of the present principal station of the Great Eastern at Shoreditch presents a rather imposing appearance the accommodation for the arrival and departure of passengers is quite inadequate to the requirements of the company's traffic. The Shoreditch station is roofed by three bays, the centre much wider and higher than those on each side. It is well lit by skylights, and the centre bay has an arcaded louvre for ventilating, of about 4ft. deep, at the eaves of the principal span. The station has four lines of rails and two platforms of something more than 100 yards long. The departure platform is about 8 yards wide, but the arrival one is much narrower. The existing station at Shoreditch will, after the completion of the new station at Liverpool-street, be devoted to the goods traffic.

The new station will have eight lines of rails, and will have two arrival and two departure platforms, of 25ft. and 20ft. wide, with a common cross platform at the inner end of 30ft. wide. The covered area of the station proper will be about 630ft. long by about 200ft. wide. This structure will have the peculiarity of accommodating two companies—not by affording space for them to run in and out on the same level, as with the London and North-Western and the North London, in the neighbouring station, but by their running in and out the one directly under the other. The lower lines will be those of the East London, which, our readers will remember, is to cross into Surrey by the old Thames Tunnel, which has already passed into the hands of the company. The rails of the East London will be 37ft. below the level of those of the Great Eastern immediately above it. This company—the East London—will have six lines into the station, and four passenger platforms, within a cross platform at the inner end. The upper roadway will be borne upon brick arched work. There will be four transverse bays of 40ft. span, and twenty-eight longitudinal arches of 12ft. span. There will also be two subordinate arches on the outside, of 22ft. span. The longitudinal arches will be segmental, and the transverse arches semicircular. The carriage ways on each side, about 18ft. wide, are by inclines of 1 in 17, with a level length in the centre.

The station will be covered by a roof of two semicircular spans, 85ft. each, with an intermediate open space in the centre of about 13ft. wide, a sort of well, designed to light, and especially to ventilate, the underground station of the East London line. In so far as the roof is concerned the new station of the Great Eastern will more closely resemble that of the Great Northern than any other we know of. The principals of the roof will be laminated girders, springing from corbels set at about 11ft. above the rail level. The height from the rail level of the East London station to the top of the roof will be about 100ft. The station will be entered by an ornamental face girder. The roofs, which will be almost entirely of timber, will be surmounted by louvres of about 20ft. across the base, and rising at their apex about 6ft. above the arch. The open sides of the louvres will be about 4ft. high. The inner springs of the girders on each side of the open space will be from longitudinal girders, supported on iron columns placed at 20ft. between centres. The crown of the roof will be covered with corrugated iron to the easing of the louvre, on each side of which there will be a broad belt of glass; the bottom portion will be slated. The range of pillars supporting the girders at their inner spring will be connected by elliptical girders; the spandrils to be filled in with ornamental ironwork. There will be an ornamental iron fence also along the platforms, partitioning them off from the well before referred to.

Both stations, the East London and the Great Eastern, will have horse and carriage docks on the outer side of the passenger platform of about 100ft. long, with three side platforms, and an end landing-stage of 25ft. wide.

The station outer buildings will present a unique and imposing appearance. The principal façade will be in Liverpool-street, closely adjoining the end of Broad-street and the new station there of the London and North-Western. The building will be in the Italian style, grand in dimensions, and although somewhat plain as regards architectural decorations, such in its general character and separate parts as will command attention, and, we believe, admiration. The peculiar feature of the station will be its having two carriage and footways, one above the other. The upper carriage way will be over a colonnade supported on columns and girders duly proportioned to the possible weights to be borne. The upper road way will be fenced by a handsome ballustrade, with panels and pilasters corresponding with the columns which are coupled at appropriate intervals. The principal façade will be about 200ft. long, and will have projecting portions in the centre and at each end, with pavilion roofs and iron finials. The side elevation will be 600ft. long, and will also be relieved by projections. The front will have a range of seventeen windows, three in each projecting portion, and four in each of the recessed parts. The colonnade will be about 25ft. wide and 21ft. high. The height of the building will be about 55ft. It will be of stock brick—no party-coloured brick to be used—with stone quoins and a massive cornice of stone and terra cotta. The front will have four floors and the side portion three, excepting the central projecting part, which will also have four. The station has been designed by Mr. Sinclair, the company's engineer, and a contract has been completed with Messrs. Lucas for the extension and station, exclusive of the outer buildings.

In addition to the contemplated new passenger station, the Great Eastern Company is providing a coal depôt in Whitechapel, on a very large scale. The coal station runs up to Buck's-row, near the London Hospital, and consists of a series of forty arches, which extend for 1,500ft. in length, and are 73ft. in width, each arch being 30ft. in span. Six lines of rails run into the station, and the coals will be shot from the bottoms of the wagons through hatchways in the road, and will be stored under the arches. A partition will extend lengthways, and on one side the height, from the ground level to the crown of the arch, will be 18ft. 6in.; on the other side the height will be 23ft.; this side will have an intervening plank floor with hatches for coal storage. There will be a roadway of above 30ft. wide along each side of the station; the whole will be enclosed all round by walls of sufficient height. Ingress and egress will be by gateways, one leading directly to the Whitechapel and Mile-End thoroughfare, the other to Shoreditch. The station occupies about seven acres, and will cost between £50,000 and £60,000. It is built on the site of what was once known as Smith's distillery, and it also displaces some cottage property of a very low character. It may be remembered that the proprietors of the distillery were detected, some years ago, tampering with the excise laws. A little matter of somewhere about £70,000 penalty seriously interfered with the proceedings of the firm; the distillery was closed, and has remained so till now.

The East London line passes under the Buck's-row end of the coal station, with a roadway of 18ft. high. The upper rails are supported on brick arches of 5ft. between centres, which spring from the flanches of cross wrought iron girders of above 2ft. in depth. The brickwork will be covered with concrete to prevent dripping from the upper surface.

We believe that the Great Eastern, when they have completed these projects, and have finally arranged for running powers and station accommodation with the Midland at their new station in Euston-road, will be ready, with good reason, to adopt and act upon the motto, "Rest and be thankful."

South Kensington Museum.—During the week ending October 21st, 1865, the visitors have been as follow:—On Monday, Tuesday, and Saturday, free days, open from 10 a.m. to 10 p.m., 9,460. On Wednesday, Thursday, and Friday, students' days (admission to the public 6d.), open from 10 a.m. till 5 p.m., 1,511. Total, 10,971. From the opening of the museum, 5,613,759.

Paris Exhibition.—The following circular has been issued by the Science and Art Department, South Kensington:—"Notice to Intending Exhibitors in the Paris Universal Exhibition, 1867.—Although the 28th February, 1866, has been fixed as the last day for receiving demands for space, intending exhibitors are requested not to delay forwarding such demands, but to send them as soon as possible. By order of the Lords of the Committee of Council on Education. South Kensington Museum, October, 1865."

Scandinavian Exhibition.—The difficulty which occurred in consequence of the determination of Sweden and Denmark to hold exhibitions of Scandinavian industry in their respective capitals at the same period, has been met by the abandonment of the project for the present, on the part of the authorities of the latter country. The Stockholm exhibition, therefore, now stands alone, and is fixed to open, as announced in the *Society of Arts Journal* some weeks since, on the 15th of June, 1866.

Accidents from Steam Machinery.—In consequence of the removal of certain restrictions respecting the employment of steam power in manufacture, the *Moniteur* has collected and published an account of the accidents which happened through the use of steam during the past year. It appears that the accidents were only sixteen in number, but that the number of persons who were killed, or died afterwards of the injuries inflicted, amounted to forty, and that fifteen other persons were wounded more or less seriously. Of the sixteen accidents, four occurred in sugar works, three in paper manufactories, two each in distillery and drug works, and one each in other industries. The causes of accidents are classified as follows:—Eight occurred by the explosion of cylindrical boilers; three by that of tubular boilers with interior furnaces; one by the explosion of a locomotive; and four by that of steam-heating apparatus. The immediate causes are supposed in eight cases to have been the bad quality of the metal employed or the vicious arrangement of the furnaces; in seven others, carelessness or want of superintendence on the part of the engineers or stokers; and in the remaining case from the imprudence of other persons. The *Moniteur* gives the details in each case, in order that manufacturers may take warning for the future. This return, of course, does not include railway or other accidents which occurred in connection with, but were not immediately caused by, steam machinery.

Rock Sawing in Quarries and Tunnels.—A French engineer, M. Paulin Gay, has lately perfected a machine, on the disc principle, for sawing or cutting through the hardest rock in quarries and tunnels. Experiments have been made lately at the Conservatoire des Arts et Métiers of Paris, and the following is an extract from the report of M. Tresca, the sub-director, countersigned by General A. Morin, chief director, relative to the performance of this machine:—"The contrivance of M. Gay depends upon the new and special application of a principle, and consists of apparatus whereby a disc of lead penetrates vertically or horizontally into the stone, being impressed with a rapid circular motion, while powdered emery is applied to the edge of the disc by means of a small jet of water. The emery, as fast as it is applied, falls into a receiver, whence it is lifted to be replaced in the feeding hopper and used over again. The disc is mounted upon a shaft so as to move in a plane perpendicular to that axis, and is guided by friction wheels whereby its motion is steadied. The body of this disc is of wrought iron plate four millimetres thick, and is pierced all round the edge with a double row of elliptic holes, to afford passage for the melted lead which is cast upon the wheels to the thickness of six millimetres, and a total width of seven millimetres. This wheel is put into motion by a machine or motive power, the strength of which is regulated by the diameter, and also by the nature of the stone to be cut, and, placed upon a movable chariot on rails, it advances into the tunnel, resting on the floor of the heading. If a block of stone be required to be cut for building or other purposes, the machine is fixed while the block is placed against the revolving disc by a counterpoise. For tunnel work M. Paulin Gay has an enormous disc two metres in diameter."—*Builder.*

PARIS UNIVERSAL EXHIBITION OF 1867.

The following important document has just been published by the Committee of the Council of Education, Science and Art Department, South Kensington. We commend its careful perusal to all intending exhibitors, as it supplies the fullest possible information on every point which can possibly be raised:—

IMPERIAL COMMISSION. GENERAL REGULATIONS DISCUSSED ON 7TH JULY, 1865, AND APPROVED BY IMPERIAL DECREE OF THE 12TH JULY, 1865.

Section I.—General Arrangements and System of Classification.

Article 1.—The Universal Exhibition to be held in Paris in 1867 will be open for the reception of works of art, and of the products of agriculture and industry of all nations. It will be held in a temporary building on the Champ de Mars. Around the Exhibition building a park will be formed for the reception of cattle and other live animals, and plants, as well as for those constructions and objects which cannot be exhibited in the main buildings. The Exhibition will open on the 1st of April, 1867, and will close on the 31st October following.

Art. 2.—The Universal Exhibition of 1867 is placed under the direction of the Imperial Commission nominated by the decree of the 1st February, 1865. The general commissioner appointed by the same decree is charged with carrying out the decisions of the Imperial Commission.

Art. 3.—In every department of the French empire the Imperial Commission will establish, before the 25th August, 1865, a local committee, whose duty it will be—1. To make known throughout the whole extent of the department the measures relative to the organisation of the Exhibition, and to distribute the forms of demands for space, and other documents issued by the Imperial Commission; 2, to point out, before the 31st October, 1865, the principal artists, agriculturists, and manufacturers whose productions would seem specially calculated to contribute to the success of the Exhibition; 3, to promote, in the manner stated in Article 29, the exhibition of the agricultural products of the department; 4, to appoint a commission of learned men, agriculturists, manufacturers, overseers, and other persons with special knowledge, to make a careful study of the Exhibition, and to publish a report upon the means of applying in the department the lessons which the Exhibition may have taught; 5, to create, by collecting subscriptions, by association, or by any other means, a fund for the purpose of enabling the overseers, husbandmen, and mechanics of the department to visit and study the Exhibition, and to pay the expenses of publishing the above-mentioned report.

Art. 4.—The Imperial Commission will make the necessary arrangements with the Ministers of War and of Marine, for obtaining a proper representation of the products of Algeria and of the French colonies in the Universal Exhibition.

Art. 5.—The commissions appointed by the various foreign governments to direct the part which their respective countrymen will take in the Universal Exhibition are in direct communication with the Imperial Commission relative to the exhibition of the works of art and other productions of their country. Consequently, the Imperial Commission will not correspond with foreign exhibitors. Products sent by a foreign exhibitor can only be admitted through the medium of the foreign commission which represents him. The foreign commissioners will also provide as they may see fit for the carriage, the reception, the arrangement, and the return of the productions of their countrymen. They must, however, conform to the regulations laid down by the Imperial Commission.

Art. 6.—Foreign commissioners are requested to place themselves as soon as possible in relation with the Imperial Commission, and to depute some person to represent them. The duty of this representative will be to arrange the questions which refer to foreign exhibitors, and particularly those relative to the allotment of the whole space among the various countries, and to the manner in which each foreign section shall be arranged in the Exhibition building and in the park.

Art. 7.—In order to facilitate the division of the space allotted to each country between the various classes of objects enumerated in Article 11, the Imperial Commission will place at the disposal of the representatives for their guidance, the plan of the arrangement of the French section of the Exhibition building, drawn on a scale of two millimetres to a metre (1in. to 41·6ft. or $\frac{1}{500}$). This plan shows the arrangement of the glass cases and counters suitable for each class of objects, as well as the shape, height, and other dimensions of the courts intended for each class. An analogous plan of arrangement showing the manner in which the portions of the Exhibition building allotted to each foreign country will be subdivided is to be transmitted to the Imperial Commission before the 31st October, 1865. Plans in detail, on a scale of two centimetres to the metre (1in. to 4·16ft., or $\frac{1}{50}$), showing the place allotted to each exhibitor and to each separate stall, are also to be forwarded with the list of exhibitors, by each foreign commission, before the 31st January, 1866, in order that in arranging the interior of the Exhibition building the Imperial Commission may be able to take into consideration the wants of each country.

Art. 8.—Each foreign country may claim, for the formation of a special park, the portion of the Champ de Mars adjoining the space allotted to it in the Exhibition building. The representative of each foreign commission will settle with the General Commissioner the plan of the paths for the circulation of the public, and of the earthworks, which will be executed at the cost and under the direction of the Imperial Commission. Each representative will also arrange with the General Commissioner so as to leave at the disposal of the Imperial Commission the portions of the ground which may be in excess of the wants of his countrymen, or to obtain an additional piece of ground from the portions to which other representatives may have given up their claim. In order to facilitate as much as possible the arrangements of the foreign exhibitors in the portions of the park allotted to them, the Imperial Commission will place at the disposal of the representatives for their guidance the plans adopted by the French exhibitors for arranging the animals, plants, model cottages, &c. (Appendix A).

Art. 9.—An official catalogue of the products of all the foreign countries will be drawn up, showing the place which they occupy either in the Exhibition building or in the park. This catalogue will contain two alphabetical lists, one of the exhibitors, the other of the products exhibited. Foreign commissioners are requested to send the information necessary for the preparation of the catalogue before the 31st January, 1866.

Art. 10.—Those states which can only be represented in Paris in 1867 by a small number of exhibitors, and which are besides in a similar geographical position, are requested to concert together so as to insure a methodical grouping of the products of an analogous nature. The Imperial Commission will place at the disposal of the representatives of the commissions of those states the plans which have been prepared, with a view to harmonise the advantages of such a grouping with the fundamental rule of national representation. In the event of these plans being approved the Imperial Commission requests the commissioners of those same states to appoint in Paris for each group an agent, whose duty it will be to carry them out. The architects and officers of the Imperial Commission will afford assistance gratuitously to these agents.

Art. 11.—In each section assigned to the exhibitors of the same country the objects will be divided into 10 groups and 95 classes, viz:—1st group—Works of art (classes 1 to 5). 2nd group—Apparatus and applications of the liberal arts (classes 6 to 13). 3rd group—Furniture and other articles intended for dwelling-houses (classes 14 to 26). 4th group—Clothing (including fabrics) and other articles worn on the person (classes 27 to 39). 5th group—Products (raw and manufactured) of mining (classes 40 to 46). 6th group—Instruments, and processes of the common arts (classes 47 to 66). 7th group—Food (fresh and preserved) in various states of preparation (classes 67 to 73). 8th group—Live products and examples of agricultural establishments (classes 74 to 82). 9th group—Live products and examples of horticultural establishments (classes 83 to 88). 10th group—Objects exhibited with the special purpose of improving the physical and moral condition of the people (classes 89 to 95). The objects which are included in these groups are given in detail in the system of classification (Appendix A) annexed to these regulations. In order to avail itself of any suggestions that may be made by the French exhibitors and the foreign commissioners, the Imperial Commission reserves to itself the right to resolve, in the successive editions of this document, all doubtful questions to which this first publication may give rise.

Art. 12.—No work of art or object exhibited in the Exhibition building or in the park may be drawn, copied, or reproduced in any manner whatever without the authority of the exhibitor who is the author of it. The Imperial Commission reserves to itself the right to authorise the taking of general views of the Exhibition.

Art. 13.—No work of art or object exhibited may be removed before the close of the Exhibition without the special authority of the Imperial Commission.

Art. 14.—Neither French nor foreign exhibitors will have to pay any rent for the space occupied by them in the Exhibition; but all costs incurred for fittings and decoration in the Exhibition building and in the park must be borne by them.

Art. 15.—Frenchmen and foreigners, by the act of becoming exhibitors, thereby bind themselves to adhere to these regulations.

Art. 16.—The Imperial Commission will correspond with the Préfets and other authorities of the French empire through the President or the General Commissioner.

Art. 17.—All communications relative to the Exhibition are to be addressed to M. le Conseiller d'Etat, Commissaire Général de l'Exposition Universelle de 1867, à Paris. Letters need not be prepaid within the jurisdiction of the French post-office.

SECTION II.—SPECIAL ARRANGEMENTS RELATIVE TO WORKS OF ART.

Art. 18.—Works by French and foreign artists, executed since the 1st January, 1855, will be received for exhibition.

Art. 19.—The following will not be received: 1. Copies, including those which reproduce a work in a manner different to that of the original. 2. Oil paintings, miniatures, water-colour paintings, pastels, designs and cartoons for stained glass and frescoes, without frames. 3. Sculpture in unbaked clay.

Art. 20. The Imperial Commission will decide, with the assistance of a special jury, respecting the admission of works by French artists. The composition and nomination of this jury, and the formalities with which Frenchmen will have to comply in requesting permission to send a work of art to the Exhibition, will be explained by regulations to be published hereafter; these regulations will make known how works of art are to be transmitted and received.

Art. 21.—The Imperial Commission will make known to the persons concerned, before the 1st January, 1867, its decisions respecting the admission of works of art.

Art. 22.—The number and nature of the rewards that may be given in respect of works of art, as well as the constitution of the international jury who will be called upon to act as judges, will be decided hereafter.

SECTION III.—SPECIAL ARRANGEMENTS RESPECTING THE PRODUCTS OF AGRICULTURE AND INDUSTRY.

CHAPTER I.—ADMISSION AND CLASSIFICATION OF PRODUCTS.

Art. 23.—All the products of agriculture and industry will be admitted into the Exhibition with the exceptions and limitations mentioned in the following article:—

Art. 24.—Detonating, explosive, and other substances of a dangerous nature will not be admitted. Spirits and alcohols, oils, and essences, corrosive substances, and generally substances which may affect injuriously other products exhibited, or incommode the public, will only be received in strong vessels, specially adapted for the purpose, and of small dimensions. Percussion caps, fireworks, lucifer matches, and other similar articles, can only be received when made in imitation and deprived of all inflammable ingredients.

Art. 25.—Exhibitors of products of an unwholesome and disagreeable nature will be bound to conform at all times to such measures of safety as may be prescribed to them. The Imperial Commission reserves to itself the right to cause the removal of any products, whether French or foreign, which by their nature or their bulk might appear injurious, unsuitable, or incompatible with the objects of the Exhibition.

Art. 26.—Before the 15th August, 1865, the Imperial Commission will notify to the foreign commissions the amount of space allotted to each of them for the display of the productions of their respective exhibitors. Before the 25th August, 1865, the Imperial Commission will publish, in a tabulated form, the amounts of space allotted in the French portion of the Exhibition building to each of the first 73 classes enumerated in Article 11.

Art. 27.—After the publication of this document, French exhibitors carrying on the trades comprised in the same class are requested to come to an understanding among themselves relative to a common plan of arrangement of the space which will have been allotted to their class. If they should agree upon the selection of the exhibitors which this allotment can accommodate, and upon the amount of space that shall be assigned to each, they will nominate one or more representatives who will place themselves into communication with the Imperial Commission, submit their plan and list of exhibitors for its approval, and generally act as the representatives of the common interest of these exhibitors.

Art. 28.—In default of such spontaneous action provided for in the preceding article, the municipal authorities of centres of manufactures, the chambers of commerce, the consultative chambers of arts and manufacture, artistic and industrial societies, agricultural societies and meetings are requested to urge the producers in their district to act in concert.

Art. 29.—The departmental committees (Article 3) will receive from the Imperial Commission and will communicate to the consultative chambers of agriculture and to the agricultural societies and meetings of the department, the plans adopted for the representation of the agriculture of the various districts of France, in order that they may co-operate in carrying out these plans. They will especially request these societies and meetings to prepare collective exhibitions of types of animals and plants, and models of farm buildings and agricultural works. The local committees of a large agricultural district will, as far as possible, act in concert, so as to display, without useless repetitions, the characteristic features of the agriculture of the district.

Art. 30.—The applications for space having reference to the arrangements described in Articles 27, 28, 29, will be made by the representatives of the exhibitors who have been acting in concert, or by those of the societies and bodies who have taken the initiative in the matter. For this purpose the representatives will cause each exhibitor to fill up and sign in duplicate, an application for space. These applications are to be addressed to the General Commissioner at Paris (Article 17).

(*To be continued.*)

LETTERS TO THE EDITOR.

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

TESTING BOILERS.

SIR,—Pertinent to the subject of testing boilers, on which a long and interesting discussion is taking place in your columns, allow me to describe a system of proof which may be called either pneumatic or hydraulic. I have used this system for many years with great advantage, and am surprised that none of your correspondents have proposed any similar proceeding.

The plan is simply to fill up boilers with water to the top gauge cock, or to that level; then close all outlets, and having attached a pressure gauge, put on pressure, either from a force pump or a water main. Run the pressure up to any judicious degree, then stop off the source of the pressure, record the time, and observe the pressure gauge.

If the boiler is tight and the fittings are all good, the pressure will not fall ten pounds in a day. A very little experience will teach the tester what to expect. The elasticity of the air cushion allows much greater exactness in setting the pressure than is possible when the boiler is filled absolutely full, and the degree of leak, if any, is more easily judged. If a boiler is tight under this kind of trial there is less need to strip and examine all the surface; and if it is not tight, the necessity for doing so is obvious.

The plan is not, therefore, put forward as superseding more precise examination, but as a preliminary test of a most reliable kind. When a large number of boilers are in use and worked in rotation, and when systematic cleaning is practised, this method of test should be applied on every occasion before a boiler is put on. In all cases where a supplementary cold feed from water mains is a permanent fixture, the apparatus is ready to hand. I am certain that, in the majority of cases where explosions have occurred, the pressure gauge applied in this way would have run back at a rate that would have clearly indicated a leak, and have proved the continued use of the boiler to be reckless.

The proof of all the fittings by the same means is of sensible advantage, and the proceeding is not upset by rain, condensed steam, or any other wet, either of which make the testing with solid water and looking for weeps, sweats, drops, and larger escapes both inconvenient and difficult; more than this, a master or superior man may, without soiling himself, see his boilers proved with his own eyes, and, if he will, "*pendente fumo.*" CHARLES GREAVES.

Old Ford, Oct. 24th, 1865.

PATENT LAW.

SIR,—Referring again to the difficulties that would be induced by the withdrawal of all legal recognition of invention, as applied to the improvement of manufactures, I remember that on one occasion when the late Mr. Wilberforce was reminded by an unbeliever in the truth of the Bible of the many difficulties in the way of belief, his answer was to this effect: "Yes, but there are more difficulties in the way of unbelief."

Some persons probably regard this answer as merely a sharp repartee, scarcely even that; but theologians recognise in it the utterance of a profound and vital truth. And there is an analogous truth underlying the question of "Patents or no patents." If Lord Stanley and others who are strongly impressed by the practical difficulties of a patent law, could succeed in establishing the proposition that there would be fewer social and commercial difficulties if such law were abolished, I should at once acknowledge the force of the argument, and regard the days of patents as numbered. But what abolitionist has thus succeeded? I do not recollect ever meeting with any conspicuous effort in this direction. And until this proposition is established by overwhelming argument, my firm belief is that patents will not be abolished. While, however, thus feeling every confidence in the appeal to reason and facts in support of a law of patents, I have an apprehension of evil arising from the probable apathy of Parliament on the subject. And this apprehension is increased by a sense of the difficulties resulting from the necessary reconstruction of the Government at this time, which is likely to occupy the minds of the majority of the Patent Commissioners who are members of the Government, to the exclusion of the patent question—that "irrepressible negro" in the eyes of many lawyers.

For my own part I would much rather have the question dealt with, and settled as soon as practicable (taking my chance of the result), than be exposed to the inconvenience of further delay.

Some of the recommendations of the Patent Law Commissioners, if vigorously carried into effect, would produce a greater improvement in practice than some persons appear to me to recognise. But there is one recommendation in particular which is of incomparably more importance than any of the rest, and it is agreed to by all the Commissioners, including Mr. Hindmarsh. I allude to that of trying patent cases by a judge, with the aid of scientific assessors, but without a jury, unless at the desire of both parties to the suit or action,—such assessors to be selected by the judge in each case.

Here is the germ of a great practical improvement, if properly carried out. It is no small evidence of its value that so large a number of independent thinkers as those who sat on the Commission should have concurred in the recommendation. Nevertheless, the words of Sir R. Phillimore, (Queen's Advocate,) contained in a paper recently read by him at Norwich on another branch of law, are applicable here:—"The success of every institution depends upon the manner in which it is worked, as the success of every law depends upon the manner in which it is interpreted. Both are merely parchment or paper, with letters and figures written upon them, until, in fact, the breath of practical life animates them into real existence."

These words remind us of the essential importance of the manner in which the judges would be inclined to exercise their powers under a law founded on the recommendation referred to. And on this point I cannot disguise from myself the fact that some of the judges have a great dislike to patent cases, which is against the presumption that they would work such a scheme efficiently. This fact is suggestive as an argument in favour of a special court. At the same time I am persuaded that some of the judges could try patent cases satisfactorily on such a system. And is it not true that in every branch of law some judges can try cases more satisfactorily than others by reason of their having more special aptitude for particular subjects more or less connected with their antecedent experience?

It is, therefore, no argument against patents that some judges dislike them because they involve questions which are remote from their usual habits of thought. There seems to be just now an unusual prejudice against patents, which I take to be a reaction from a former feeling of undue favour towards them in some instances, and which may, therefore, be only temporary. At the same time it is advisable for patentees to avoid giving just cause of offence in their dealings with the public, for we find Lord Brougham (while generally favourable to them) admitting "that there are grave objections to the inventor's rights as at present exercised, may be true." Lord Brougham evidently does not regard this as a reason for abolishing patents; but he seems to consider it as a mode of accounting for some of the existing prejudice against them.

Still it is always to be remembered that the present weak administration of patents in courts of law has a tendency to produce and increase the evil complained of; and that the recommendation of the Commission, if properly carried out, would have great effect in diminishing it, both directly and indirectly. WILLIAM SPENCE.

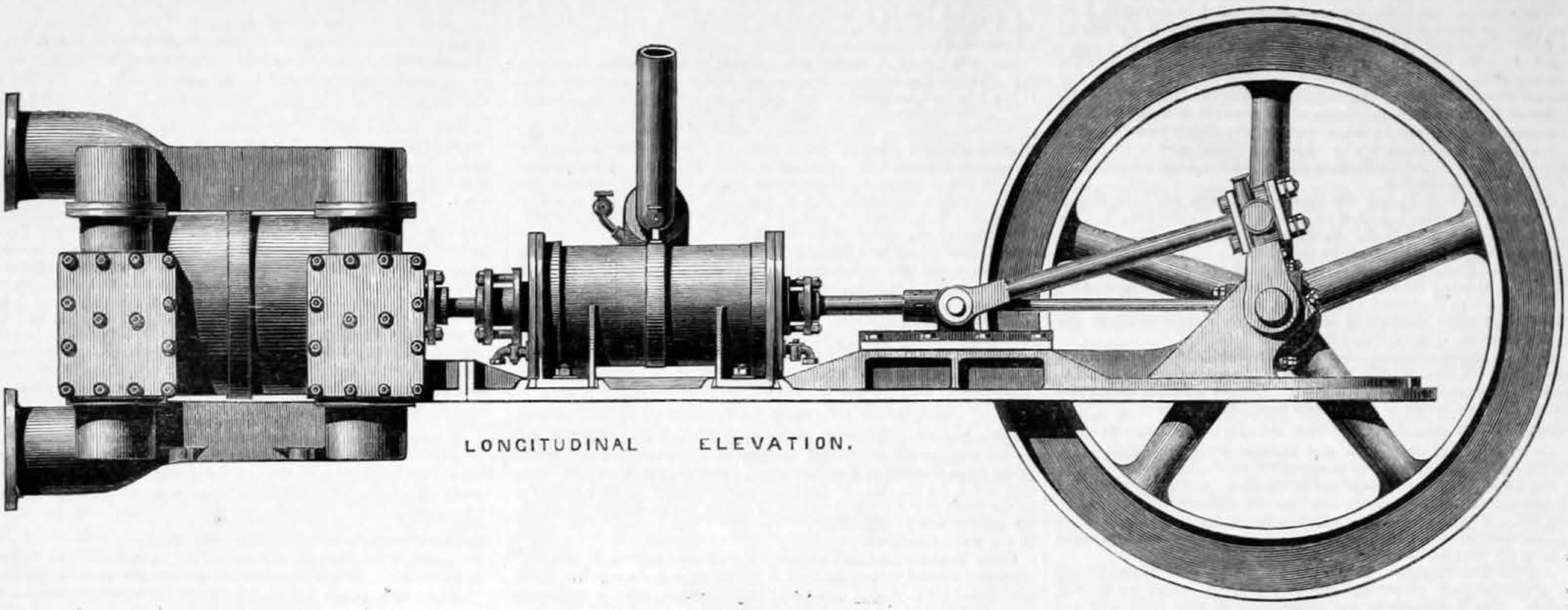
8, Quality-court, Chancery-lane, W.C., 25th October, 1865.

SUGAR MACHINERY.

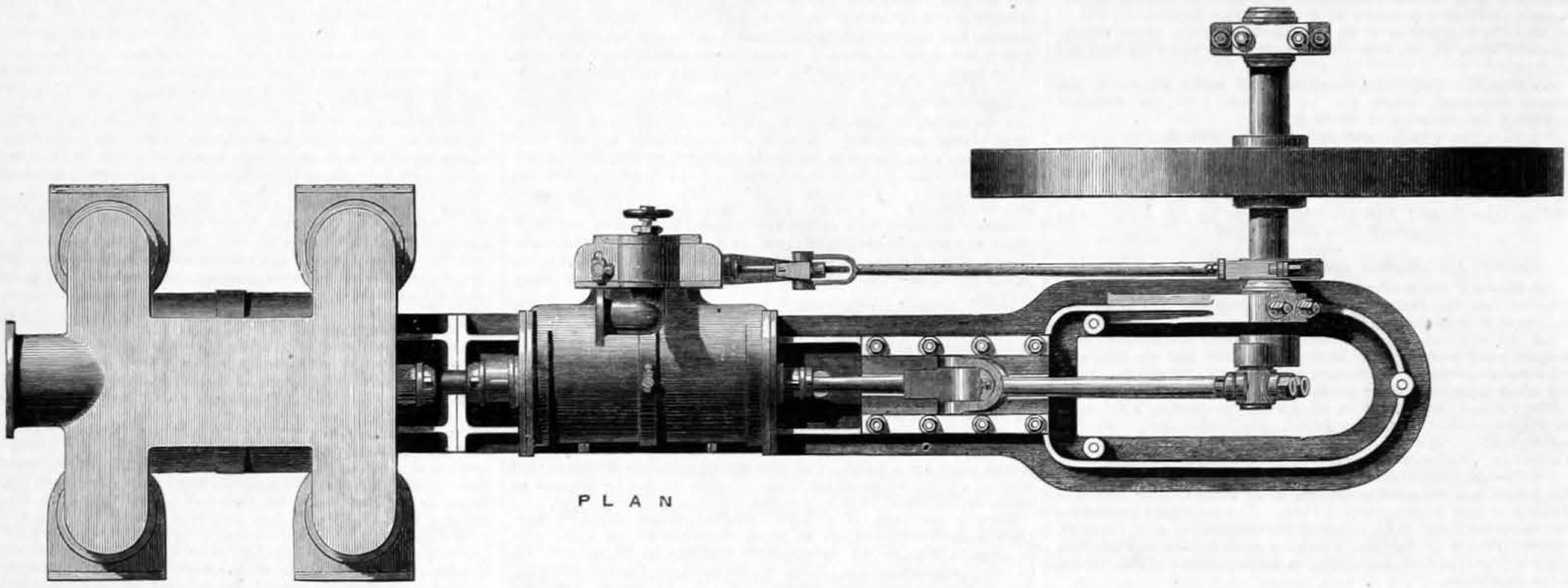
Vacuum Pumps.—The cause and effect of creating a vacuum in vessels used for chemical processes is, of course, well-known. It is difficult to point out any portion of mechanical contrivances requiring more attention than the vacuum pump, the imperative ally to the vacuum pan. The modes of working the pumps now under notice are various; in some instances vertical action is employed, in other cases an angular arrangement is adopted, a third system is that of the horizontal type. Now to ascertain the better mode will be to theorise on the cause and effect, after which the application of the mechanical powers. To exhaust air or water from a vessel is to cause a vacuum in a certain space for a given time. To obtain a vacancy for the supply is a simple matter, but to discharge effectually is the vital part. It can be readily understood that should any air remain in the pump between the piston and the suction valve or valves, it will, to a certain extent, reduce the vacuum to be attained. Pumps of the class now under notice should have perfect valves and joints to attain the desideratum. Vertical action for the piston is often considered to be the correct or better mode to attain a good vacuum due, perhaps, to the fact that the water and air will assist to cause the descent of the piston or bucket. The angular arrangement is simply a separate modification to work two pumps from the same crank pin. The action of the water will, of course, in either case assume the level line, hence the vertical arrangement may be termed the better when compression or discharge is in question. The disposition of the valves of the pumps should be carefully considered. In some instances pumps with vertical action have the suction valves located at the bottom of the barrel at the side of the same; the discharge valves are secured in like manner at the top of the barrel. The piston is itself a moving valve and seating, so that two valves are always in constant action. To obviate this the suction and delivery valves can be located opposite each other at the top of the pump. The piston in this case can be solid as far as the action of the water is concerned. The bottom of the barrel being secured in a cistern of water would ensure the absence of leakage of air during the up stroke. With reference to the access for repair the latter arrangement is undoubtedly the better, a fact not unworthy of notice. When the valvular piston is adopted and the suction valve directly under the same, it is obvious that great disarrangement must ensue ere the lower valve can be inspected. In the case of the locality of the valve in question being at the side of the pump, a portion of water and air will remain, equal in volume to the space occupied. Another evil in perforated pistons is the contraction of the area of the passages in proportion to those above and below. The valves now universally employed are of india-rubber, and their position does not affect their action. In a good arrangement for vertical pumps the valves are arranged perpendicularly or secured on each side of the top of the barrel, the piston having a projection to effectually discharge the air and water at each stroke. Another mode of securing the valves worthy of notice may be mentioned. The suction valve is inserted at the side of the barrel at the top—the discharge valve being opposite on the same level, but reverse in action, it is obvious that on compression taking place the air will be discharged before the fluid, a fact not to be disregarded. The engines commonly used for vertical pumps are of two kinds, beam and direct-acting; when the former is adopted the pumps are located one on each side of the centre of vibration, hence the requirement of duplicate connections and details complete. For vertical engines the pumps are variously located; in one example cranks between frames or standards impart the motion required; a second example has the pumps below the steam cylinders, thus attaining a direct action, the crank shaft and wheel being overhead. It is almost needless to state that, to the present, single-acting pumps have only been reverted to; those of double action can be truthfully termed the better. Pumps of this class are peculiar in arrangement. It is well known that the piston must be neutral in relation to the passage of the water; the locality of the valves must be duly considered to attain a good result. When the vertical pump is adopted the suction valves can be secured at the top and bottom at the side of the barrel, those for discharge being arranged opposite, a connecting piece on each side forming the discharging and supply pipes or chambers. The means of access to the suction valves is by doors at the top and bottom of the barrel; the delivery valves are inspected by doors on the connecting chambers. The valves are composed of india-rubber discs perpendicularly secured. The horizontal double-acting pump consists of a barrel, with the suction and delivery valves located under and over the same at each end. In some examples the suction valves are inverted over the pump, those for the discharge being on the same level, but of course reverse in action; the doors for access are suitably arranged at the side and ends of the discharge and suction chambers. In some of the arrangements of the modern sugar factories the condenser is situated at the top of the building (as before stated in a previous article); the pump exhausts the air only from the pan, while the injection water and condensed steam passes through a separate communication. With this arrangement the piston *must* discharge the air from the barrel at each stroke of the same. Pistons suitable for the pumps now in question should have projections beyond the packing ring, so that the entire space beyond the frictional surface will be filled at each end of the stroke, and thus cause a perfect discharge. The disposition of the valves should be as near the periphery of the barrel as possible. In some instances gun-metal valves are preferred for atmospheric pumps, particularly those working at high velocities. Solid plungers are sometimes preferred to those of the piston type. When this plunger is adopted the valves are located at the bottom on each side of the barrel, single action being only attained. The arrangement of the engines for the horizontal type is varied; one example has the steam cylinder secured at the end of the framing, the piston rod being prolonged to that of the pump, thus securing a direct action; the rod passes through the pump, and is prolonged to the crosshead of the connecting rod, the remainder being the same as for ordinary engines. It will thus be understood that the pump is placed between the steam cylinder and the piston rod guides. A second arrangement consists of the vacuum pump and valve chambers secured on each side of the steam cylinder; motion is imparted to the pumps by ordinary cranks, connecting rods, and guides. In this example each connection is separate; a bed-plate common to the whole ensures rigidity. A third disposition of both pumps and engine has, the former opposite the front end of the latter, the connections and the mode of working being as for that last noticed. The illustration represents a vacuum pump and engine of the horizontal double-acting type; the barrel and valve chambers are in one casting. The suction and delivery pipes are of the same exact shape and size, so that one pattern is only required, with the exception that the suction pipe has provisions or bosses for the holding-down bolts. The valve gear and seatings, as will be seen, are of the ordinary marine type, with separate doors to each set of valves for inspection and repair. The suction valves are on a level with the bottom of the barrel, the delivery valves are directly above those last alluded to, the space betwixt being due only to the area required. By this arrangement only a very small portion of water can remain in the pump during the return stroke. By locating the suction valves on the level of the barrel the least friction and ebullition is maintained. The piston is of the ordinary metallic kind, with spring ring and adjusting screws; the projections on each side of the ring are for the better purpose of discharging the pump at each stroke. The spaces filled at the termination of each stroke are very small, as before alluded to, so that an almost perfect discharge is certain, while compactness and simplicity is maintained. The front projection is recessed to receive the stuffing-box, this latter being separate from the barrel; the door at the back of the pump is for the purpose of adjusting and removing the piston when required. It will by this be understood that no disarrangement of any two portions at the same time is required either for adjustment or repair. The steam cylinder is secured between the pump and guide channel; the pump rod is prolonged to and through the steam cylinder, and connected to the guide block beyond the latter. The mode of securing the rod in the pump piston is by a nut at the back end, which can be readily removed when required. The rod in question passes through the steam piston, as before stated; the means of securing the rod in the same is by a cone at the back and a nut at the front. This nut is suitably formed for a box spanner, so that a disconnection is readily attained at the front end of the cylinder. The steam piston is of the ordinary kind, fitted with a metallic ring and spring. Should it be required to remove the piston, the rod can be readily withdrawn by unscrewing the nuts alluded to. The guide channel is arranged for a solid shoe guide of the marine type, the connecting rod is also of similar design. The engine framing or bed-plate is secured to the pump between the barrel and cylinder, sufficient room being allowed for the removal of the cover of the latter. The slide valve is of the ordinary kind, cutting-off at a fair grade; the means of imparting motion to the slide are direct. The stop-valve wheel can be on either side of the steam casing, according to the local position of the entire engine and pump. The arrangement now alluded to is designed with a special care as to light weight of material, combining strength, simplicity, and accessibility. Each portion can be disconnected readily without disarrangement, a matter of the greatest importance in colonial machinery. N. P. B.

DOUBLE-ACTING VACUUM PUMP AND ENGINE.

DESIGNED BY N. P. BURGH, ENGINEER, LONDON, FOR A SUGAR ESTATE IN PERU.

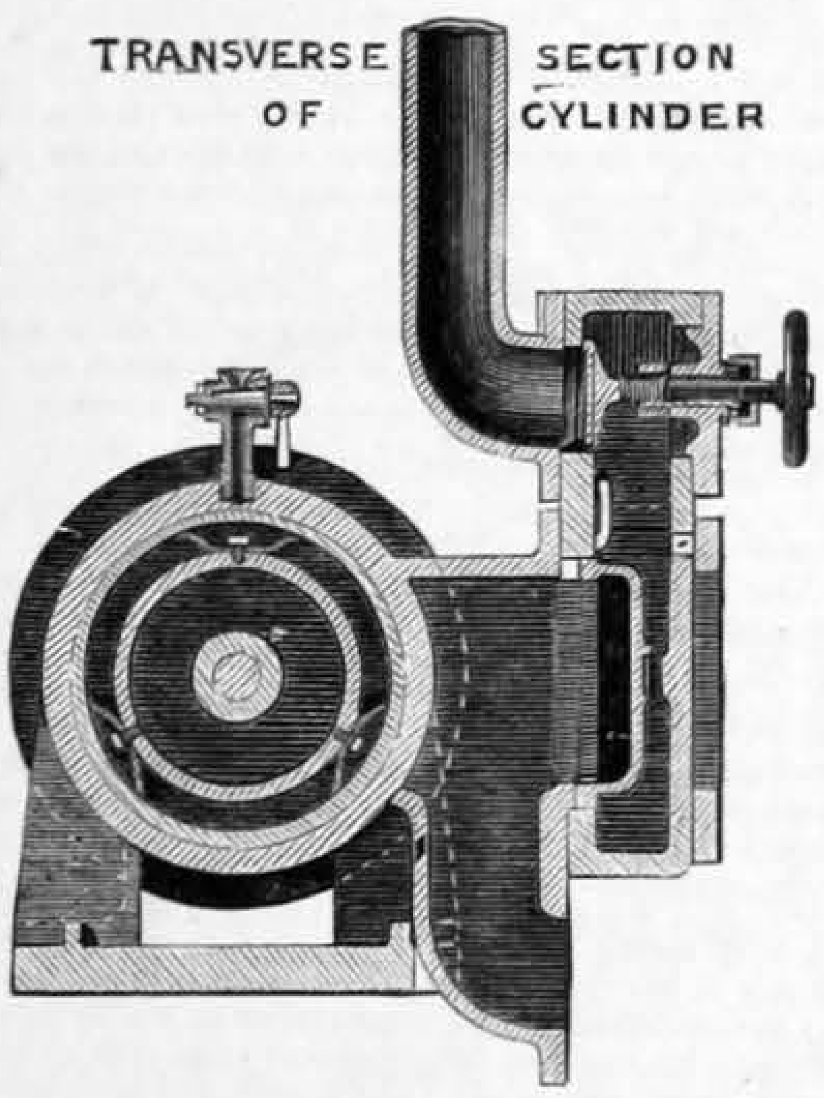


LONGITUDINAL ELEVATION.

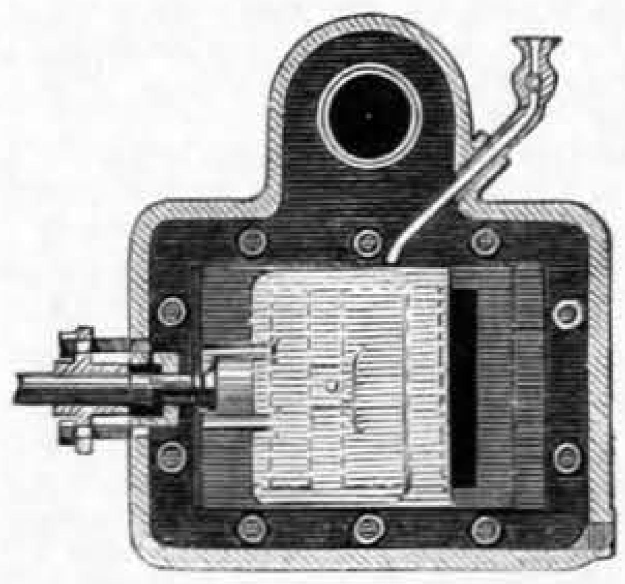


PLAN

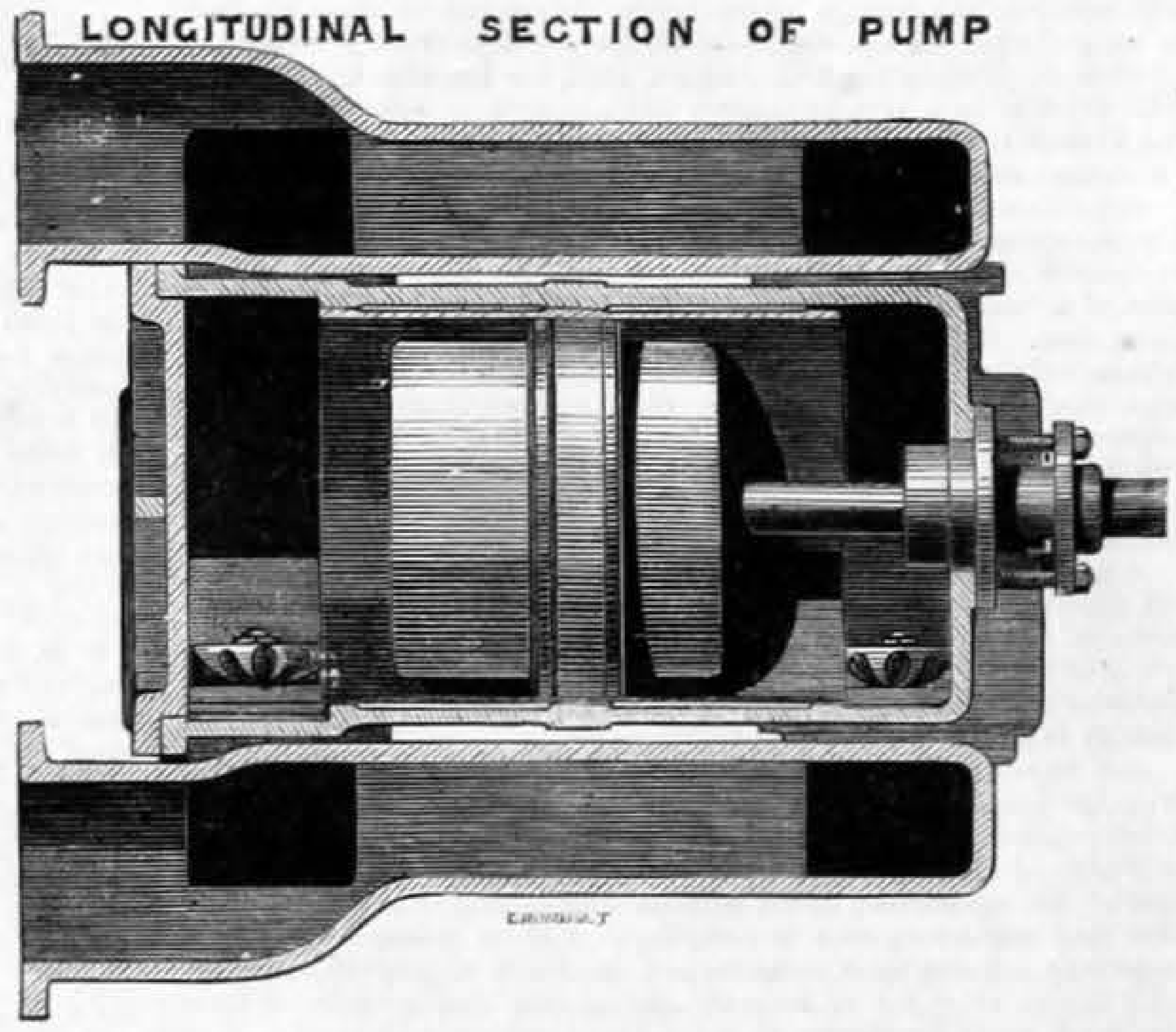
TRANSVERSE SECTION OF CYLINDER



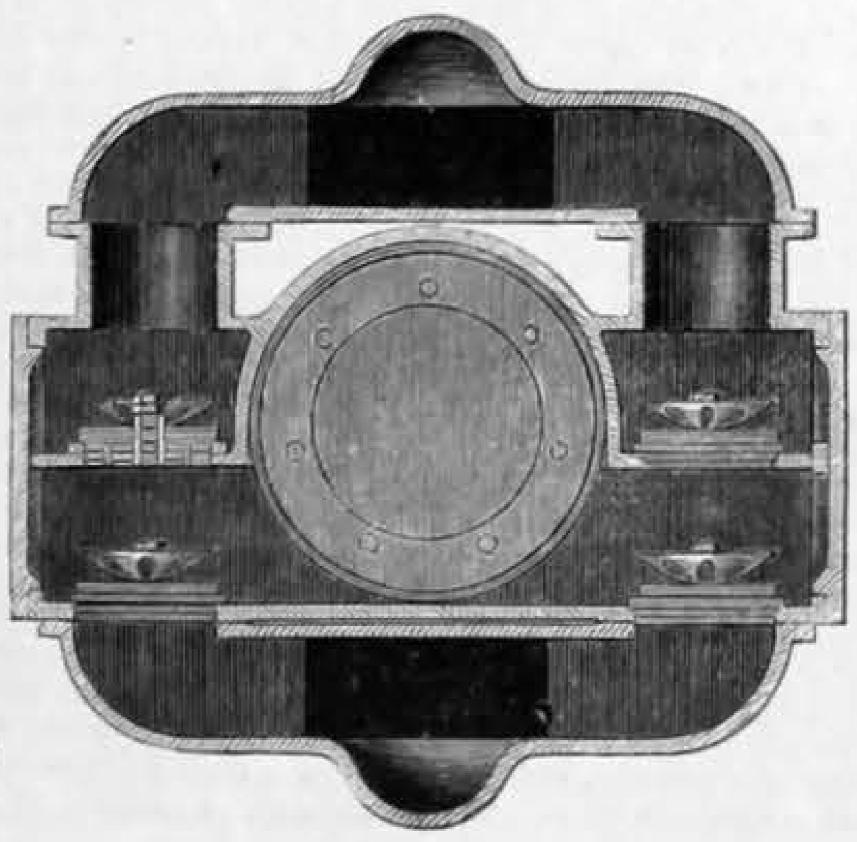
SECTIONAL ELEVATION OF VALVE & CASING



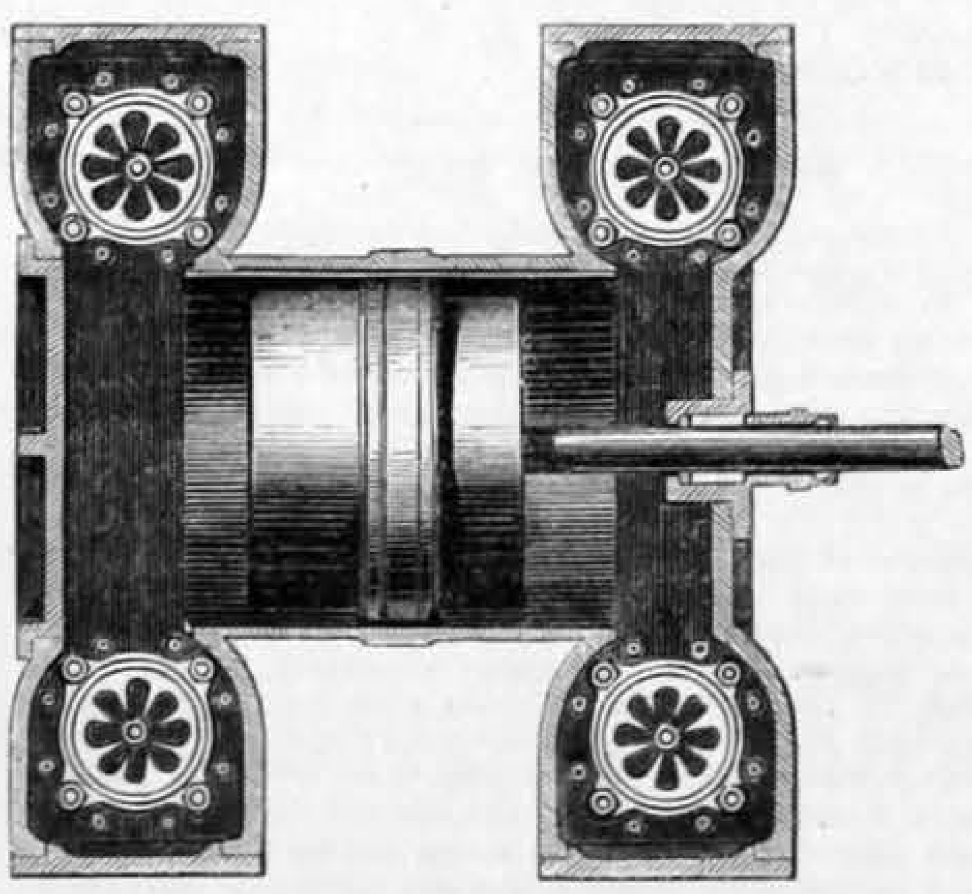
LONGITUDINAL SECTION OF PUMP



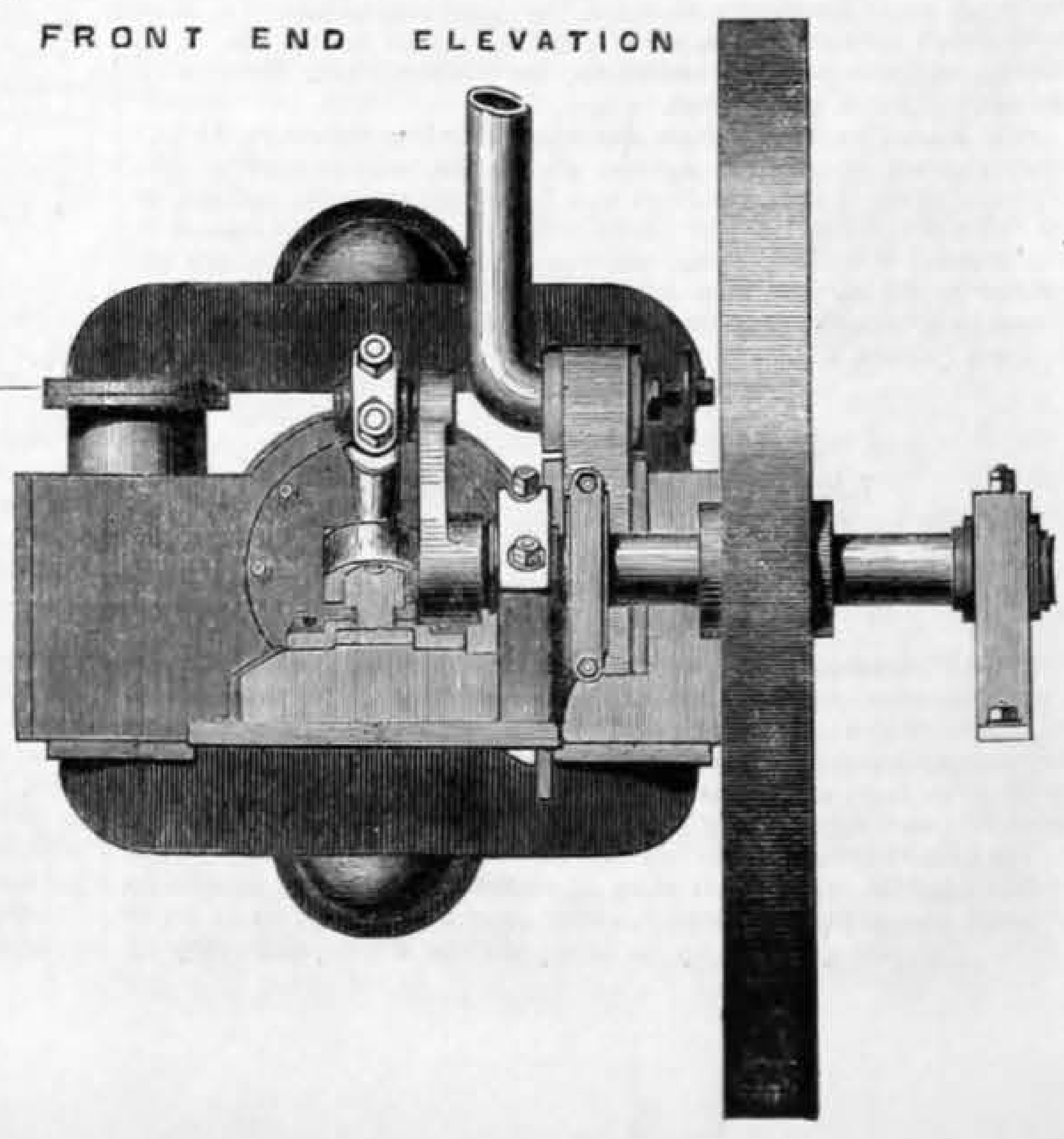
TRANSVERSE SECTION THRO VALVE BOXES



SECTIONAL PLAN OF PUMP



FRONT END ELEVATION



TO CORRESPONDENTS.

T. J. (Pontypool).—*Received, and will be examined.*

A. M. (Preston).—*Mr. Barry is the architect, and the cost £1,600.*

G.—*No. 3, ordinary pattern. The injector will work in any position.*

W. S. N.—(Chard).—*We do not know the address of the party to whom you refer.*

CONSTANT READER.—("Paper Pipes.")—*A letter lies at our office for this correspondent.*

NEMO.—*Scott Burns' is the best work on agricultural machinery. As far as we are aware, there is no distinct treatise on paper machinery in existence.*

F. H.—*Any publisher will supply you with a list of several works of moderate price, on the strains and strength of girders. You will find a formula in Molesworth's Pocket-book, last edition, which may answer your purpose.*

A. E.—*An aqueduct is a conduit for water supported on some structure above the general surface of the ground; a viaduct is a structure formed to unite one carriage road with another, as across a valley. The boiler you describe would require a pressure of about 600 lb. per square inch to burst it. It may be worked safely to 100 lb.*

G. R. M.—(Middlesboro'-on-Tees.)—*We have no doubt that your scheme would answer admirably. The application of a Gauntlett's pyrometer and self-acting damper would secure the cylinder from injury. As you are apparently in a position to reduce the invention to practice, we should advise you to secure a patent.*

C. J. B.—*You cannot procure a good and comprehensive treatise on docks and ships for £2 2s. Steward's "Docks and Harbours of the United States" would have answered your purpose, but, unfortunately, it is out of print. You can obtain a great deal of information on the subject in the shape of papers, &c., for £2 2s., by addressing any scientific publisher, Messrs. Spon, for example.*

R. M.—*As you give neither the speeds nor the pressures it is impossible to answer your question properly. Assuming that the engine is of the ordinary condensing class, running at 240ft. to 300ft. per minute, a crank shaft 5½in. in diameter will answer; the second shaft 1in. to 1¼in. larger. If the machinery be exposed to sudden shocks or strains, both these dimensions must be increased.*

THE DUBLIN EXHIBITION.

(To the Editor of The Engineer.)

SIR,—In your article No. 3 on the Dublin International Exhibition, page 245, in THE ENGINEER of this date, you describe a pumping engine exhibited by Messrs. Courtney, Stephens, and Co., of Dublin, as "an invention of theirs, possessing some novelty of principle."

In 1862 we designed and made pumps of this kind for Messrs. Perkins and Sons, the patentees of the well-known aniline mauve and other dyes. You will see, therefore, that the design and application was made by us long prior to Messrs. Courtney, Stephens, and Co.'s use of it.

Essex-street Wharves, Strand, London, GWYNNE AND CO.
October 20th, 1865.

THE ENGINEER.

FRIDAY, OCTOBER 27, 1865.

THE ORDNANCE SELECT COMMITTEE ON NAVAL GUNS.

IT will be remembered that in June last, Mr. Baillie demanded from the Government an explanation of the proceedings of the Ordnance Select Committee as regarded the experiments undertaken by it, to determine the relative merits of the different systems of rifling known as Commander Scott's, Mr. Lancaster's, Mr. Britten's, Mr. Jeffrey's, and that at first spoken of as the French, and subsequently termed the Woolwich system. In the course of his speech, Mr. Baillie implied that Commander Scott was not dealt fairly with, and he accused the members of the committee of going beyond their province as judges and assuming the office of inventors. The Marquis of Hartington in his reply stated that the Scott gun had been overrated in certain quarters as would be seen when the official report was published; while the Woolwich gun was not an invention but an adaptation. It is unnecessary to dwell further on the speeches of either Mr. Baillie or the noble lord. The report demanded by the former gentleman now lies before us, and we can state, with all due deference to the Marquis of Hartington, that we have risen from its perusal with the conviction that the statements he made in the House of Commons have not been verified, and that, notwithstanding an extremely judicious use of figures, the Scott gun holds a place as the best weapon for naval purposes brought forward during the entire competition.

We do not pretend to dispute for a moment the fact that more than one of the rival systems approached that of Captain Scott so nearly, that it becomes as difficult in one sense to decide the question of relative merit, as it is to determine which is the better horse in a race won by a head. The questions at issue may be, and probably will be, warmly discussed; but in order to arrive at anything like a really valuable decision, it is absolutely necessary to set up some standard of excellence, or of qualifications, to which the guns must approximate more or less closely in order that they may be fit for naval service at all; that which approximates most closely being, of course, the best. So long as guns are merely tested against each other, their places in the order of merit may be changed daily with the nature of the test. No one system can excel in every point, nor does it follow that the gun of the highest average merit is necessarily the best. A gun may, indeed, be radically bad in some one characteristic, and yet a very excellent gun for particular purposes notwithstanding. No one would think of shooting snipe with an Enfield rifle; yet, regarded in the abstract sense as an instrument constructed on scientific principles, the rifle is immeasurably superior to the smooth-bore fowling-piece.

Now it so happens that naval men have long since made up their minds as to the kind of gun which they want, and were they but left to follow their own devices they would have had this gun two or three years ago. In high quarters, however, the sailor is still regarded as an infant, if not an idiot, unable to take care of himself, and above all things not to be trusted in the selection of the weapons wherewith he is expected to rule the waves, and keep Britons from slavery. This duty has hitherto devolved mainly on the officers of the Royal Artillery—gentlemen who, for the most part, know a good deal about guns, especially in theory, and nothing whatever about a ship, save in that general way in which all landsmen are familiar with the vessels which make war upon the seas. The best gun for sailors' use is, in one word, that which can burn most powder with safety behind projectiles of adequate weight. This qualification wanting, all others are absent. Next comes facility of loading—not only at the practice-ground, but under all possible exigencies of weather or of warfare. As to ease of handling, a gun of six or twelve tons is as easily moved as six or twelve tons of iron in any other form; and as all guns can be placed, weight for weight, on an equality in this respect, the question requires no consideration at present. An extended range—the power of throwing shot, or rather shell, to a distance—is worth something; and last of all we may place accuracy of fire—an essential point in any gun intended for land service, but practically unnecessary—at least in the highest degree—and unattainable at sea; at once because of the magnitude of the object to be struck, and the unsteadiness of the base—the deck of a rolling ship—from which the gun is fired. Ordnance is useless without projectiles, and we find that these present questions of hardly less importance than those connected with the guns from which they are to be fired. In the first place they must admit of being kept for long periods without deterioration; they must be simple in structure, consisting of the fewest possible parts and the smallest variety of materials; they must be strong and hard, and in the case of shells, capable of holding very large bursting charges. And, finally, they must be cheap, provided that very admirable feature be not purchased at the expense of others of yet more importance. It is just possible that some of our readers may take exception to this list of qualifications, considering, perhaps, that we have placed the last first and the first last. We believe, however, that all naval men will endorse our opinions, while few arguments can be produced by others against them; and taking this list as a basis, and the testimony of the select committee as evidence, we shall find that the Scott gun has not only held its own but completely distanced all its competitors save the French-Woolwich gun; while its projectiles possess so marked a superiority over those of this last that we find ample confirmation of all that has been said in its favour as a weapon for naval use.

The report contains a vast mass of figures in the form of an appendix, and a general summary of the results obtained. An exception might, with strict propriety, be taken to the manner in which this summary has been prepared. We presume that a little "cooking" is unavoidable in these matters, however; and in order to avoid complication, or the suspicion of favouritism, we prefer, for the present, to confine ourselves strictly to the consideration of the summary. We have already given sections of the guns, and the following description will supply all the additional information requisite:—"The guns are muzzle-"loading. They have solid steel tubes three inches thick, "a solid forged breech piece, and external strengthening "coils. Their weight averages 149 cwt., and the length "of bore is 10ft. 6in. Cammell's steel is used in Scott's, "Lancaster's, and the Jeffrey and Britten guns, and "Firth's steel in the other. They are vented 5·75in. from "the end of the bore, being the position to give the greatest "initial velocity with a charge of 20 lb. . . . . Dry "sponging was used for the first forty-five rounds, and "would, apparently, have sufficed to keep the guns clean; "but the loading of Lancaster's gun with a second supply "of shot became so difficult that a wet sponge had to be "used with that gun, and it was then used with "the others also, so that all might be placed on an "equal footing." From this it is evident that Mr. Lancaster's gun failed in one very important point at the outset. We may add that it is necessary to suspend a guiding cradle on the muzzle of the gun, in order that the exact position in which only the shot will enter the bore may be secured. About 350 rounds have been fired from each piece, and the committee state that, as far as concerns the infliction of injury to the rifling, all the guns are on a perfect equality. As to easiness of loading, "The French "gun was certainly the easiest to load, but there was "nothing to complain of in this respect in Commander "Scott's gun; Mr. Lancaster's shot were *all* got home with "more or less difficulty, and in some cases a metal rammer "had to be used." . . None of the projectiles are liable to injury from knocking about, but the Lancaster should take the first place in this respect; Commander Scott's first plan, second place; the French shot, on Palliser's system, the third; and Scott's second plan the last. As Mr. Lancaster's oval shot have neither ribs, nor other projections of any kind, they are in precisely the same condition as round shot. The ribs on Scott's shot are cast in one with the mass of the projectile, and therefore, as they are broad and of little elevation, and without corners, they are not much worse off. The buttons of the Palliser shot are certainly open to injury from hard knocks. In Scott's second plan (not that, be it be observed, which he deems best) zinc ribs are inserted into dovetailed grooves, to protect the rifling, instead of small copper studs, and although these may possibly get knocked about a little by very rough usage, serious injury can scarcely be done them. In fact, all the guns appear to be tolerably perfect in this respect.

The power of a gun to impart injury to armour plates depends, other things being equal, on the velocity of the shot; and as plates of average thickness cannot be punched at all at long ranges, we may proceed a step further and state that the power of punching or smashing depends on the initial velocity of the shot; this velocity depends, *cæteris paribus*, upon the charge of powder, the nature of the grooving, and the weight of the projectile. The faculty of imparting a high initial velocity is obviously the most valuable characteristic which a naval gun can possess. We find from the report that, to use the committee's own words, "the gun rifled on the French "system has somewhat decidedly the lowest velocities, "and Mr. Lancaster's, on the whole, the highest. He is "in every instance superior in this respect to Commander "Scott, but is exceeded once by Mr. Jeffrey, and once by "Mr. Britten." To reduce this statement to its proper dimensions we may state simply that Mr. Jeffrey and Mr. Britten's shot being lead-coated, were found at an early period of the competition to be totally unsuitable for use with heavy charges, the lead being blown off in fragments, and the flight of the shot consequently erratic to a degree. These systems were therefore withdrawn from competition. Two of Commander Scott's rivals thus disposed of, Lancaster remains; but it so happens that shell break up in the bore of his gun from the peculiar nature of the strain to which they are exposed. Lest there should be any mistake we shall quote the words of the report:—"The Lancaster shells were found on recovery, with only "one exception, to be split at the head, showing appa-"rently, as has always been suspected, that in that system "the projectile has a great tendency to jam in the bore, "bringing severe pressure on the gun and projectile." It is but fair to add that, since these first shells were fired, Mr. Lancaster has produced others of a different pattern, from which better results were obtained. Still, "the "committee were unanimously of opinion that the Lan-"caster system should be rejected, on account of the "tendency to crush in the bore, its inferior accuracy, and "the difficulty of loading." The competition is thus reduced to exceedingly narrow limits; and as the so-called French system is "somewhat decidedly" inferior in initial velocity to the Scott gun, the conclusion cannot be resisted that, in this particular, the latter gun is "somewhat decidedly" the better of the two. The initial velocities of the two guns are given as follow:—with 25 lb. charges, Scott, 1,594, French, 1,529ft. per second; with 20 lb. charges, Scott, 1,502, French, 1,444; with 12 lb. charges, Scott, 1,277, French, 1,254 — elongated projectiles, weighing 110 lb. With round shot the difference is even more distinctly marked. With 20 lb. and 12 lb. charges respectively the velocities in the case of the Scott gun were 2,162ft. and 1,827ft.; while with the French gun and the same charges they fell to 2,081ft. and 1,718ft. per second. These figures require no comment.

So far we find that the Scott gun not only held its own but excelled its rivals on more than one important point. Nevertheless the committee have rejected it in favour of the French-Woolwich gun. Why? Ostensibly because it is said to have been deficient in accuracy. Yet we find that the mean reduced deflection amounted to but 6·7 yards on the average, at elevations varying from 2 deg. to 10 deg., and at ranges of 1,100 to 4,500 yards; while that of the Lancaster gun reached 7·4 yards, and that of the French gun 3·6 yards. But while the elevation was confined to 2 deg. we find that the average deflection of the Scott gun reached but 2·03 yards, while that of the French gun reach 1·1 yards, and this, be it remembered, at ranges of 1,400 yards. It is very like splitting straws to draw a distinction here, and we shall not attempt it. It must be borne in mind that the guns were not tested at sea but on land. Had the experiment been tried in the proper place—on a ship's deck—the results, such as they are, might have been very different. In anywise great accuracy is not required at sea. Even the old 68-pounder made splendid practice at Simonasaki, on board the Leopard under Admiral Kuper; and the superiority manifested by the French gun even in this respect is so trifling that it cannot for a moment be brought into comparison with the superior advantages in other respects possessed by the Scott gun. We have hardly touched upon the relative merits of the projectiles for the two systems. We have said enough, we think, to show that a gun, absolutely the first of the kind ever made, has, nevertheless, from the first moment manifested in competition with comparatively well-known systems, a superiority which may possibly be yet further developed by the introduction of those modifications usually required in novel designs, and which, as it is, is sufficient to entitle it to the rank of the best 7in. rifled naval gun yet constructed.

PATENT LAW REFINING.

PEOPLE will no doubt continue till the end of the chapter to allow their interests to obscure their judgment. But it is often amusing to see the *naive* earnestness with which a man will sometimes forsake a conclusion to which he has arrived through the long vista of his own interests. From a broad point of view the interests, for instance, of manufacturers and inventors might be considered identical; but this is unfortunately not so in practice, no more so than with buyers and sellers, or masters and servants. Vested interests will constantly assert themselves, and the coppersmiths of society will always cry that the Diana of the Ephesians is great. Capitalists with plant that may be depreciated by new schemes are not over anxious to appreciate the schemer. A manufacturer has seldom any interest in superseding his own machine and plant, and his judgment is more or less warped by a constant attention to the cramped ideas of routine. A worthy capitalist of this kind need be no ill-natured man to feel vexed on waking up some fine morning to find a keen-eyed inventor whose rights he has to buy off. We also can sympathise with the worthy manufacturer. Yet that is no reason why we should sympathise with the attempt he might make to improve the inventor off the face of the earth. But we are obliged to hold Mr. R. A. Macfie, an eminent sugar refiner of Liverpool, guilty of a mild attempt of this kind. Doubtless also a further and more subtle motive unconsciously lends its aid to Mr. Macfie's exertions. To be wealthy, and with perhaps plenty of time on one's hands, and yet to live in ordinary retirement, is more than what some men can put up with. Pseudo-science now seems to offer a ready means of some sort of distinction. We may thus, with every probability, trace to their origin "treatises on corpulence" or on patent reform, and perhaps also a facetious work on the "Quadrature of the Circle," by a fellow townsman of Mr. Macfie, who has pestered every distinguished mathematician in England with his ridiculous theory, and who is barefaced enough to print the notes, expressing mingled annoyance and contempt, which he has received in reply. But then the satisfaction of seeing one's name in print—of seeing one's name in the columns of a review, make any chance flagellation of such folly an operation of mingled pain and pleasure.

The text of Mr. Macfie's last sermon against patents is—"Long restrictions in the use of inventions, and obligation to make heavy payments to patentees, incompatible with free and fair trade." It is at once clear that he objects to the long duration of successful patents, and also to the amount of the royalties. We will now see the arguments upon which he bases the objections he made before an assembly, the president of which—who, as a lawyer of the highest eminence, has probably devoted more time to the subject than anyone now living—stated in his inaugural address that the exclusion of a patentee "from the monopoly he now enjoys is extremely hard to be distinguished from that which would deprive authors of their copyright." Mr. Macfie, very obligingly, does not deny the right of property of an inventor in his invention; what he disputes "is his exclusive right." Rushing in where Lord Brougham feared to tread, he repeats the usual weak argument against drawing an analogy between patentright and copyright, which is founded on the supposition "that to grant exclusive privileges to an author interferes with nobody else's composition." The meaning of this assertion is, we suppose, that the ideas of a previous author may be legally repeated if they be, at the same time, clothed in other words. An action at law could probably not be brought for mere plagiary; but the same sort of thing may be done in mechanical invention, as it is possible to evade paying the patent-right on an invention by carrying it out with different means, mechanical or chemical. Neither the mere ideas in a book can be absolutely protected from plagiarism by the law of copyright, nor can the mere principle of a patented invention be even legally protected by patent-right. We then find that he speaks of the manufacturer being "denied the use of an invention." So are we denied the enjoyment of Mr. Macfie's doubtlessly very excellent sugar, unless we are able to pay its trade price; and we should have to wait still longer than fourteen years, unless we were before enabled to pay for it. A patent has also its market price, and its value is regulated by the laws of supply and demand, just as with any other commodity. The worthy author then gives a full rein to his eloquence, successively asserting that a patent monopoly is "despotic," "erratic," "retarding," "preposterous," "illogical," "inquisitorial," "unnatural," "cruel," "extravagant," "partial," and, lastly "irremediable; for equal treatment is morally impossible at home and abroad." As a proof how superficially Mr. Macfie has really studied the subject, he says that "only some states grant patents at all." In Europe these few exceptions are Switzerland and Turkey—in the first case a little republic split up into a number of disputative cantons; in the second, a despotic and semi-barbarous state, which one would have thought to have been at least the last in Europe to be cited as an example for our imitation. Lord Houghton lately observed at Birmingham, that the only Swiss invention he knew of was that of the alpenstock; and even in Turkey exclusive privileges are granted to inventors by means of the Sultan's firman.

With courage and perseverance worthy of a better cause, our author repeats "as still in his opinion practicable and "expedient" the proposal submitted at the Edinburgh meeting of the Social Science Congress, viz., "to grant national rewards in money." A competent board should be appointed to award to each patentee "a fair "sum." This agreeable little arrangement—which Mr. Macfie dignifies with the title of "a system"—"would "sweep away [of course] every hindrance to the immediate "enjoyment by every one of every invention." It would, in fact, bring about a millenium of sugar and other manufacturers, and the manufacturing lamb would calmly lie down with the inventive panther. This proposal is so childish and impracticable that we had believed it to be long ago torn up to the last shred. It is not improbable that a patent tribunal will be instituted in this country for deciding on the novelty of any invention it is proposed to patent; but there are objections and difficulties to be encountered in forming a tribunal with even this limited scope. To leave such questions to the decision of lawyers would only be a change from one bad system to another. A tribunal of practical men will in any case have to be appointed, with all its members disconnected with trade, as a jury chosen from men actually engaged in manufacturing would often have a direct interest against a patent right. We must confess that we should be rather chary of, for instance, trusting to Mr. Macfie's decision in an important improvement for refining sugar, while quite willing to believe that he would do his best to be disinterested. Again, there are some trades, such as that of working up india-rubber, in which only very few people are engaged, and of which but few therefore have a practical knowledge. All these difficulties would have to be overcome by a tribunal formed to take only novelty into consideration. But Mr. Macfie's tribunal would have to consider not merely novelty, but also utility, merit, and many financial points. For our own part, we should prefer not being employed in the thankless task of a daily distribution of such a number of golden apples of discord. Would Mr. Bessemer have carried out his steel-making process without the patent law to aid, merely with the hope of a Government grant? We may state that Mr. Bessemer was only prevented by chance from publicly declaring at the meeting of the Social Science Section of the British Association at Birmingham that, without the patent laws, there would be no such thing as the Bessemer process. And, in any case, what tribunal would have had the courage to grant Mr. Bessemer the £100,000 per annum he is now very deservedly earning in royalties?

But even Mr. Macfie is without hope that he will live to witness a patent millennium—that "happy year of release." He therefore purposes to grant patents, "such "as heretofore (not resisting any reformation that may "appear expedient), but to enact that, on the demand of "any manufacturer, after three years of monopoly, any "invention may be valued—not, of course, on the basis of "the return which it might bring, but on that of its "originality, the cost incurred in working it out, its advantage, &c.; whereupon it shall be lawful for a Patent "Board to extinguish the grant in any of the following "circumstances:—1. If the patentee's books (which he "should be obliged to keep in all cases where his fees from "any individuals exceed £100 per annum) show that he has "already received in fees the valuation price. 2. If "manufacturers and others buy as much as will make the "price up. 3. If the State pay the remainder of the price, "purchasing the invention for the nation." "And," continues our worthy sugar-refiner, "I would include a condition that any one may obtain exemption for himself, or "his firm, by paying, say, a tenth of the price." It is seen that all Mr. Macfie's proposals, reasonable as they appear at first from a manufacturer's point of view, are based on the practical possibility of forming a suitable tribunal for the just examination, not merely of the originality and novelty of an invention, but also as to its utility; the cost incurred in working it out; the merit and energy displayed by the patentee in putting it on the market, and the thousand and one other points involved in the matter. We all know what enormous difficulty—amounting in some cases to impossibility—our courts of law, at least at present, have in answering the single question whether a patent be valid or not, be novel or not. But here a complete bunch of connected questions have to be answered. And supposing that the probably impossible feat of forming a sound tribunal of the kind could be overcome, Mr. Macfie's proposition amounts to neither more nor less than granting a manufacturer the right to bring an action against any successful patentee whose invention he covets. Who is to fee the counsel and the train of scientific witnesses who would have to be called upon by the patentee to establish his case against that of the manufacturers? The more valuable the patent would be the greater the expenses, just as the more valuable a patent now is, the greater—and, therefore, necessarily the more expensive—the opposition made before the Judicial Committee of the Privy Council against its prolongation. Like any other cause which is brought before any other human tribunal, the ultimate decision will very much depend upon the ability with which it is conducted, more especially when, as here, the decision will be as to a greater or less amount of money, and not as to the existence or non-existence of the patent. Mr. Macfie's suggestions are doubtless well-meant—in the interests of manufacturers; his paper has been read by us with an attention all the greater that its obscurities of style demanded a concentrated attention, without which it would have been unintelligible. We have, indeed, come to the conclusion that the author's exertions will find a more congenial sphere in refining sugar than in refining our laws. Should, however, Mr. Macfie have any spare time on his hands next year, we would propose as the text of his next sermon before the Social Science Congress—"Title deeds for the long possession of houses, and obligation to make heavy annual payments to the owners of house property, incompatible with the free and fair rights of man."

"THE IMPERIAL RAILWAY" SCHEME.

In calling the attention of our readers to one of the most remarkable railway schemes ever projected, we wish it to be understood that for the present we have no wish to express any decided opinion whatever on its merits. That is a question which only time can decide. In the fact that the scheme is gigantic, that if carried out it must involve the expenditure of enormous sums, and materially affect the interests of existing railway companies, we find sufficient reason for affording it a moment's consideration. It is evident, too, that the mind which has originated the idea possesses considerable power, for the details have apparently been worked out with a care and forethought which impart a certain weight to the project. It is, indeed, impossible to read a species of prospectus which has recently found its way into somewhat limited circulation, without perceiving that we have not a dream, but something which may become a tangible reality to deal with. We feel that it is possible that the idea may be carried out, but we feel it much as a generation just passing away may have felt about the railway system itself at the time when Stephenson's road between Manchester and Liverpool had been open for a few months. Fortunes will certainly be made and lost before the Imperial Railway of Great Britain is opened to the public; and even the most ardent speculators will think twice before embarking on an enterprise which cannot fail to involve an immediate expenditure nearly unparalleled in the history of railway construction.

As the affair stands at present, the projectors—whosoever they may be—contemplate the construction of three great lines of railway extending from a central station on the south side of New Oxford-street in London, to Dover, Holyhead, Edinburgh, and Glasgow. The grand principle to be observed in the construction of these lines is complete isolation. They are intended to unite termini, not contiguous districts or towns. Nor are they to assimilate in any way with existing lines. They will have a distinct gauge, and no connection whatever will exist, or be permitted to exist, between them and other lines. The first section will consist of a railway seventy-five miles long, uniting the metropolis with Dover Harbour. Crossing the Thames between Somerset House and the Temple, it will proceed in the most direct route possible to Dover. On this section there will be no intermediate stations. The second section will be a railway 240 miles in length, uniting London with Holyhead. On it there will be but two intermediate stations, one at Stratford-on-Avon, and one at Shrewsbury. The third section will be a railway 435 miles long, uniting London with Edinburgh and Glasgow. On this section it is proposed to provide four stations, at Nottingham, Leeds, Carlisle, and at Peebles, from which a branch would extend to Glasgow. The gauge of all the lines will be seven feet, this width being adopted at once to permit the use of engines of maximum power, to secure safety at excessive speeds, and to enable luxurious accommodation to be provided for passengers. Under no circumstances will heavy goods be conveyed. The line will be absolutely devoted to the transport of passengers, mails, and possibly troops; and no accommodation will be provided for any other kind of traffic.

It will be seen that, according to this programme, we should have 750 miles of railway with but six intermediate stations, and neither junctions nor sidings. The amount of accommodation provided for the public at large would therefore be reduced within very narrow limits; but, on the other hand, the most serious element of the danger attending express railway traffic would be completely eliminated, and a certain amount of saving would be effected in the first cost of construction. The absence of junctions with their attendant complications is, indeed, absolutely essential to the working of the lines. The paramount object had in view in the construction of the system is to produce safe, rapid, and easy communication between the metropolis and distant parts of the kingdom; and it is, therefore, specially provided that not less than six trains shall leave London and arrive there each day on each section, and that the medium speed shall be 60 miles per hour, stoppages included. Thus the time to be occupied in going to Dover would be about one hour and a quarter, to Holyhead four hours, and to Edinburgh and Glasgow six hours and twenty minutes and six hours and three-quarters respectively. The fares are calculated at the following very moderate rates:—London to Dover, Stratford, or Nottingham, first class, 12s.; second class, 8s. London to all other stations—First class, 20s.; second class, 15s. Between each of the intermediate stations—First class, 15s.; second class, 8s. But in no case would a higher fare than one pound be charged for first class passengers. Furthermore, there would be no third class, the fares being below 1d. per mile at the rates we have given, nor would there be return tickets nor special rates of any kind.

It is quite evident that such accommodation as this cannot be provided at a moderate sum; and we find, accordingly, that the cost of the line is estimated at the rate of £35,000 per mile. The total cost of the railway would thus reach about £30,000,000, including £2,000,000 for rolling stock and £1,750,000 for contingences. Without entering into details, we may state, generally, that a revenue of £2,584,000 per annum is reckoned upon, from which a dividend of £5 per cent. may be paid, leaving 40 per cent. for working expenses.

Regarded merely from an engineering point of view there is nothing whatever to prevent this magnificent scheme from being carried out to the fullest extent. The practical skill and scientific attainments of the members of our profession are sufficient guarantee that works precisely similar to those which have already been executed well, would be executed still better; and it would be absurd to deny that £35,000 per mile is a very liberal estimate for the cost of even a first-class broad gauge double line, laid with steel rails. Speeds of 70 miles per hour have been sometimes reached with moderate loads and powerful engines, but not without incurring heavy expenses. It is just at this point that a project, otherwise skilfully prepared, breaks down. The working expenses could not possibly, as far as we can see, be kept within 40 per cent. of the receipts, as calculated. Engines weighing less than 40 to 44 tons would not be competent to the performance of the required work; and unless Mr. Rambottom's water-trough system were extensively employed, tenders of excessive weight, holding possibly 3,000 gallons of water, must be provided. Loads such as these propelled at a speed of 60 to 65 miles per hour are certain to tell heavily on track, and even steel rails could not keep maintenance expenses within moderate limits. The consumption of fuel, too, could not fail to be heavy—as much possibly as 45 lb. or 50 lb. per mile run; while the weight of the train—of the paying load in short—would bear a very moderate proportion to that of the engine. In order that the lines might be worked at such speed with any prospect of success, it would be indispensable to render them as nearly dead level as possible, the speed being already so high that nothing is to be gained by descending inclines, which absorb power not to be spared in effecting their ascent. This, of course, in turn entails increased first cost, and we are strongly of opinion that, even under these conditions, before the Imperial Railway had been open many months it would be found expedient to reduce the speeds to something considerably less than 60 miles per hour. The maximum average pace on the London and North-Western is at this moment under 40 miles.

Whether or no the scheme will ever be carried out it is, of course, impossible to determine in the absence of a special gift of prophecy. There is no reason to doubt that among one section of the community it would be regarded as something too good to be true, while another would be disposed to regard it as something too bad to be brought to pass. Numbers would benefit largely, while certain of our railway companies would suffer not a little from a species of competition worse than anything which has as yet haunted the mind of the most timorous of directors. We might extend the list of possibilities considerably were it necessary. There is but one point about the whole matter that deserves to be termed a certainty, which is simply, that a very large proportion of the proposed capital will find its way into the pockets of the gentlemen of the wig and gown before the first sod of the Imperial Railway is turned.

A French company has obtained leave to lay down the first railway between Teheran and the popular shrine for pilgrims or holiday-makers, the tomb of Schah Abdel Azim.

ON RETAINING WALLS.

By Arthur Jacob, B.A., Assoc. I.C.E.

In designing masonry works there is hardly any subject that presents itself more frequently than the retaining or revetment wall; and in some form or other, it is found to enter into almost every design. To the military engineer, no less than to his civil brother, is the subject one of importance and interest, entering as the revetment wall does into the composition of works of defence; and our acknowledgments are due not only to our own military engineers, but to foreign engineers, for much valuable information on this, as well as on other subjects. The subject is one that has received the fullest and most able treatment at the hands of mathematicians, and solutions for every case that could possibly occur in practice are to be found in our text-books. But the mathematical investigations of this and many other questions of common occurrence in practice, unquestionably valuable as they are, in determining the principle involved, and establishing final rules applicable to practice, are it is believed, but rarely resorted to by practical engineers. Even when such examples have to be dealt with by those sufficiently acquainted with the mathematical mode of proceeding, they are generally decided without hesitation by some empirical rule, the result of experience. Such a method may, and doubtless occasionally does, lead to accident from weakness, and not unfrequently, to clumsy waste of material and expense. But it is not clear that less of failure or clumsiness would result if every retaining wall were calculated with mathematical precision, for, in truth, the data involved are so variable and imperfect, and the disturbing causes are of such a character as to neutralise, to a great extent, the accuracy of the investigation. With certain specific data theoretical accuracy can always be attained, but the engineer, as a rule, knows nothing certainly either of the weight of the earth he has to sustain in position, or of the masonry that he intends to adopt in doing so. These, and other data, he must assume before he enters on his calculations.

It is not proposed now to regard more than with a cursory glance, the principles involved in determining the strength of retaining walls to support earthwork. Such simple rules will be given, as it is hoped will serve—due regard being had to the peculiarities of each particular case—to guide the less experienced in designing works of this class.

It must not be presumed that the failure and destruction of a retaining wall is necessarily due to the wall being of itself insufficiently strong. It may be quite heavy enough to resist the pressure of a bank, if due regard be had to the mode of forming the earthwork, and to drainage; but, if these points be not fairly considered and observed at first, a retaining wall of quite sufficient thickness will probably give way sooner or later. As much care should, in fact, be devoted to the method of backing-up and draining a wall, as to the calculation of its section; and indeed if these matters be disregarded, no retaining wall, properly so called, can be implicitly relied upon to stand. With the exception of one particular case, which will be noticed hereafter, walls are designed on the assumption that they are to support a dry material—or one, at any rate, not permeated by water—and deposited in such a manner as to have no predisposition to slide against the wall. It is, of course, also presumed that the wall shall be of fair workmanship and materials, and, where these points cannot be relied upon, as is sometimes the case in foreign works, some allowance should be made in the dimensions of the wall. It has not unfrequently happened that a retaining wall will have stood for a considerable number of years without showing any appearance of yielding, and yet give way suddenly and completely, without apparent cause. Such failures can generally be accounted for by the fact of the wall not being designed to resist a *maximum* pressure, and never having been tried fully till the time of its destruction. Much apparent anomaly is observed in the way that retaining walls are found to fulfil the purpose for which they are designed. Some will yield, while others of less dimensions, will continue to stand. To account for such anomalous results the cause of the failure must be sought elsewhere than in the section of the wall.

The first and simplest case of a retaining wall to be considered is that in which the pressure of water has to be counteracted; not indeed that the question in such a form belongs, strictly speaking, to the subject under notice; it, nevertheless, becomes absolutely the method of determining the strength of walls for certain positions. It not unfrequently happens, as in some hydraulic works, or with the wing-walls of aqueducts, that the infiltration from behind, which is not always avoidable, may produce such a pressure as no retaining wall, properly so called, could be expected to bear. With this in view the engineer's limit of safety will be attained when the structure is designed to sustain the full hydrostatic pressure. The pressure of water upon any plane surface immersed, is known to be *equal to the area of that surface, multiplied by the depth of its centre of gravity below the level of the water, and by the weight of a unit of water.* Generally speaking the unit adopted in calculations is a foot; and the unit of water being taken at a cubic foot, weighing 62·5 lb., the resulting product, from the multiplication of the three quantities, will give the *pressure* in pounds on the surface immersed. Let it be supposed for simplicity, that water to the depth of 10ft. has to be sustained by a vertical rectangular wall. It is usual to take but 1ft. length of the wall for the calculation, though it will not affect the result whether 1ft. or 100ft. be the length assumed. We then have the unit under pressure = 10 square feet, the depth of the centre of gravity = 5ft., and the weight of a cubic foot of water = 62·5 lb.; the product of which quantities gives us 3,125 lb., the *pressure* on 1ft. length of the wall. But this pressure is not the whole of the force tending to overturn the wall; the leverage that it exerts must also be taken into account. In the example under consideration, namely, that of a vertical plane, with one of its sides coinciding with the surface of the water, the whole of the pressure is so distributed as to be equal to a single force acting at a point one-third of the depth from the bottom. Thus the total force to be resisted by the wall is $3125 \times \frac{10}{3} = 10416$ lb.

It is evident that a certain weight of wall must be opposed to this overturning force; and as the height of the wall, and the length, are determined quantities; the thickness alone remains for adjustment. As a rectangular wall in, upsetting is considered to turn upon a single point, namely the outer line of the foot of the wall, there will be a certain amount of leverage to assist the wall in resisting the pressure of the water. This leverage is the horizontal distance of the centre of gravity of the wall from the turning point, and when the structure is rectangular and vertical, it is equal to half the thickness. *The amount of the wall's resistance will then be equal to the number of cubic feet in one foot of its length, multiplied by the weight of a single cube foot of masonry, and by half the thickness of the wall.* Taking w = the weight of a cubic foot of water, w^1 = a cube foot of masonry, say 112 lb.; x = thickness of the wall, and h = the height; the conditions of simple stability will be fulfilled when

$$w^1 \times h \times x \times \frac{h}{2} = w \times h \times \frac{h}{2} \times \frac{h}{3}$$

$$\frac{w^1 h^2 x}{2} = \frac{w h^3}{6},$$

and solving for x we get

$$x = \sqrt{\frac{w h^2}{3 w^1}}$$

The thickness of the wall = 4ft. 4in.

A simple example has been selected for illustration, but of course a rectangular section of wall would not be found generally applicable in practice, nor would it be expedient to limit the dimensions of a retaining wall, of whatever kind, to the minimum that would sustain the pressure; some margin of safety must be allowed to cover inferior work and materials. It is true that no account has been taken of cohesion, which, if the wall be founded on rock or concrete, may be assumed to add to its stability about 36,000 lb. for every square foot of base. In addition to this, practice seems to indicate an increase on the calculated thickness, and in the example the mean width might be augmented to 5ft., the stability being further increased by altering the section from a rectangle, to a battering wall with offsets at the back.

A good general rule for the dimensions of a wall designed to support water or earth in a semi-fluid condition will be top width = 0·3, middle do. = 0·5, bottom do. = 0·7, the height being represented by unity.

Proceeding to the consideration of walls for the support of dry earth, it will be found that the question is one that will in general require the engineer to exercise his judgment; to determine what angle of repose he will base his calculation upon. The natural slopes assumed by earths of different tenacity are so various, that an average figure cannot be adopted with safety; the calculation of pressure from earth in fact, depending as it does essentially on this point, and a disregard of it will lead to very doubtful results, The following are a few of the slopes assumed by different materials,* but it is probable that the engineer's judgment will be of more service than any table in deciding the angle of repose:—

	Angle of repose.	Slope.
Dry sand, clay, and mixed earth	From 37 deg. —	1·33 to 1
	to 21 deg. —	2·63 to 1
Damp clay	45 deg. —	1 to 1
Wet clay...	From 17 deg. —	3·23 to 1
	to 14 deg. —	4 to 1
Shingle and gravel	From 48 deg. —	0·9 to 1
	to 35 deg. —	1·43 to 1
Peat	From 45 deg. —	1 to 1
	to 14 deg. —	4 to 1

It has been ascertained, that when a vertical wall sustains the pressure of a bank of earth the top of which is horizontal, the maximum horizontal pressure to which it can be subjected will be reached when the plane of fracture of the earth bisects the angle, that would be formed were the earth to slope from the foot of the wall backwards at the natural inclination. This fact is somewhat striking; for it would appear at first sight, and was for long assumed, that the angle of fracture ought to coincide with the natural slope of the earth—such is, however, not really the case. If we suppose the angle made between the sloping plane and the vertical to be bisected, the prism of earth enclosed between the bisecting plane and the wall will, represent the mass, the pressure of which has to be resisted; and this being the *maximum* pressure that a horizontal topped bank is capable of exerting, it is usually the point to be determined.

The following formula, in which P = the *pressure* sought in pounds; w = the weight of a cubic foot of the bank, also in pounds; h = the height of the wall in feet; and c = the angle contained between the natural slope of the earth and the back of the wall, or the complement of the angle of repose, will represent the maximum pressure to be resisted. *When the top of the bank is horizontal*

$$P = \frac{w h^2}{2} \tan.^2 \tfrac{1}{2} c$$

Having calculated the *pressure* of the earth, the next consideration will be, what weight of wall will suffice to sustain it; and the method of arriving at this is similar, for the most part, to that adopted for water. Taking as above, the moment of the wall to resist the pressure; the following equation will represent the conditions of stability:

$$\frac{w' h^2 x}{2} = \frac{w h^2}{2} \tan^2 \tfrac{1}{2} c \times \frac{h}{3}$$

It being observed that the centre of pressure is in this case also, equal to $\frac{1}{3}$ of the height of the wall. Solving for x, the thickness of the wall, we have—

$$x = \sqrt{\frac{w h^2 \tan^2 \frac{1}{2} c}{3 w'}}$$

and, if the weight of a cubic foot of earth be taken equal to a cubic foot of the wall, the value will be—

$$x = \sqrt{\frac{h^2 \tan^2 \frac{1}{2} c}{3}}$$

which would give a thickness of 2·69ft. for a rectangular wall supporting a bank of earth; the angle of repose being taken at 40 deg. The average weight of brickwork, and ordinary clay, will generally be nearly the same; but, if great accuracy be desired, and the respective weights of the materials be known, the first of the two formulæ must be used.

(*To be continued.*)

* Rankine's "Manual of Civil Engineering."

THE ROUQUAYROL SELF-REGULATING DIVING APPARATUS.

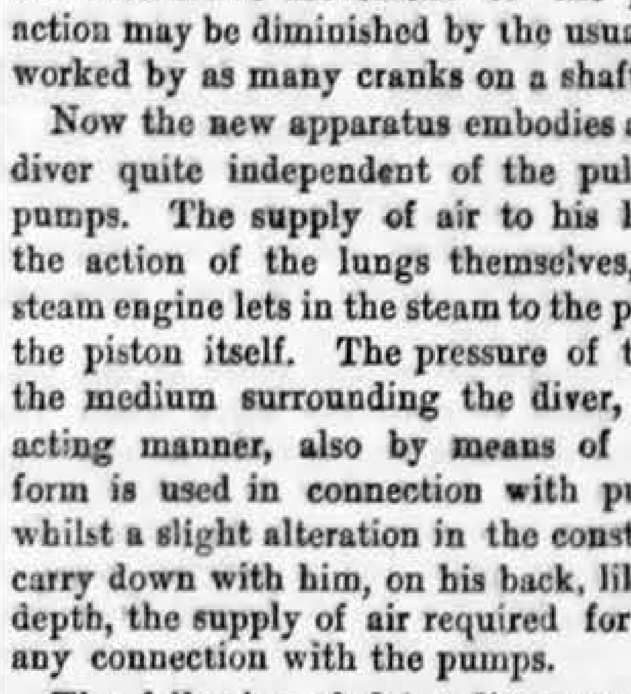
While the French and English navies were on their late visit to Plymouth, a lieutenant in the Imperial navy, M. Denayrouse, provided with an introduction to our Admiralty, was allowed to make practical trials on board our ships of a new diving apparatus. Many of the seamen on board the present men-of-war are accustomed to the use of the ordinary diving apparatus, which has to be often employed in cleaning the ships' bottoms, and for other submarine purposes. But these men, though of course provided with the usual daring and bodily strength of the English sailor, refused to descend in the new-fangled apparatus. Fortunately for Lieutenant Denayrouse, he was enabled to call upon the services of his comrades in the French frigate, the Magenta, as some hundred of his diving apparatus have been for some time used on board the Imperial navy, and more especially the Magenta. And when the English sailors, to their surprise, saw their French rivals remain comfortably beneath the surface of the water for more than half an hour, by means of the apparatus we are going to describe, they exclaimed that what Frenchmen could do for half an hour Englishmen could do for two hours. From that time, M. Denayrouse had no lack of English volunteers in carrying out trials which have already led to important orders from our Admiralty for his diving apparatus. The importance of a really good and easy plan of the kind is such, both to our royal and mercantile navies, more especially as no preventive means have yet been discovered for keeping ships' bottoms clean, that we make no apology in calling to our aid a number of published private and official documents on the invention.*

The aim of the apparatus, like that of any other diving apparatus, is necessarily to furnish air to a man placed in an unbreathable medium, of a pressure either equal to, or lower than, that of the atmosphere. When a man dives under water, his organs of respiration undergo a pressure increasing with the depth. The air furnished him ought thus to be at a pressure equal to that which he undergoes; at a lower pressure than that of the surrounding medium his chest might be crushed in, at a much higher pressure than that of the surrounding medium his lungs would be torn. In the ordinary apparatus, the diver, surrounded with an air and water-tight covering, breathes the air pressed into it by a force-pump. By means of a valve he can let off any excess of air, if necessary; while his supply may be increased by setting in action a signal agreed upon with the men working the pumps. It is clear that the lungs and other organs of the diver may be thus affected by the variations of the alternative movement of the pumps, however much this action may be diminished by the usual plan of using three pumps worked by as many cranks on a shaft regulated by a fly-wheel.

Now the new apparatus embodies a principle which renders the diver quite independent of the pulsations of the air from the pumps. The supply of air to his lungs is in fact regulated by the action of the lungs themselves, just as the slide-valve of a steam engine lets in the steam to the piston by the indirect means of the piston itself. The pressure of the air delivered is at that of the medium surrounding the diver, being determined in a self-acting manner, also by means of the apparatus itself. One form is used in connection with pumps in the ordinary way, whilst a slight alteration in the construction permits the diver to carry down with him, on his back, like a knapsack, and to a given depth, the supply of air required for about half an hour without any connection with the pumps.

The following skeleton diagrams are intended to explain the principle of the apparatus divested of its practical details. Leaving out the pumps, the entire apparatus for furnishing air to the diver, in successive supplies regulated by the action of his lungs, and at pressures mainly regulated by the action of the medium surrounding the apparatus, may be said to be completely shown by Fig. 1. That part intended to equilibrate the pressure of the breathable air with the pressure of the surrounding water mainly consists of a reservoir R containing compressed air. Above this reservoir is the equilibrium or air case B. This case is closed at its upper part by means of a metallic or wooden plate, of a lesser diameter than that of the casing, and also covered over with a disc of india-rubber, or of pliable leather, of a larger diameter. A self-tightening joint is thus formed on a somewhat similar principle to the ordinary self-adjusting collar of a hydraulic press. It is seen that this joint allows the top of the case to rise, as when the interior exceeds the outside pressure, and *vice versâ*. The reservoir R and the air chamber B communicate by a small hole, closed by a conical valve opening from above. This forms the air valve, and, similarly in the centre of the apparatus, the self-adjusting cover carries a guided stem, the axis of which is prolonged from that

Fig. 1.

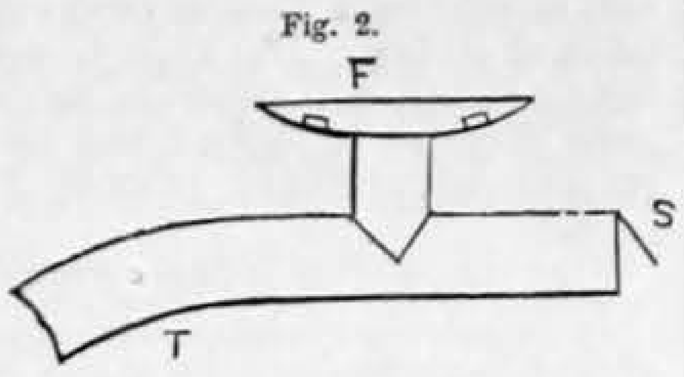


Skeleton Diagram of the Regulator.

* Rapport de la Commission chargée d'experimenter l'Appareil plongeur Rouquayrol à Air comprimé à Bord de la Fregate Cuirassée, La Gloire.—Rapport de la Commission assemblée à Bord de la Fregate La Themis, pour experimenter l'Appareil plongeur Rouquayrol à Air comprimé.—Rapport de la Commission chargée d'experimenter l'Appareil plongeur Rouquayrol à Air comprimé au Port de Brest.—Rapport de la Commission chargée d'experimenter l'Appareil plongeur Rouquayrol à Air comprimé, dans l'Arsenal de Cherbourg. Paris: E. Thunot et Cie. 1865.—Note sur l'Appareil Plongeur Rouquayrol à Air comprimé et sur son Emploi dans la Marine. Par A. Denayrouse, Lieutenant de vaisseau. Publication authorisée par S. Exc. M. le Ministre de la Marine et des Colonies. Paris: Arthus Bertrand.—Notes sur l'Appareil plongeur Rouquayrol pour Travaux Sous-marines, Mines et Sauvetages. Par G. Horeau. Nancy: Prosper Trenel. 1865.

of the air valve. The inhaling tube T takes the air from the chamber B, and it communicates at M with the mouth of the diver. At A is an exhaust valve, which opens from the inside to the outside. The whole apparatus thus substantially consists of a reservoir R, containing a store of air, in communication or not with the pumps; of another vessel B, itself communicating with the reservoir by means of a valve; of a self-adjusting cover; and of a tube T with the mouthpiece M, and out-let valve A.

Fig. 2.



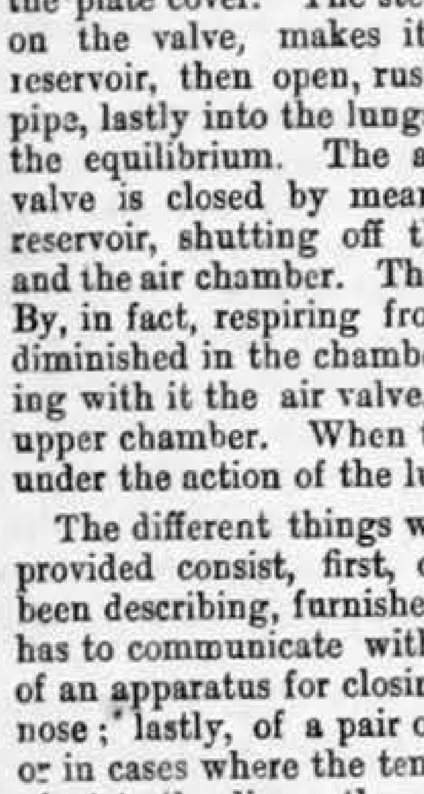
Skeleton Diagram of the Inhaling and Exhaling Valves.

The apparatus thus arranged gives out, as we shall show further on, a current of air at a constant pressure. The inhaling pipe T is fixed under the air-chamber. The diver, having arranged the apparatus on his back, the compressed air keeps the conical valve on its seat. The cover of the air chamber has, above and below it, air at one atmosphere, and everything is in equilibrio. As soon as the workmen has placed the breathing pipe T between his teeth (his nose being closed by any ordinary means) he inhales a portion of the air contained in the case through the india-rubber tube. The atmospheric pressure immediately forces down the plate: and the india-rubber packing gives way, carrying with it the plate cover. The stem, fixed to the cover, and thus pressing on the valve, makes it open the passage; the air from the reservoir, then open, rushes forth into the chamber, then into the pipe, lastly into the lungs of the operator, and thus re-establishes the equilibrium. The action of respiration having ceased, the valve is closed by means of the excess of pressure in the air reservoir, shutting off the communication between the reservoir and the air chamber. The stem again forces up the plate, and so on. By, in fact, respiring from the tube T, the pressure of the air is diminished in the chamber B, the cover being pressed down, carrying with it the air valve, which opens and lets the air into the upper chamber. When the air is exhausted, the valve then opens under the action of the lungs and lets the air out.

The different things with which the diver must necessarily be provided consist, first, of a "regulator," of the kind we have been describing, furnished with a breathing tube, and also, if he has to communicate with the pumps, with a feed pipe; secondly, of an apparatus for closing the mouth; of another for closing the nose; lastly, of a pair of cast iron soles. For hydraulic works, or in cases where the temperature of the water would be inconvenient to the divers, they are clothed in an india rubber dress with a mask, simply for protecting them against the cold water, but without any intention of using the dress as a reservoir of air. This dress can therefore get torn without any danger.

We will now describe these different parts more in detail. As we have said, the principal apparatus, which we have called the regulator, consists of two parts: first, the air reservoir; second, the air chamber. The air reservoir is made either of iron or steel plate, about three-eighths thick, in order to resist the pressure of the air, and to, at the same time, obtain an apparatus of sufficient weight. The air is let in through a copper socket, screwed in on the right hand side of the regulator, when placed on the back of the workman. This gland also carries a small valve, which can be closed by the inside pressure in case that the feed pipe from the pumps should get broken. The air chamber is cold-soldered on the air reservoir, and both are tinned inside to prevent rusting. It is also made with two holes, in which are respectively soldered the sockets for the breathing tube, and the valve through which it is exhaled. The air valve, placed in the centre of the air chamber, is the most important detail of the apparatus. It is made of aluminium bronze, and it consists of several parts—the valve seating, the valve and its stem, the spindle and its different adjuncts, shown in Fig 3.

Fig. 3.

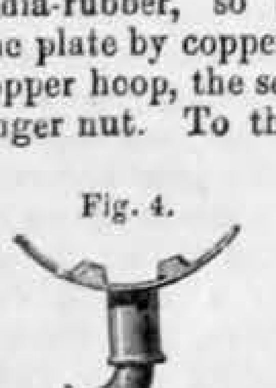


Air Valve (One-third full size.)

The spindle of the cover at the top, intended to open the valve when the cover descends, and to allow its shutting when the cover rises, is evidently not always in contact with the valve. The covering plate has a narrow range of action, but yet rather longer than that of the valve; that is to say, when the valve rises up against its seat the plate can still also rise up beyond a determinate amount, to be increased or diminished by regulating the apparatus. It thus happens that when the air is being exhausted from the lungs of the operative this air begins by raising the plate of the chamber. Beyond a certain range the action of the cover ceases, and the exhaled air is forced through the air chamber out at the exhaling valve and into the water. By regulating the upward range of the cover the exhaled air, mixing with the fresh air from the regulator, is breathed over a second time. It is found in practice that a considerable economy of air, unattended with any inconvenience to the diver, is thus obtained.

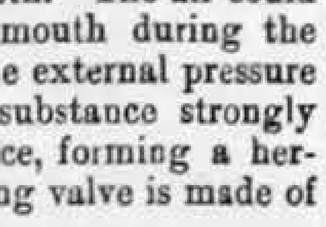
The solid brass seating is made six-sided, in order to take a screw key, and the inside is tapped for the seat of the valve itself; this small valve is conical, and its seat is made with four slits at its base, so that the air gets freely under the mushroom. The spindle attached to the covering plate, and used to regulate the alternative action of the valve, as we have explained, must necessarily exercise great influence on the consumption of the air; the screwed part of this stern spindle carries the cover. The joint of the cover is generally made of very pure india-rubber, so as to have great elasticity; it is fixed on the plate by copper screws, and on the air chamber by means of a copper hoop, the segments of which are tightened by a bolt and a finger nut. To the inhaling pipe is attached the apparatus for closing the mouth; the air being inhaled passing through the centre of this mask. It is made of an oval plate of vulcanised india-rubber, with two projections inside, which are to be seized by the teeth. The air could only penetrate into the mouth during the action of inhaling, but the external pressure itself applies the elastic substance strongly against the teeth and face, forming a hermetic joint. The exhaling valve is made of two thin plates of vulcanised india-rubber, stuck together longitudinally, and fixed to one of the brass sockets in the air-chamber. It is clear that the least effort of the lungs drives out the plates, thus making a way for the air; but that, as soon as the effort ceases, the outside pressure keeps the two plates strongly against each other. The whole regulator thus composed is kept, like a knapsack, at the back of the man by two india-rubber braces, so arranged that, by opening a single ring, the diver can, in case of accident, free himself of the entire apparatus. His nostrils are closed with the steel nipper shown in Fig. 6, the blades of which are faced with india rubber. This detail forms a spring, the pressure of which is regulated as required by a screw placed behind the joint. The two strings are tied behind the head, in order to keep the nippers from being lost should they chance to slip down. As a sort of ballast for the diver at the bottom of the water, it is necessary to attach weights (Fig. 7) to his feet. These soles are made of cast iron, weighing about 18 lb. each, and are fixed with straps, like skates. A spring heel-piece holds the cast iron sole, so that, by pressing on the pedal with one foot, the man can disengage himself from the weights without stooping. Though of secondary importance in practice, Lieutenant Denayrouse considers that the increased confidence thus given to the men is of great importance, as they are thereby afforded the means of at once rising to the surface in case of any accident. Thus equipped with the single apparatus, the diver, merely clothed in a flannel dress as a protection against the cold, is quite free in his movements, and can instantly jump into the water to disengage a fouled screw or anchor, or to even stop up a hole made by a bullet. In less than a minute he can put on his weighted soles, sling the regulator on his back like a knapsack, and fix on the nippers for closing his nostrils. But in winter, and generally in very cold climates, or when lengthy hydraulic works have to be done, the low temperature may require the diver to be protected from any contact with the water. A waterproof coat and mask are then used. This dress is waterproof, and is furnished with wristbands of pure vulcanised india-rubber; the collar is also edged with a large band of india-rubber and cloth. The wristbands are tightened with elastic bracelets in a single piece, and the neck-band is fixed round the bottom of the mask with a copper collar kept by a single bolt. The mask of tinned iron is furnished with a strong piece of glass, through which passes the breathing pipe attached to the mouthpiece. The man thus breathes in the same way as if he had no dress; but he must take the precaution of exhaling a few breaths of air into the mask, in order to place the air within it in equilibrio with the surrounding pressure. A small tap, fitted to the top of the mask, allows the diver to evacuate any air which may be in excess when he rises in the water, and, therefore, with an attendant change in the extraneous pressure.

Fig. 4.



Mouthpiece (One-fourth full size).

Fig. 5.

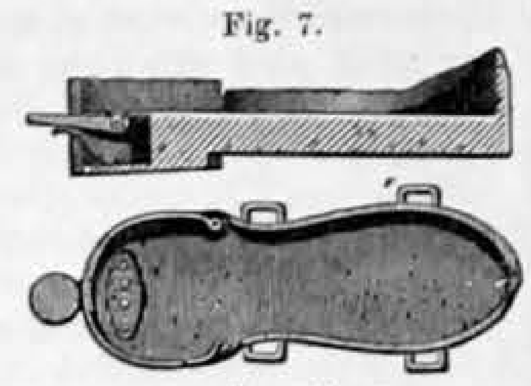


Air Exhaling Valve (One-fifth full size).

Fig. 6.

Nose Nippers (one-fourth full size).

Fig. 7.



Cast Iron Soles (One-tenth full size).

As regards the capacity of the apparatus and the duration of their action, we may observe that a reservoir intended for low pressures has a capacity of 8 litres, about one gallon three quarts. We may suppose it charged with air at 6 atmospheres for a diver working in a depth of 5 metres, or 16ft. 4in. It is evident that the air of the reservoir, if it be not renewed, can be breathed by the diver till its pressure is lowered to that of the surrounding medium, or 1½ atmospheres. Eight litres of air at a pressure of 6 atmospheres represent 32 litres at 1½ atmospheres. The diver has thus at his disposal, before emptying the reservoir, 32−8 = 24 litres of air; or 30 respirations, of 0·8 litres. The man under water has, therefore, a supply of air for two minutes should the pumps cease to work, or the feed pipe get torn.

The reservoir of the high pressure apparatus can contain 35 litres, or nearly 7 gallons 3 quarts. If charged with 40 atmospheres for a diver working under 15 metres, or 49ft. of water, and if we calculate on the same data, we shall find that he can use 525 litres, or more than 115 gallons at the surrounding pressure. This quantity is sufficient for 656 respirations, at seventeen per minute; giving a period of 38 min. without it being necessary for the air reservoir to communicate with the pumps. This time can be still further lengthened out if the stroke of the cover be regulated in such wise as to cause the man to use a second time a portion of the air exhaled.

Such is the description of a diving apparatus, certainly combining remarkably ingenious and original features. In the construction of its regulating apparatus is embodied the very novel idea of *utilising a vital force for determining an alternative movement.* It is probably the first time that such a delicate organ as the lungs has been made to produce useful mechanical work of the kind. When the Rouquayrol regulator is in action, the least dilatation or contraction of the man's chest is accompanied with a corresponding rise and fall of the top plate, and the air bubbles formed in the water by the exhaled air rise with the regularity of a stop watch. The success of the two hundred apparatus of the kind in the French and Dutch navies may be said to have taken the invention out of the domain of theory, but Lieutenant Denayrouse makes the following simple calculation in elucidation of the action of the regulator. When compressed air is let into the reservoir its elastic force closes the conical valve, and the pressure rises within this confined space. If we suppose a weight K placed on the unity of surface of the cover, and that it causes the valve to open, the compressed air will then rush into the air chamber, and, acting on the cover, will produce an effect tending to raise the weight K. Calling S the surface of the plate; s the surface of the conical valve; p the pressure in the reservoir; p^1 the pressure in the air chamber, then the mechanical effort tending to lower the cover is KS, and the resisting effort is

$$p^1 S + p s.$$

There will be equilibrium when we have

$$KS = p^1 S + p s,$$

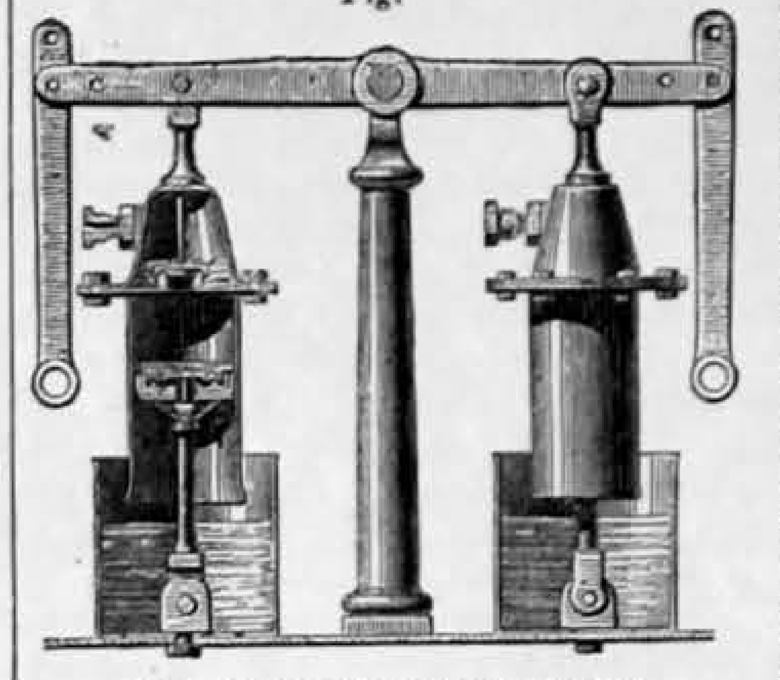
whence

$$p^1 = \frac{KS - ps}{s} = K - p \times \frac{s}{S}.$$

It is therefore seen that if s be taken sufficiently small in relation to S—an easily realised condition between the two surfaces—there will be a pressure under the cover pretty nearly equal to that above it. If the air in the chamber be let out the pressure p^1 diminishes, and the conical valve tends to open; but the air then penetrates under the cover and re-establishes the equilibrium. A constant flow of air is thus obtained, which can be regulated by establishing a suitable relation between the weight K and the surfaces S and s. Substituting any numbers in this formula, it is seen that the air furnished to the lungs is almost exactly at the surrounding pressure, and that the action of breathing therefore occurs without effort; the lungs, in fact, only receive the exact quantity of air they require. In this calculation the weights of the parts, as can be at once seen, have been omitted on account of their low amounts having but an unappreciable effect on the working of the apparatus.

According to the pressure of the air employed there are three kinds of the diving apparatus we have been describing. The low-pressure apparatus requires to be continuously fed with air of a pressure not exceeding 6 atmospheres. The medium-pressure apparatus holds a supply of air compressed in advance to a pressure of not more than 20 atmospheres; while the high-pressure reservoir contains a supply of compressed air at from 30 to 40 atmospheres. A practical means had thus to be found for condensing air, without leakage or heat, down to a pressure of from 30 to 40 atmospheres. The pumps employed by the inventors for these purposes embody several original features. The reversed pistons (Fig. 8) are fixed, and it is the cylinders hung from the beam which compress the air at each of its oscillations. By this means each valve can be covered with a layer of water, which is found to prevent leakages, even under considerable pressures; and these layers of water also keep the air, which is obliged to pass through them, from being heated. A pump, with a pair of cylinders, worked by two men, can furnish two divers, working under six metres of water, with sufficient air. The pressure gauge placed in the T-pipe is marked with a second graduation for the depths. The men at the pumps are hereby enabled to at once ascertain the minimum pressure for the different depths of water.

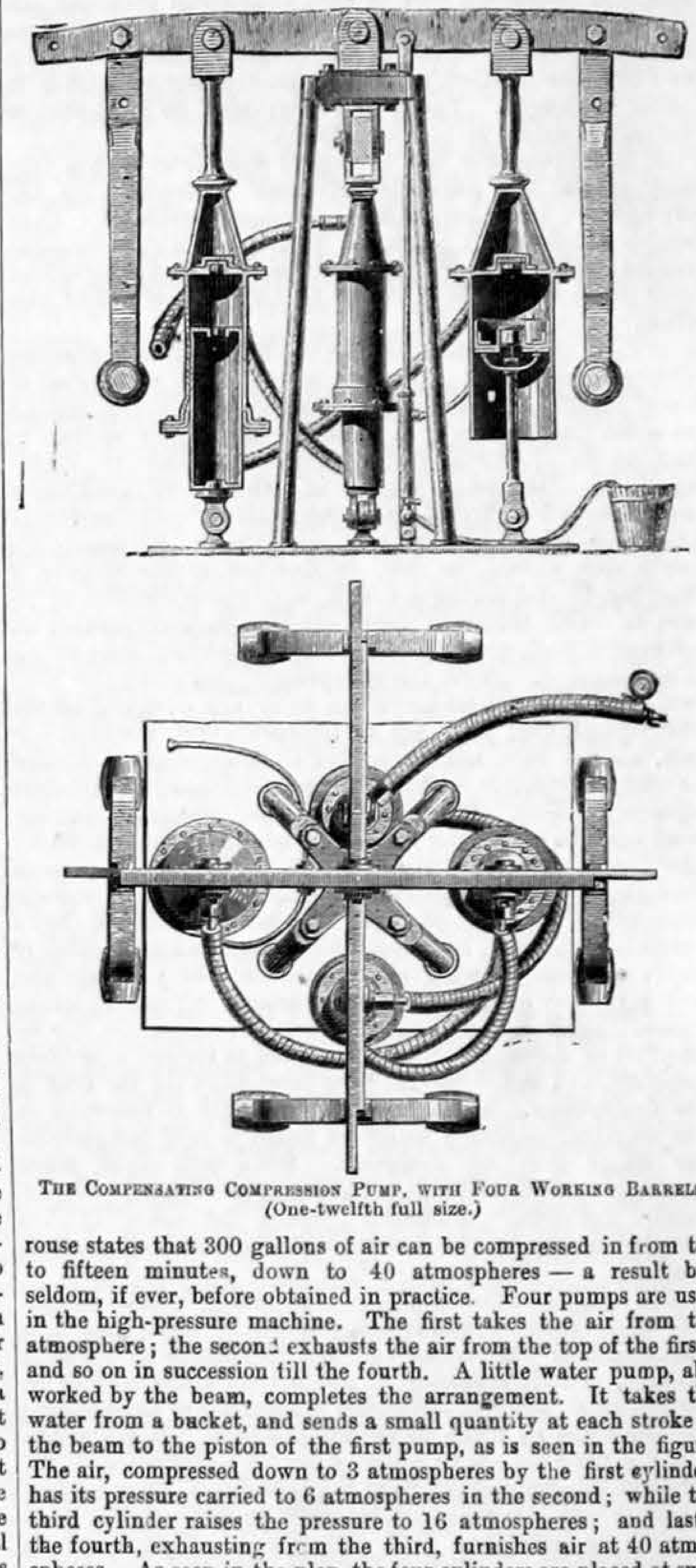
Fig.



Small Pump (One-twelfth full size).

With the high-pressure apparatus a somewhat different set of pumps is employed, termed a *compresseur compensateur* by the inventors (Fig. 9). With one of these pumps Lieutenant Denayrouse states that 300 gallons of air can be compressed in from ten to fifteen minutes, down to 40 atmospheres — a result but seldom, if ever, before obtained in practice. Four pumps are used in the high-pressure machine. The first takes the air from the atmosphere; the second exhausts the air from the top of the first; and so on in succession till the fourth. A little water pump, also worked by the beam, completes the arrangement. It takes the water from a bucket, and sends a small quantity at each stroke of the beam to the piston of the first pump, as is seen in the figure. The air, compressed down to 3 atmospheres by the first cylinder, has its pressure carried to 6 atmospheres in the second; while the third cylinder raises the pressure to 16 atmospheres; and lastly the fourth, exhausting from the third, furnishes air at 40 atmospheres. As seen in the plan, the four cylinders are placed at such a distance from the centre beams that the effort exerted is the same at each end. By the use of four cylinders, instead of directly condensing the air, the resistances are equally distributed through the stroke. The water from the little pump is also conveyed, by means of the stream of air, through the whole system, forming everywhere water joints against leakage, and keeping the air from getting heated. The fourth pump is in fact found to be as cool as the first.

Fig. 9.



The Compensating Compression Pump, with Four Working Barrels (One-twelfth full size.)

The above account is mainly extracted from the work of M. Denayrouse, who appears to have brought the invention into a working shape, and that of M. Horeau. The latter states that he witnessed a man, with the apparatus on his back, swim and dive as if quite free. The additional weights and soles, tending to keep his body at the bottom of the water, were taken off him, and the air reservoir, suspended from its ordinary braces, was tied to a belt, in order to keep it from swinging on the man's back. In this state the reservoir weighs about one kilogramme more than the water it displaces. This excess of weight does not prevent the man's swimming, either on his belly or his back, but it suffices to lower him slowly as soon as he ceases his movements, and brings his arms close to his body. The man was able to swim freely; he could plunge either head or feet foremost, rising up almost as easily as if he carried nothing. In the water where the experiments were conducted, which was six metres deep, he was able to descend and remain at the bottom, rising to the surface by means of a simple movement of the legs.

Many experiments were officially tried in the Imperial Navy before the present large number of these apparatus were ordered. The report of the commission which, on board La Gloire, carried out a number of these experiments, in recommending its adoption in the Imperial Navy, states that the apparatus "allow all sub-"marine works to be carried out with as great facility and security "as possible." It is further observed that Rouquayrol's apparatus does not require special divers as the "*premier venu* can use it without any previous teaching." Similar opinions are expressed in the report made on board the frigate La Themis, with the additional remark that another of its advantages is the great simplicity of the apparatus, as, when the temperature allows it, the diver can lower himself without a waterproof dress. The official examination, conducted at the port of Brest, and in which the apparatus was tested with a common diving apparatus, led to similarly favourable results. The members of the Brest commission remark that "the use of signalling for regulating the quantity of air is "not required. The pump itself may even be worked irregularly "and at intervals; it may even be damaged without causing "any danger to the diver, and without its being noticed by him. "With the ordinary diving apparatus it is indispensable that the "movement of the pump be continuous and very regular, and "this result can only be attained in experienced hands." The "conclusions arrived at by the Cherbourg commission are, that "the diver, at whatever depth he may be, always inhales air at the "pressure of the surrounding medium. The quantity he requires "is regulated by the play of his own lungs, independent of the "more or less continuous way in which the men at the pumps may "work. . . . . Another advantage is that as long as the "breathing of the diver takes place regularly the bubbles of air "rise and break up at the surface, and at sensibly equal intervals "of time. Should these intervals be considerably increased or "diminished—should anything unusual take place in the breathing "of the driver, the non-arrival of the air bubbles shows that he is "not breathing, and that he must be at once taken up. On the "contrary, with the ordinary apparatus, whatever may be the "bodily state of the diver, the air is always escaping from the "valve of the helmet. This advantage of the new apparatus is "of considerable weight, as it can but greatly increase the con-"fidence shown in it by all the men who have used it under water." They also observe that the lightness of the dress, used as a protection against the cold leaves more freedom to the movements of the submarine operative. These reports are all exceedingly interesting, and in each are most minutely and scientifically described all the conditions of the several experiments conducted with the apparatus.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Grants of Provisional Protection for Six Months.

1555. VICTOR DUTERNE, Rue des Fourneaux, Paris, "An improved metallic stuffing box."—*Petition recorded 7th June*, 1865.

2029. HENRI ADRIEN BONNEVILLE, Porchester-terrace, Bayswater, London, "Improvements in checking or controlling the payment of fares in cabs and other public vehicles."—A communication from Léon Becker and Joseph Leib, Boulevart Magenta, Paris.—*Petition recorded 4th August*, 1865.

2039. JOHN PETRIE, jun., Rochdale, Lancashire, "Improvements in machinery or apparatus for washing wool and other fibrous materials."—*Petition recorded 5th August*, 1865.

2137. RICHARD ARCHIBALD BROOMAN, Fleet-street, London, "Improvements in the manufacture of cast steel and cast iron, and the manufacture of a mixed metal."—A communication from Emile Martin and Pierre Emile Martin, Paris.—*Petition recorded 18th August*, 1865.

2217. RICHARD LAMING, Priory-road, Kilburn, Middlesex, "Improvements in electrical telegraphy."—*Petition recorded 29th August*, 1865.

2313. JOHN HOSE, Leicester, "An improved wheel feed for sewing machines."—*Petition recorded 9th September*, 1865.

2322. CHARLES JAMES WEBB, Randalstown, Antrim, Ireland, "Improvements in means and apparatus applicable to the lighting and reviving of fires."—*Petition recorded 11th September*, 1865.

2357. LOUIS GUSTAVE SOURZAC and LOUIS BOMBAIL, Bordeaux Gironde, France, "Improved means for rendering leather more durable and flexible."—*Petition recorded 15th September*, 1865.

2393. LEON VILLETTE, Aber-street, West Derby-road, Liverpool, "Improvements in machinery for cutting and shaping cork, with apparatus for registering the manufacture."

2397. DANIEL JOSEPH FLEETWOOD, Birmingham, "Improvements in the manufacture of spoons, forks, and other similar articles, and in apparatus or machinery to be employed therein."—*Petitions recorded 20th September*, 1865.

2417. FREDERICK THOMAS BRANDRETH and JOHN HENRY BRANDRETH, Preston, "Improvements in machinery for brushing hair."—*Petition recorded 22nd September*, 1865.

245. JACOB DREISORNER, New York, U.S., "Improvements in hydraulic pressure engines."—*Petition recorded 23rd September*, 1865.

2461. THOMAS FREDERICK CASHIN, Sheffield, and JOSEPH FELIX ALLENDER, Parkgate, near Sheffield, Yorkshire, "Improvements in the manufacture of iron and steel, and of furnaces and machinery for purifying, puddling, or heating the same."—*Petition recorded 26th September*, 1865.

2483. REES REECE, Llandilo, Carmarthen, "Improvements in obtaining and applying sulphurous acid and in apparatus used therein."

2485. BENJAMIN WREN, Stockton-on-Tees, Durham, "Improvements in grinding wheat and other grain, and in apparatus for drying and improving the condition of damp wheat or other grain."—*Petitions recorded 28th September*, 1865.

2523. CHARLES DENTON ABEL, Southampton-buildings, Chancery-lane, London, "Improvements in the mode of treating the roots of the lucerne plant for the purpose of manufacturing paper, pasteboard, fabrics, and ropes therefrom."—A communication from John Peter Caminade, Rue d'Hillier's Orleans Loiret, France.—*Petition recorded 2nd October*, 1865.

2531. CHARLES POMEROY BUTTON, Cheapside, London, "A new revolving cover for dishes, bowls, and other vessels requiring a movable cover."—A communication from Julius Rhodes Pomeroy, Broadway, New York, U.S.—*Petition recorded 3rd October*, 1865.

2547. WILLIAM BLAKEY STOCKS, Liversedge, JAMES WHITWHAM, Huddersfield, and WILLIAM BLAKEY, Batley Carr Top, near Dewsbury, Yorkshire, "Improvements in means or apparatus for cutting or shearing the nap or pile of nap, or pile fabrics."—*Petition recorded 4th October*, 1865.

2551. MICHAEL HENRY, Fleet-street, London, "Improvements in sewing machines."—A communication from Joseph Louis Kieffer and Charles Nicolas Erny, Boulevart St. Martin, Paris.

2553. JOHN MILLAR, Bethnal Green, and BETHEL BURTON, Hackney, London, "Improvements in breech-loading fire-arms."

2555. WILLIAM ROBERT BARKER, New Bond-street, London, "Improvements in apparatus for administering injections and douches to the human body."

2557. EDWARD MARSLAND and PETER WILLIAMS, Manchester, "Improvements in and applicable to machines for opening and cleaning cotton and other fibrous materials."

5559. WILLIAM HENRY PHILLIPS, Nunhead, Surrey, "Improvements in apparatus and means for extinguishing fires, part of such improvements being applicable for other purposes."

2561. ARCHIBALD RICHARD SHAW, Marina St. Leonards, Sussex, "Improvements in breaks for carriages and other vehicles."—*Petitions recorded 5th October*, 1865.

2567. RICHARD ARCHIBALD BROOMAN, Fleet-street, London, "Improvements in rotary engines and pumps."—A communication from Fidèle Chatelain, Lille, France.

2569. GEORGE WIGHTWICK RENDEL, Newcastle-on-Tyne, "Improvements in the construction of gun carriages."

2571. VICTOR JEAN BAPTISTE GERMAIX, Philippeville, Algiers, "Improvements in the manufacture of bricks and other analogous materials."

2573. ROBERT MACINTYRE CAMERON and DUNCAN CAMERON, Edinburgh, Mid-Lothian, N.B., "Improvements in pens used for writing."

2577. THOMAS MACHIN, Andover-road, Holloway, London, "Improvements in machinery or apparatus for the manufacture of wooden spills."—*Petitions recorded 6th October*, 1865.

2581. HENRY GRIFFITH CRAIG, Passage West, Cork, Ireland, "Improvements in the construction of railway carriages, wagons, and trucks, and other road vehicles."

2587. JOHN HOWARD, Fenchurch-street, London, "Improvements in the construction of compound cylinder engines."—A communication from Matthew Murray Jackson, Zurich, Switzerland.

2593. JULIUS HOMAN, The Grove, Camberwell, Surrey, "Improvements in the construction of wrought iron girders."—*Petitions recorded 7th October*, 1865.

2597. ROBERT WALMSLEY, Liverpool, "Improvements in apparatus for mangling and callendering."

2599. THOMAS MILES, Queen-street, Finsbury, London, "Improvements in the manufacture of scent and smelling bottles."

2601. WILLIAM CLARK, Chancery-lane, London, "Improvements in apparatus for propelling vessels."—A communication from Cléanthe St. Coumbary, Boulevart St. Martin, Paris.—*Petitions recorded 9th October*, 1865.

2607. GEORGE GLOVER RICH, Chesterford-terrace, Stanley-road, Hackney, London, "Improvements in the action of upright pianofortes."

2609. JOHN GARRISON WOODWARD, St. John, New Brunswick, "An improved ventilating apparatus for use in steamboats, vessels, and other places requiring to be ventilated."

2611. MARK WALKER, Mansfield, Nottinghamshire, "Improvements in flyers used in doubling machines."

2613. ARTHUR NICHOLLS, Barnsbury-row, Islington, London, "Improvements in rules for measuring, and in other instruments or articles requiring to be adjusted or disposed at various angles."

2615. JOHN JOSEPH PARKES, London-street, Paddington, London, "Improvements in the manufacture of railway station and other gas lamps."—*Petitions recorded 10th October*, 1865.

2617. THOMAS WARBURTON, Stoneclough, Lancashire, "Certain improvements in breaks for carts, wagons, and other vehicles."

2619. JAMES CRUTCHETT, Stroud, Gloucestershire, "Improvements in the manufacture of bands, belts, or straps for harness for driving machinery or for other purposes."

2621. MICHAEL HENRY, Fleet-street, London, "Improvements in railway carriages and locomotives."—A communication from Henry Giffard, Boulevart St. Martin, Paris.

2623. THOMAS DU BOULAY, Sandgate, Kent, "Improvements in carriages propelled by manual power."—*Petitions recorded 11th October*, 1865.

Invention Protected for Six Months by the Deposit of a Complete Specification.

2627. VERNON AUGUSTUS MESSINGER and VIRGIL JACKSON MESSINGER, Boston, Massachusetts, U.S., "Certain new and useful improvements in shirt collars and bosoms."—A communication from Celius Edgar Richards, North Attleboro', Massachusetts, U.S.—*Deposited and recorded 12th October*, 1865.

Patents on which the Stamp Duty of £50 has been Paid.

2804. HENRY WICKENS, Tokenhouse Yard, Bank, London.—A communication.—Dated 17th October, 1862.

2852. WILLIAM SUTTON GAMBLE, Frederick-street, Caledonian-road, Islington, London.—Dated 23rd October, 1862.

2956. MOSES MERRYWEATHER, RICHARD MOSES MERRYWEATHER, Long Acre, and EDWARD FIELD, Buckingham-street, Adelphi, London.—Dated 1st November, 1862.

2842. JAMES SPENCE, Portsmouth.—Dated 22nd October, 1862.

2849. THOMAS GREENWOOD, Leeds, Yorkshire.—Dated 22nd October, 1862.

2871. JOHN CLARK, Buchanan-street, Glasgow, Lanarkshire, N.B.—Dated 20th October, 1862.

2834. JOHN THOMAS COOKE, Leicester.—Dated 21st October, 1862.

2838. GEORGE HASELTINE, Fleet-street, London.—A communication.—Dated 21st October, 1862.

2846. HENRY HERMAN KROMSCHROEDER and JOHN FREDERICK GUSTAV KROMSCHROEDER, Princess-terrace, Regent's Park, London.—Dated 22nd October, 1862.

2853. ALEXANDER CHAPLIN and GEORGE RUSSELL, Glasgow, Lanarkshire, N.B.—Dated 23rd October, 1862.

2862. RICHARD ARCHIBALD BROOMAN, Fleet-street, London.—A communication.—Dated 23rd October, 1862.

2883. WILLIAM JAMES WILLIAMS, Dorset-street, Salisbury-square, London.—A communication.—Dated 27th October, 1862.

2979. JOHN HENRY JOHNSON, Lincoln's-inn-fields, London.—A communication.—Dated 4th November, 1862.

2854. JOHN TURNBULL, Barnard Castle, Durham.—Dated 23rd October, 1862.

Patents on which the Stamp Duty of £100 has been Paid.

2321. CHARLES WEST, Mornington-place, Camberwell New-road, London.—Dated 18th October, 1858.

2332. ALEXANDER ALLAN, THOMAS WHIMSTER, and ROBERT GRAY, Perth, N.B.—Dated 19th October, 1858.

2408. BENJAMIN FOSTER, Denholme, near Bradford, and PRINCE SMITH, Keighley, Yorkshire.—Dated 28th October, 1858.

2695. JAMES TANGYE, Birmingham.—Dated 27th November, 1858.

Notices to Proceed.

1441. THOMAS HALLAM HOBLYN, Rickling, Essex, "A new or improved compound spherical rest for ornamental turning lathes."—*Petition recorded 25th May*, 1865.

1555. VICTOR DUTERNE, Rue des Fourneaux, Paris, "An improved metallic stuffing-box."—*Petition recorded 7th June*, 1865.

1588. GAETEN BONELLI, Rue St. Appoline, Paris, "A new or improved method of obtaining or producing optical illusions."

1589. GEORGE SPEIGHT, Collingwood-street, City-road, London, "An improved machine for curling or curving collars and cuffs."

1593. WILLIAM JAMES HIXON, Bayswater, London, "Improvements in the permanent way of railways, and in locomotives applicable thereto."—*Petitions recorded 12th June*, 1865.

1596. JONATHAN ALONZO MILLINGTON, Sandling-road, and ALFRED ALLNUTT, Loose, near Maidstone, Kent, "Certain improvements in machinery employed in and for the manufacture of paper."

1600. CHARLES JAMES COLLINS, Upper Thames-street, London, "A new or improved artificial fuel."—*Petition recorded 13th June*, 1865.

1606. CHARLES DE VENDEUVRE, Caversham-road, Kentish Town, London, "A new or improved apparatus for the purpose of stopping and casing strains on ships' cables when in use."

1613. SIDNEY COURTAULD, Waddon, Surrey, and CHARLES WILKINS ATKINSON, St. George's, Bloomsbury, London, "Improved arrangements for opening and shutting carriage windows."

1614. HENRY ORMSON, Chelsea, Middlesex, "Improvements in multitubular hot water boilers."—*Petitions recorded 14th June*, 1865.

1624. PHINEAS LAWRENCE and GEORGE JEFFERYS, New York, U.S., "Improvements in copying presses."

1625. JOHN HARTLEY, Otley, Yorkshire, "Improvements in corn screens."—*Petitions recorded 15th June*, 1865.

1628. MICHAEL HENRY, Fleet-street, London, "Improvements in the method of and apparatus for effecting and recording telegraphic communications."—A communication from Sarah Martha Buckwell, Luino, Italy.

1633. WILLIAM TREVOR WANKLYN, Manchester, "Improvements in silk winding machines, part of the said improvements being also applicable to cleaning and doubling machines."—*Petitions recorded 16th June*, 1865.

1636. AUGUST KLEIN, Bridge-street, Blackfriars, London, "Improvements in gunpowder for mining and war purposes."—A communication from Gustav Adolph Neumeyer, Dobitz, Saxony.

1637. WALTER HOWES and WILLIAM BURLEY, Birmingham, "Improvements in lamps for railway and other carriages, and in connecting lamps to carriages, a part of which improvements may also be applied to handles for carriages."

1638. GEORGE PAYNE, Belmont Works, Battersea, Surrey, "Improvements in purifying cotton seed oil."

1642. VALENTINE BAKER, Dublin, "Improvements in hydraulic motive power machinery."—*Petitions recorded 17th June*, 1865.

1663. EMILE DUPONT, Fayt Ironworks, Belgium, "An improved system of wheels for railway carriages."—*Petition recorded 20th June*, 1865.

1703. CHARLES WORSSAM, Commercial Wharf, Kingsland-road, and GEORGE EVANS, Gloucester-place, Portman-square, London, "An improved pulping and compressing machine for the treatment of peat as a fuel and gas for illuminating purposes."—*Petition recorded 26th June*, 1865.

1723. RICHARD BOOT, Arboretum-street, Nottingham-lane, and JOHN COXON, Long Hedge-lane, New Sneinton, Nottingham, "Improvements in twist lace machines."—*Petition recorded 28th June*, 1865.

1773. JOHN BRAITHWAITE, Crook, near Kendall, Westmoreland, "Certain improvements in machinery or apparatus for turning and cutting wood and other substances, to be employed in the manufacture of spools or bobbins, or other similar articles."—*Petition recorded 5th July*, 1865.

1791. JOSEPH WILSON SWAN, Gateshead, Durham, "Improvements in the production of printing surfaces by photographic agency, and in obtaining prints therefrom."—*Petition recorded 6th July*, 1865.

1811. GEORGE BALDWIN WOODRUFF, Cheapside, London, "An improved apparatus for gauging and marking the width of tucks and pleats on fabrics under operation in sewing machines."—*Petition recorded 8th July*, 1865.

2033. GEORGE BALDWIN WOODRUFF, Cheapside, London, "Improvements in the construction of binders for sewing machines."—*Petition recorded 4th August*, 1865.

2065. ARNOLD BUDENBERG, George-street, Manchester, "An improved apparatus for adjusting levels and other instruments."—A communication from Carl Johann Reinhart Jahns, Berlin, Prussia.—*Petition recorded 9th August*, 1865.

2088. HENRY ROBERT GUY, London-street, London, "Improvements in the construction of submarine telegraph cables."—*Petition recorded 11th August*, 1865.

2098. WILLIAM BUNGER, Southampton-buildings, Chancery-lane, London, "Apparatus or means for ascertaining the quality and condition of grain and seed."—A communication from Christian Joseph Schmitz, Raeren, near Aix-la-Chapelle, Prussia.—*Petition recorded 14th August*, 1865.

2312. WILLIAM EDWARD NEWTON, Chancery-lane, London, "Improvements in machinery for making lace."—A communication from Alfred Masson, St. Pierre les Calais, France.—*Petition recorded 9th September*, 1865.

2357. LOUIS GUSTAVE SOURZAC and LOUIS BOMBAIL, Bordeaux, Gironde, France, "Improved means for rendering leather more durable and flexible."—*Petition recorded 15th September*, 1865.

2432. WILLIAM TURNER and SAMUEL SHORE, Tunnicliffe Mill, and WILLIAM HALLIWELL, Rochdale, Lancashire, "Improvements in cards used in carding engines and other similar machinery."—*Petition recorded 23rd September*, 1865.

2627. VERNON AUGUSTUS MESSINGER and VIRGIL JACKSON MESSINGER, Boston, Massachusetts, U.S., "Certain new and useful improvements in shirt collars and bosoms." — A communication from Celius Edgar Richards, North Attleboro', Massachusetts, U.S.—*Petition recorded 12th October*, 1865.

And notice is hereby further given, that all persons having an interest in opposing any one of such applications, are at liberty to leave particulars in writing of their objections to such applications, at the said office of the Commissioners, within twenty-one days after the date of the Gazette (and of the Journal) in which this notice is issued.

List of Specifications Published during the week ending 21st October, 1865.

3026, 1s. 6d.; 3027, 8d.; 3028, 8d.; 3029, 1s. 4d.; 3030, 4d.; 3031, 4d.; 3032, 8d.; 3033, 4d.; 3034, 8d.; 3035, 4d.; 3036, 6d.; 3037, 4d.; 3038, 10d.; 3039, 6d.; 3040, 4d.; 3041, 1s. 8d.; 3042, 6d.; 3043, 1s. 4d.; 3044, 4d.; 3045, 4d.; 3046, 4d.; 3047, 8d.; 3048, 4d.; 3049, 4d.; 3050, 4d.; 3051, 1s.; 3052, 10d.; 3053, 8d.; 3054, 4d.; 3055, 10d.; 3056, 10d.; 3057, 10d.; 3058, 4d.; 3059, 10d.; 3060, 6d.; 3061, 8d.; 3062, 2s. 4d.; 3063, 4d.; 3064, 4d.; 3065, 3s. 2d.; 3066, 1s.; 3067, 4d.; 3068, 4d.; 3069, 10d.; 3070, 4d.; 3071, 1s. 4d.; 3072, 4d.; 3073, 1s.; 3074, 4d.; 3075, 4d.; 3076, 4d.; 3077, 4d.; 3078, 10d.; 3079, 1s. 2d.; 3080, 4d.; 3081, 10d.; 3082, 8d.; 3083, 1s.; 3084, 4d.; 3085, 4d.; 3086, 4d.; 3087, 8d.; 3088, 8d.; 3089, 4d.; 3090, 10d.; 3091, 4d.; 3092, 4d.; 3093, 4d.; 3094, 4d.; 3095, 4d.; 3096, 8d.; 3097, 4d.; 3098, 4d.; 3099, 10d.; 3100, 8d.; 3101, 6d.; 3102, 4d.; 3102, 10d.; 3104, 10d.; 3105, 3s.; 3106, 4d.; 3107, 8d.; 3108, 1s. 4d.; 3109, 4d.; 3110, 4d.; 3111, 4d.; 3112, 4d.; 3113, 6d.; 3114, 1s.; 3115, 1s.

*** Specifications will be forwarded by post on receipt of the amount of price and postage. Sums exceeding 5s. must be remitted by Post-office Order, made payable at the Post-office, 5, High Holborn, or Mr. Bennet Woodcroft, her Majesty's Patent Office.

ABSTRACTS OF SPECIFICATIONS.

The following descriptions are made from Abstracts prepared expressly for THE ENGINEER, *at the office of her Majesty's Commissioners of Patents.*

CLASS 1.—PRIME MOVERS.

Including Fixed Steam and other Engines, Horse, Wind, and Water Mills, Gearing, Boilers, Fittings, &c.

905. J. PINCHBECK, *Reading*, "*Engines worked by heated air or gases.*"—*Dated 31st March*, 1865.

The objects of these improvements are to effect greater economy and to increase the power obtained from engines in which atmospheric air and gases are exploded inside the cylinder by means of an electric spark, or by any other method. To carry out this invention the inventor connects the exhaust or discharge pipe of the cylinder with a condensing chamber in a similar manner to that employed in ordinary condensing steam engines. The heated air is condensed in the chamber by a jet of cold water, and by this means a vacuum is produced in the cylinder; the ordinary air pump is used to discharge the injection water.—*Not proceeded with.*

906. J. D. B. and O. SWARBRICK, *Baxenden*, "*Steam boilers.*"—*Dated 31st March*, 1865.

Instead of placing fire-bars in the flue or flues for supporting the fire, the patentees employ a hollow fire-box, having in it any convenient number of vertical tubes, open at the top to the fire and at the bottom to the ash hole, the said tubes being round, rectangular, or of any other suitable shape. To the said fire-box and boiler they connect pipes through which the water will pass into the fire-box and circulate therein, so that the heated surface of the fire-box and exterior of the vertical tubes shall give additional heat to the water, and at the same time keep the box at a lower temperature than the ordinary fire-bars, and thereby prevent the clinkers from sticking. They also place one or more movable metal heat spreaders behind the bridge, and in the back part of the flue or flues, in order to cause the heat and flame to radiate and impinge upon the inner circumference of the flue or flues, and in order to enable the heat spreaders to cause as little obstruction as possible they make their surfaces facing the fire of a spherical or circular shape.

CLASS 2.—TRANSPORT.

Including Railways and Plant, Road-Making, Steam Vessels, Machinery and Fittings, Sailing Vessels, Boats, Carriages, Carts, Harness, &c.

878. F. W. WEBB, *Crewe, Cheshire*, "*Manufacture of steel tires for railway wheels.*"—*Dated 28th March*, 1865.

In carrying out these improvements the patentee casts the steel in a mould of peculiar shape and arrangement, the lower side of the mould being formed by a plate, upon which he rests or secures the mould box, which is of such shape in its interior as to form a casting resembling a solid railway wheel with a part attached to one side representing the axle at the outside of the wheel, which is placed in a vertical position in relation to the plate forming the bottom of the mould. That part of the mould box forming the upper side of the tire as it is cast is coned from the part forming the periphery of the tire to the vertical stalk representing the axle, which cone form of the mould allows a free escape for the air or gases when casting, and gives the casting an additional thickness to allow for the consolidation of the metal in the subsequent process. That part of the mould representing the axle extends above the body of the tire, so as to give a sufficient head to the molten metal when poured into the mould to make the casting as sound and uniform as possible. The stalk not only allows head in casting, but forms the part where the shrinkage of the metal will occur called piping, but as this stalk need only be made use of to facilitate the process of manufacture, and is subsequently removed, that portion of the casting intended to form the tire is as sound as a casting can be made of steel. The casting thus made is next heated sufficiently, and to its stalk a handle may be secured, by which the intended tire can be manipulated, the edge or periphery of which is brought between swages of a suitable form, acting by pressure or percussion, so as to consolidate the metal. The casting is then placed upon a flat block or a swage of suitable shape, having a hole in its centre to receive the stalk, and is consolidated by another flat surface or swage of suitable form acting upon its upper side by pressure or percussion, then a punch is brought upon the centre of the casting, and forced through it by pressure or percussion, driving out that part of the metal to which the stalk is attached, or the stalk may be turned or bored out and the tire completed in the usual manner.

895. G. GREENISH, *Harpurhey, Lancashire*, "*Mechanism for propelling wagons in connection with railway hoists.*"—*Dated 30th March*, 1865.

This invention relates to transferring the wagons or trucks from the permanent way of railways to the platform of the hoists employed in connection with such permanent ways, and consists in the employment and use of drums and pulleys supported in suitable bearings fixed to the side of the hoist, and driven by the engine working the hoist, or with a separate engine; these drums have coiled round them ropes or chains which pass round pulleys or blocks fixed at suitable distances from the hoist, and are arranged so that, by coupling the ends of the said ropes or chains to the wagons or trucks, they may be drawn along the rails and transferred to the platform of the hoist, or *vice versa*, by coupling the ends of the ropes to the truck or wagon; when placed upon the turntable it is reversed in order that it may be transferred by the aforesaid means to the platform of the hoist. The drums or pulleys round which the ropes or chains are coiled are set in motion at will by means of a clutch box situate upon the drum shaft.—*Not proceeded with.*

916. G. R. STEPHENSON *and* G. H. PHIPPS, *Great George-street, Westminster*, "*Construction of locomotive engines and railway carriages for facilitating their passages round curves.*"—*A communication.—Dated 31st March*, 1865.

This invention consists of such a combination of the axles, axle boxes, and framing of locomotive engines and railway carriages generally, whereby any of the axles of such engines or carriages to which the invention may be applied take up a position pointing radially towards or near to the centre of any curved portion of railway on which the said engines or carriages may be working, and thus facilitating the passing round such curve. This object may be accomplished by connecting the axle boxes to the side framing of any engine or carriage by means of radial links, so placed that whenever through the action of the curve the axle, and with it the axle boxes, undergo any end-on motion with respect to the frame, the axle is also forced by the action of the radial links to undergo the requisite amount of angular motion to plant it at or near to a direction radial to the curve of the railway.—*Not proceeded with.*

923. R. A. BROOMAN, *Fleet-street, London*, "*Street railways.*"—*A communication.—Dated 1st April*, 1865.

This invention consists in constructing rails of an iron bar formed with a curved under side, adapted to and resting upon a corresponding convex surface of a sleeper; the rail is also formed with a curved upper surface with standing sides or edges, being sectionally of a crescent-like form, thicker in the middle than at the edges, and sufficiently strong where the wheels run upon the rails, while the thinner and slanting sides or edges are only sufficiently thick to guide the wheel flanges, and form a cap to protect the sleeper. When laid upon the sleeper the rails are to be secured by screws passed vertically through them. Beneath the joints of the separate rails the inventor inserts a curved metal plate which prevents the ends of the rail becoming imbedded in the sleeper, and both the rails and the joint plate direct off any water that falls on the rails, thereby keeping the upper surface of the sleeper, as well as the portion under the joint plates, as dry as possible.—*Not proceeded with.*

930. P. Haenlein, *Woburn-place, Russell-square, London,* "*Navigable balloons.*"—*Dated 1st April,* 1865.

This invention cannot be described without reference to the drawings.—*Not proceeded with.*

935. W. C. Gollings, *Kentish Town, London,* "*Paddle-wheels.*"—*Dated 3rd April,* 1865.

This invention cannot be described without reference to the drawings.—*Not proceeded with.*

Class 3.—FABRICS.

Including Machinery and Mechanical Operations connected with Preparing, Manufacturing, Printing, Dyeing, and Dressing Fabrics, &c.

887. E. *and* F. A. Leigh, *Manchester,* "*Apparatus used in carding cotton or other fibrous substances.*"—*Dated 29th March,* 1865.

This invention cannot be described without reference to the drawings.

889. R. Holroyd *and* J. H. Bolton, *Manchester,* "*Apparatus for drying warps of cotton, &c.*"—*Dated 29th March,* 1865.

The patentee claims, First, drying warps by the application of heated air to their surface during their passage over rollers, or while in motion in the manner described. Secondly, the novel arrangement and combination of the chambers, heating apparatus, flues, and rollers for effecting the said object, as described.

901. A. Turner, *Leicester,* "*Machinery for winding yarns or threads on to quills, spools, and bobbins.*"—*Dated 30th March,* 1865.

The patentee claims, First, the mechanical arrangements shown and described for winding yarns or threads on to quills, in the manner set forth, so as to admit of the yarn or thread being drawn off (in the operation of weaving) with uniform tension. Secondly, the mechanical arrangements described for winding taper or conical bobbins, whereby the thread as it is wound on to the bobbin is made to cross and re-cross, and thus to lock each previous layer of thread, which will thus be prevented from falling off the bobbin or getting entangled, but can be drawn off with ease and regularity.

907. L. Bridge, *Accrington,* "*Looms for weaving.*"—*Dated 31st March,* 1865.

The object of this invention is to dispense with the emery beam, and consists in using an ordinary wood beam or roller on which the cloth is taken up as it is woven, and to prevent it slipping the patentee arranges an apparatus to cause an additional rod to press upon the beam or roller, and thus keep it in a tight and regular position, but to allow this rod to adjust itself to the increasing diameter of the cloth as it is taken up he attaches a rod to the aforesaid apparatus, and connects it by a slide to another apparatus in the framing of the loom. Part of this apparatus consists of two brackets resting on a frame or lever, and having each a slot which clips a rim wheel, and are kept up to their places by springs. As the cloth increases in diameter, the rod upon it rises, and the other rod is depressed, so as to give a gradually diminishing stroke to the frame or lever which carries the slotted brackets, and gives a gradually decreasing speed to the taking-up motion.

919. W. Mayall, J. Knott, *and* W. Dennis, *Moseley, Lancashire,* "*Mules for spinning cotton, &c.*"—*Dated 1st April,* 1865.

This invention relates to certain mechanism in connection with the head-stock of the mule, and is designed to prevent the excessive strain upon the driving strap gearing and bands of the mule during the time the backing-off frictional gearing is coming into operation, by which means the wear and tear of the said parts is diminished. The improvements consist in a novel construction and arrangement of mechanism for effecting the said purpose, which mechanism consists of a disc revolving in bearings secured to the head-stock of the mule, and provided with an adjustable stud or projection, which, as the disc revolves, comes into contact with and forces back one end of a bell-crank lever, the opposite end of which becomes raised and gives a vertical lift to a sliding plate. This sliding plate before being lifted is interposed between the stud which actuates the mechanism of the backing-off frictional gearing and the lever of the frictional gearing, so that, while interposed, it prevents the said gearing coming into operation too soon, so as to prevent the excessive strain; the said gearing should not operate until the run out or forwardaction of the mule carriage is complete, at which time the sliding plate is lifted by the aforesaid mechanism, which thus allows the backing off frictional gearing to come into operation.—*Not proceeded with.*

921. W. Kilby, *Anchor-street, Shoreditch, London,* "*Apparatus used in the winding and re-winding of silk, &c.*"—*Dated 1st April,* 1865.

In carrying out this invention the parts of the apparatus are so combined that a number of supports carrying runners and spindles for winding on are each set at an equal distance from a common centre upon or attached to a circular table or frame. Arms carrying spindles for re-winding are also attached to the same table, and so arranged that, while the silk or fabric is in process of winding from the skein, the same action and roller set in motion the spindles for re-winding. Simultaneous motion to the whole of the winding and re-winding runners and spindles is given by a treadle and crank in connection with a band wheel carrying bands to the rollers; the axis of the band wheel turns in the centre of the circular table or frame. A wheel carrying a regulator to each winding spindle is placed under the circular table or frame, and action given to the same by cog wheels and a cam connected with the axis of the band wheel. The circular table carrying the runners and spindles is made to revolve and turn upon castors or runners attached to a stand supporting such circular table.—*Not proceeded with.*

928. A. W. Pearce, *Dundee,* "*Looms for weaving.*"—*Dated 1st April,* 1865.

This invention relates to a certain new arrangement of the parts of looms used for weaving which are employed to give motion to the pick stick, whereby the shuttle is caused to traverse the warp. The chief part of the arrangement consists in causing the cam, whereby motion is communicated to the pick stick, to move the conical roller in a direction the reverse of that at present employed. The shaft upon which the cam is fixed moves or revolves in the same direction as formerly, but the shaft carrying the friction roller upon which the cam or tappet strikes is arranged on the reverse side of the cam, the reciprocating motion of the cam being thus communicated direct to the upper side of the roller. Instead of this friction roller upon which the cam or tappet strikes being fixed upon the vertical shaft, by which in existing arrangements of picking motion the motion of the cam is transmitted to the pick stick, it is in the present arrangement attached to a short reciprocating shaft, this latter being connected by a link to a short crank on the picking shaft, by the intervention of which the motion of the rod and picking movement takes place in the same direction as formerly.

Class 4.—AGRICULTURE.

Including Agricultural Engines, Windlasses, Implements, Flour Mills, &c.

898. W. Savory, *Gloucester,* "*Treatment of meal and the dressing of flour.*"—*Dated 30th March,* 1865.

Among the principal features of this invention are the following:—For the purpose of cooling and maintaining the grain and the meal, or other form of produce resulting from the process of grinding, cool, and so in the best condition for being economically manufactured, the patentee, instead of making the metal casings of millstones of a single thickness of metal, makes a hollow or double casing for the purpose of containing water, which he causes to circulate therethrough, and thereby the heat generated during the grinding is rapidly abstracted; or, in some instances, he uses a hollow metal ring made to encircle the bed stone, with suitable feed and discharge pipes to cause the water to circulate round or through it, so that when the meal issues from between the stones it shall spread over the upper surface of the ring. A brush is fixed on the runner stone to sweep off the meal into the spout or shoot. In order to further carry out the heat-abstracting process, instead of allowing the meal to be conveyed from the grinding stone or cooling ring direct to the bolter, he conducts it by a suitable spout into a double or hollow trough, or a double or hollow cylinder or tube, which is so constructed that a flow or current of water can be established therethrough, and may be fitted with a screw motor, the threads of which may be cast or formed hollow around a hollow shaft or axis, through both of which a current of water may be caused to pass at any required velocity. Other means of carrying the meal along in contact with the cold surfaces may be substituted for the worm or screw.

925. W. Gray, *Sheffield,* "*Rolling or forging steel or wrought iron in bars to be used as beaters or beating bars upon the drums, concaves, or breast plates of concaves in threshing machines.*"—*Dated 1st April,* 1865.

This invention consists in producing these beating bars in steel or wrought iron by rolling or forging, thereby producing a much superior article in toughness, besides being harder, lighter, and stronger, and of much greater durability than those which are now in use, which are merely cast; and also in grooving or fluting the surfaces of such rolled steel or wrought iron bars, as shown in the drawings.—*Not proceeded with.*

927. R. Willacy, *Penwortham Priory, Lancaster,* "*Apparatus for preparing and supplying food for cattle.*"—*Dated 1st April,* 1865.

This invention relates to a peculiar combination of machinery or apparatus for preparing and supplying food for cattle, whereby a large number of cattle may be fed with any particular quantity of food in a short space of time. According to this invention it is proposed to combine a turnip-cutter, or an oil cake or corn crusher or bruiser, or other like food preparer, with a wagon running along trams laid down inside the cattle shed. The main shaft of the food-preparing mechanism communicates by gearing with one of the axles of the wagon, so that on driving this shaft, in order to cut the roots or otherwise prepare the food, the wagon will be simultaneously caused to travel along the trams. Along the side of the tramway there is placed a feeding trough of a peculiar construction extending along the entire length of the cattle shed or house; the back of this trough is made considerably higher than the front, so as to form a species of continuous shoot for directing the prepared food (which falls from the machine as it travels along) into the bottom of the trough. The trough, which is of an angular section, and may be usefully employed irrespective of the machine, in some cases, is thus supplied with a regulated quantity of food distributed easily from end to end. A rail is placed in front of the cattle and along the side of the tramway, a little above the floor, to prevent the cattle bringing their heads within the range of the machine's course, but at the same time allowing sufficient space underneath for the cattle to feed out of the trough conveniently.—*Not proceeded with.*

934. R. R. Riches *and* J. Watts, *Norwich,* "*Apparatus applicable to machines for cutting hay, straw, &c.*"—*Dated 3rd April,* 1865.

This invention relates, in the First place, to the knives or cutters and the mode of connecting them. One form of knife or cutter intended to be used has a cutting edge of a V form, or the lines of such cutting edge may be curvilinear instead of straight, and the knive or knives is or are mounted on a drum or carrier, the axis of which is at right angles to the line of direction in which the material to be operated upon is fed through the mouth of the machine; the edge of the drum or knife carrier being thus presented to the mouth of the machine, knives with straight instead of angular cutting edges may also be used on a drum or carrier mounted in the manner stated, and such knives may be fixed on the periphery of the drum or carrier, either parallel with the axis of the same or obliquely thereto. The mouth of the machine is curved to suit the curvature of the knife or knives. The drum or knife carrier may also be mounted with its axis at right angles to the line of direction above stated, when knives with the angular cutting edges referred to are used. The invention relates, in the Second place, to the feeding apparatus, and consists in the use of a suitably formed cam fixed on the axis of the drum or knife carrier, which cam is caused by its revolution to act alternately on two friction rollers, which are mounted on a slotted connecting rod, the other end of which rod is connected to a pawl attached to a slotted lever working loosely on the axis of one of the feeding rollers, on which a toothed wheel is fixed. The extent of movement of the pawl over the toothed wheel is regulated by shifting the end of the rod connected to the pawl nearer to or further from the axis of the feeding roller; and the pawl is double, so as to admit of its being turned over in order to work the ratchet wheel in the opposite direction when required. The invention consists, in the Third place, in the adaptation and application of a spring to one of the feeding rollers, or to the pressure plate, for the purpose of regulating the pressure on the mandril under operation as required. And the invention consists, Lastly, in the adaptation and application of a rotary screen of perforated wood or metal over machines of the kind referred to, in order that long screenings may fall from the screen into the box of the machine and be cut over again, without the necessity of hand labour.—*Not proceeded with.*

Class 5.—BUILDING.

Including Brick and Tile Machines, Bricks, Tiles, Drain Pipes, and House Fittings, Warming, Ventilating, &c.

826. C. J. Morgan, *Rotherham,* "*Stoves or fire-places, ash pans, and fenders.*"—*Dated 23rd March,* 1865.

This invention consists in combining certain new arrangements for the escape of smoke or other gaseous products of the fuel into the flue or chimney, together with the means of obtaining a more perfect control over the draft or drafts than has hitherto been secured, affording varied outlets to suit the peculiarities of different chimneys or shafts; also in constructing different parts so that a better radiating surface can be obtained with a better concealment of the ashes and other products, and making certain other parts that can be made at pleasure into a guard or dress protector. The improvement consists in making a door at the back of the grate of this fire set of such construction that it falls back from its closing point, which is about an angle of twenty-five to thirty-five degrees on one side of the perpendicular to about the same angle on the other side of the perpendicular, to allow a good outlet for the smoke, and by having the door concaved it hides the back part of the flue when the valve is open, and makes a good conductor for the smoke, and allows the folding doors or valve to open without obstruction to make the aperture almost as large as the interior of the grate. The novel valve or folding doors are so hung that, with a sliding hinge or grooved joint, they, by their own weight, or impingement, can be opened or closed and remain stationary at any point. The guard attached to the grate can be drawn out to any angle on the same principle, as more particularly described in the fender part of this fire-set. The next improvement is in the hearth, consisting of an arrangement of circular or straight iron, steel, or other metal plate or plates placed on the hearth to work like a Venetian blind, either by springs, centres, impingement, their own weight, or otherwise. A further improvement on the hearth consists in constructing a guard to the hearth (or grate as before referred to) having a rod or rods connected with telescopic or other standards capable of being raised, and thus produce a dress protector.

875. F. Thomas, *Bishopsgate-street Within, London,* "*Kitchen ranges having their fire-places enclosed.*"—*Dated 28th March,* 1865.

This invention cannot be described without reference to the drawings.

879. H. W. King, *Torrington-square, London,* "*Ventilating blinds.*"—*Dated 28th March,* 1865.

This invention consists in constructing blinds of a series of segments of tubes pivoted at top and bottom upon stationary rods or bars, and connected near one end to studs upon a movable bar. The segmental plates, or portions of a tube, are placed so close to each other that even when in position to allow of the passage of the greatest amount of air the blind cannot be seen through. The blind may be more or less closed by causing the plates to move on their pivots by means of the movable bar.—*Not proceeded with.*

911. B. Greenwood, *Cumberland-place, Westbourne-grove North,* "*Curing or preventing smoky chimneys.*"—*Dated 31st March,* 1865.

This invention relates to improvements in the means of preventing or curing smoky chimneys, and consists in forming a communication between the interior of the chimney, a short distance above the fire, and the external air, by means of a pipe let in the wall and carried to the outer wall of the house, or by a channel or passage formed in the brickwork while building the house.—*Not proceeded with.*

939. A. Lockwood *and* A. Lockwood, jun., *Chester,* "*Manufacture of bricks.*"—*Dated 3rd April,* 1865.

For the purposes of this invention bricks are first formed by expressing clay or brick earth through dies, causing each brick to have a longitudinal hollow passage through it, formed by a core in each of the dies employed. Other bricks are also similarly made, having through them transversely one or more hollow passages formed by a core or cores in each of the dies employed. So far, however, there is no novelty, as it is not new to form bricks with hollow tubular passages through them longitudinally or transversely. The partially formed bricks having been thus produced by expressing clay or brick earth through moulding dies or orifices with suitable cores, are allowed partially to dry, when each brick is subjected to pressure in a mould of the size of the finished bricks; these moulds are made simply to contain the bricks, the pressure being applied by means of mandrils which are made somewhat conical, and which are forced into the hollow passage or passages in a brick, two mandrils being thus used to enter at the ends or sides of the mould to press and expand the clay or brick earth, so as to cause it completely to fill the mould.—*Not proceeded with.*

Class 6.—FIRE-ARMS.

Including Guns, Swords, Cannon, Shots, Shells, Gunpowder, Implements of War or for Defence, Gun Carriages, &c.

932. J. Von Der Poppenburg, *Birmingham,* "*Projectiles and cartridges for central fire breech-loading fire-arms and ordnance.*"—*Dated 3rd April,* 1865.

This invention consists of the improvements hereinafter explained, in projectiles and cartridges to be used with such breech-loading fire-arms and ordnance as have pins or needles in a line with the axis of the barrel for the purpose of discharging the cartridge, which said fire-arms and ordnance are commonly called "central" fire-guns. The invention, as applied to projectiles and cartridges for central fire breech-loading fire-arms, is carried out as follows:—In making projectiles according to this invention the patentee makes the projectile, ball, or bullet of any of the ordinary forms; in the base of the projectile he makes an annular depression concentric with the axis of the projectile, and of a size proper to receive an ordinary percussion cap. He places a percussion cap in the said depression, the nipple-like piece in the centre of the projectile occupying the inside of the percussion cap. By means of a hammer or mallet, or by pressure, he forces the percussion cap upon the said central piece until the closed end of the cap is flush with the base of the projectile. The lead or other soft metal or alloy of which the bullet is made is not sufficiently hard to cause the detonation of the percussion cap as the latter is being fixed into its place in the bullet. A projectile of the kind described is made into a cartridge in the ordinary way, the pin or point of the gun passing through the powder of the cartridge to strike upon and discharge the percussion cap. In making blank cartridges according to this invention the patentee forms a tubular cap of papier mâché, or other hard non-metallic substance, the base of the said cup having an annular recess similar to that already described in the projectile or bullet, and in the said annular recess an ordinary percussion cap is fixed. This tubular cup is made up into a cartridge in the ordinary way. By making a series of longitudinal incisions in the said tubular cup it expands immediately it leaves the muzzle of the gun, and exposes such a surface to the air that its flight is speedily arrested. The cartridge last described may be converted into a sporting cartridge by filling the cup with shot. Projectiles and cartridges for ordnance are made in the manner hereinbefore described, but of a larger size.

Class 7.—FURNITURE AND CLOTHING.—None.

Class 8.—CHEMICAL.

Including Special Chemical and Pharmaceutical Preparations, Fuel and Lighting Materials, Preparation and Preservation of Food, Brewing, Tanning, Bleaching, Dyeing, Calico-Printing, Smelting, Glass, Pottery, Cements, Paint, Paper, Manures, &c.

872. W. Walsh, *Warrington,* "*Apparatus employed in the concentration of all solutions where quick or speedy concentration or evaporation is required.*"—*Dated 28th March,* 1865.

This invention relates particularly to the manufacture of caustic soda and potash, carbonate of soda and potash, chloride of sodium and potassium, or similar alkalies or acid solution, in which a quick concentration or evaporation is essentially necessary; but it is also applicable to all solutions where a quick or speedy concentration or evaporation is required. For this purpose the inventor places or fixes an agitator of any suitable construction in the pan or vessel in which the aforesaid alkalies and acid solutions are required to be concentrated or evaporated, and he gives a revolving motion to the said agitator by placing or fixing to it a pulley to revolve inside the liquor or solution, over which pulley he passes a chain, and extends it to a pulley on the line shaft above the pan or vessel. He thus avoids the necessity of a cross shaft and stuffing-boxes outside the pan or vessel, which are very objectionable.—*Not proceeded with.*

874. A. D. Gascon, *Paris,* "*A new febrifuge and digestive elixir.*"—*A communication.*—*Dated 28th March,* 1865.

This invention consists in the composition of a liquor which the patentee calls febrifuge and digestive elixir, and which he prepares in the following manner:—First, in a quart of good brandy he puts about two ounces of socotrine aloes or aloes perfoliated; secondly, three drachms of zedoary; thirdly, three drachms of white argaric; fourthly, three drachms of gentian; fifthly, three drachms of saffron; sixthly, three drachms of rhubarb; seventhly, three drachms of theriaca. The whole is pulverised and left to infuse about fifteen days, when it is decanted and kept for use.

880. E. Savage, *West Meriden, Connecticut, U.S.,* "*Hardening and tempering steel.*"—*Dated 28th March,* 1865.

This invention consists in the employment of solutions in which to immerse the heated steel, which possess a very high degree of conducting character for heat, so that the utmost rapidity in the cooling will be attained, for in this the true theory of the operation appears to be involved. The patentee has discovered that metals having the greatest conducting power for heat, and which can be held chemically in solution, constitute those solutions media, whereby results may be attained in hardening steel which have hitherto been wholly unattainable. Thus, he employs solutions of gold, silver, copper, and other metals, and the results obtained are in the direct ratio of the respective conducting powers of the metals and the specific gravity of the solution.

892. S. Childs, jun., *Putney,* "*Treating fatty matters.*"—*Dated 29th March,* 1865.

In carrying out this invention the inventor submits the solid or semi solid compounds of fats and lime produced in the saponification process to a high temperature after the usual boiling is completed and the water drawn off, which temperature may be made to reach any desired point short of decomposition, namely, 400 deg. Fah. This he can effect in various ways, viz.:—First, by drawing a current of superheated steam through the mass of lime soap when the saponification has been effected in an iron or other suitable vessel having a closed lid or cover, and when the water used in the saponification has been withdrawn. Secondly, by placing the lime soap in one or a set of iron or clay retorts properly set in a furnace, and there subjecting it to the furnace heat. The pressure produced by the vapour of water set free from the compound by the heat may be regulated by a proper safety valve in connection with all the retorts in operation. Thirdly, by placing the lime soap in an oven or reverberatory furnace properly constructed, and there heating it to the temperature desired.—*Not proceeded with.*

893. W. M. Fuller, *Wolverhampton,* "*Reducing or preparing waste animal matters for the purpose of employing the sand in the preparation of manures or fertilising compounds.*"—*Dated 29th March,* 1865.

This invention relates to the treatment of shoddy, woollen rags, leather, or other kinds of animal refuse, with a view to disintegrate the same, and render it easily reducible to powder, that being the form in which such animal refuse is best adapted for use as a fertiliser. This result is accomplished by the destruction of the fibre without the use of acids or alkalies which are usually employed for the purpose. The patentee attains this object by employing solely superheated steam brought into direct contact with the material to be treated.

899. W. Brookes, *Chancery-lane, London,* "*Improved mode of rapidly reducing, cementing, and melting iron and other ores, also slag or cinders, dross and scales or crust, to produce directly therefrom steel or malleable or cast iron.*"—*A communication.*—*Dated 30th March,* 1865.

The object of this invention is to produce malleable iron or steel or cast iron directly from any kind of pulverised iron or other ore, and also from iron slag, cinders, scoria, crust scales, oxidised cast or malleable iron turnings, or the residuum of pyrites. According to this invention the said iron ore, slag, cinders, or other matters, is first pulverised fine, and is then mixed with lime or other suitable flux. To this mixture is added pulverised coal or charcoal, tar, or other carbonaceous matter, and when well mixed together the mixture produced is reduced in a reducing or cementing furnace, either in a powder or after having been compressed, and when reduced is introduced into a heating or melting furnace containing melted neutral or furnace slag or cinders, or slag obtained from the matters above mentioned already melted by this process, and in a liquid state. The cementing or reducing furnaces in which the reduction takes place are situated on the side of the heating or melting furnace, the said cementing furnaces containing retorts heated externally and inclined towards the heating or melting furnace, so that the contents of the said cementing furnaces may readily pass into the heating or melting furnace, or the cementing furnaces may be formed with several compartments one above the other, and heated both above and below the soles. The melting or heating furnace is of ordinary construction, the sole thereof being divided into a series of crucibles or cavities, arranged beside the reducing or cementing furnace, so that one of the said crucibles or cavities may receive the reduced matter from two or more of the cementing furnaces; the said crucibles or cavities contain melted neutral slag, or slag obtained from furnaces or from matter already melted according to this invention, in a melted state. The pulverised iron ore, cinders, or slag, mixed with a suitable flux and charcoal, or other carbonaceous matter, as above described, is charged either into retorts or into the upper part of the cementing furnaces, and is spread upon the sole thereof. It is left in the said furnace for one or two hours, and is then made to pass over the lower compartment of the said furnace, and is spread over the sole of the said lower compartment, and when sufficiently reduced it is pushed through a suitable aperture into the heating or melting furnace, where it falls into the crucibles containing neutral or furnace slag in a melted state, the said neutral or furnace slag preserving the reduced or cemented metal from oxidation or decarbonisation and aiding to melt the gangue. In the space of from six to twelve hours malleable or cast iron or steel will be produced, and may be removed from the heating or melting furnace for use.

900. A. A. Croll, *Coleman-street, London,* "*Manufacture of sulphate of alumina.*"—*Dated 30th March,* 1865.

These improvements have for their object the obtaining a sulphate of alumina with increased rapidity, economy, and quantity, considered in relation to the quantities of clay or other aluminous base and of acid under operation, and the time employed in obtaining the results. And the invention consists in employing sulphuric acid (oil of vitrol) diluted to a limited extent with water, and heated to a high degree of temperature to act upon the aluminous base.

Class 9.—ELECTRICITY.

Including Electric, Magnetic, and Electro-magnetic Apparatus, Electrical Apparatus, Galvanic Batteries, &c.

910. H. A. Bonneville, *Porchester-terrace, Bayswater,* "*Telegraphic apparatus.*"—*A communication.*—*Dated 31st March,* 1866.

This invention consists in an improved system of telegraphic apparatus, allowing of calling and corresponding directly between all the stations of the same circuit with a single line, that is to say, whatever may be the position occupied by the station called and the calling station, they may call each other and correspond without its being necessary to ask for communication at the intermediate stations, without troubling the clerks at these stations, and without even calling their attention.

Class 10.—MISCELLANEOUS.

Including all Specifications not found under the preceding heads.

814. C. H. Crowe, *Lodowick-terrace, Gloucester-terrace, Regent's Park, London,* "*Stoppers for bottles, jars, &c.*"—*Dated 23rd March,* 1865.

A stopper made according to this invention, suitable for being used as a substitute for an ordinary cork for stopping the mouth or neck of a wine or other bottle, is constructed as follows:—The stopper consists of a cylindrical plug, which may be made of wood, metal, or other suitable material, but by preference of wood, and of a size capable, when ready for use, of passing easily into the neck of the bottle it is intended to close. This cylindrical plug is slit up or divided longitudinally into two, three, or more parts (four being a convenient number) combined or fitted together, and formed with a conical or wedge-shaped hollow at the lower end, into which a corresponding conical plug fits, having a stem or rod which passes out at the upper end of the cylindrical plug, the upper end of the stem or rod having a screw thread cut thereon to receive a screw nut, which is prevented from coming off the end of the screw by means of a collar or otherwise. The lower part of the cylindrical plug is covered with a capsule of india-rubber, or other suitable elastic or compressible material, so that when the plug or stopper is inserted into the neck of a bottle, and the screw nut is screwed down against the end of the neck or mouth, the internal cone will be drawn upwards into the hollow conical chamber at the lower end of the plug, causing the parts to be expanded outwards, so as to compress the capsule against the inner surface of the bottle, and thus effectually close the same.—*Not proceeded with.*

816. L. A. Leins, *Bucklersbury, London,* "*Apparatus for securing the frame carrying the fittings in travelling bags.*"—*Dated 23rd March,* 1865.

The patentee forms the frame with four legs, two at each end, extending outwards from the centre; he prefers that the legs terminate in square feet, but they may be of other shape. To each foot he fits a spring loop or stirrup. To the bottom of the bag he fits a plate or foundation to receive the feet, one plate for each pair of feet, and in each plate he fits a pair of spring bolts or catches with the outer ends sloped.

825. R. Tidman, *Jermyn-street, London,* "*Apparatus for paying out and for raising electric telegraph cables in deep water.*"—*Dated 23rd March,* 1865.

This invention consists in employing a raft or floating platform constructed with divisions or wells on the under surface, in order to give great buoyancy in the water. The inventor attaches lee-boards to steady it, which boards also act as a helm to steady the raft. He also constructs and connects to the floating platform, by chains or other means, a lighter raft, or a series of lighter rafts or sea cradles, coupled by chains or otherwise, to which are attached lee-boards, and furnished with horizontal rollers, over which the cable passes on its way to the sea, and also with rack pulleys to keep the cable central. These lighter rafts or sea cradles are used only for paying out cables, being unnecessary when cables have to be raised. The cable to be payed out has one end fastened to, and is then coiled upon, the principal raft or floating platform, and then a casing is built over it. In the top of this casing rollers are placed, between which the end of the cable passes out on to and over the rollers of the lighter rafts or sea cradles, on which rafts are also guide rollers to prevent the cable leaving them. The principal raft is towed by a steamer or steamers, and the cable runs freely out of the casing and over the roller rafts into the sea. The light rafts trailing behind the principal raft will readily sink to a certain extent should any sudden or great strain tend to come upon the cable, and the strain being thus at once yielded to, the cable cannot by any possibility be injured. To raise cables previously sunk it is only necessary to fix a steam engine upon the principal raft or floating platform and wind the cable up in the opposite direction to that in which the cables are payed out from the same.—*Not proceeded with.*

831. T. Farmer *and* F. Lewis, *Bilston,* "*Ornamenting the surfaces of japanned goods and papier-maché goods, &c.*"—*Dated 24th March,* 1865.

The patentees claim ornamenting the surfaces of japanned goods and papier maché goods, and other varnished surfaces, by applying thereto positive photographic pictures, substantially in the manner described.

833. R. Sublinski, *City-road, London,* "*Umbrella and parasol tip fasteners.*"—*Dated 24th March,* 1865.

The object of this invention is by a novel arrangement to allow the silk or alpaca, or other material of which the umbrella may be made, to dry without the necessity of being left open. The invention consists in the use of one piece of metal tube about two inches long, or thereabouts, or other suitable size and shape; the piece of tube is fastened to one end of a metal shield or plate where the elastic passes through, and to the other end is firmly fastened a piece of elastic, or other suitable material, which elastic passes up and down the tube, the object being to let in as much elastic as will be found necessary to stretch round the tips of the umbrella. In some cases the patentee uses a small coiled tube, into which the elastic or other material may be inserted. The box or coiled tube, or other substance used, is inserted in the stick of the umbrella, or may be fixed outside the stick, the top being ornamented as may be desired.

834. J. B. Brown, *St. Petersburg-place, Bayswater,* "*Casks or vessels for storing petroleum and hydrocarbons.*"—*Dated 24th March,* 1865.

For this purpose a compound cask or vessel is constructed, consisting of an interior cask or vessel of lead and an exterior vessel or cask of wood. It is preferred that the interior vessel or cask should be of a cylindrical or nearly cylindrical form, for facility of manufacture. At each end of the cylinder or vessel of lead a head or end of lead is fixed by soldering or otherwise, so as to be perfectly fluid and vapour-tight. In one end or head there is formed a tubular opening to receive a screw plug or cap, which will close the opening fluid or vapour-tight. This vessel or cask of lead is placed within or projected by an exterior vessel or cask of wood, made in like manner to ordinary wood casks, but it is preferred to have as little bilge as may be, more particularly when the lead cask or vessel is made without bilge, or with very little bilge.—*Not proceeded with.*

835. J. Green, *Leeds,* "*Apparatus for cutting or chasing the threads of screws or worms.*"—*Dated 24th March,* 1865.

This invention consists in mounting a carriage or slide upon a lathe-bed or gantry of the ordinary kind, upon which are placed the fast and loose headstocks of the lathe, which may be either cast upon or fastened to it. The spindle of the fast headstock is connected at its extreme end, by means of suitable gearing, to the driving pulley, and upon this spindle are cut worms or threads in one lateral direction, or towards the right hand, and the other part having them in the contrary direction, or towards the left hand.

837. J. A. Swanzy, *Plymouth,* "*Machine for washing, wringing, and mangling.*"—*Dated 24th March,* 1865.

In a tub or vessel of suitable form is mounted a cylinder or drum composed of two circular ends connected together by turned rails. On two opposite sides of the cylinder are reversible boards, which serve as doors to the same, through which the clothes are introduced into the cylinder. These boards are either provided with bristles, so as to act as brushes, or furnished with rods or rails like the other parts of the cylinder. The cylinder is mounted on a central axle, so that it can be readily removed from the tub or vessel and replaced. A continuous rotary motion is given to the cylinder by means of a fly-wheel and handle, connected to the cylinder axle by means of spur wheels, which are capable of being thrown in or out of gear when required. At one side of the tub or vessel is a pair of wringing or mangling rollers, mounted in slots in suitable cast iron standards, which are connected together by a top piece, the centre of which is furnished with a boss, through which passes a screw. This screw acts upon a spring which bears upon a cross bar, the ends of which press on the axle of the top wringing or mangling roller, and so give a parallel and uniform pressure to the roller. The rollers are driven by means of spur gearing, also connected to the fly-wheel, and capable of being disconnected or thrown out of gear at pleasure. Beneath the rollers is a drip-board to convey the water back into the tub or vessel when wringing, and in connection therewith is a shelf or board for the clothes, which is furnished with hinges and with suitable supports underneath, so that it can be let down when not required for use.—*Not proceeded with.*

843. E. Wolverson, *Birmingham,* "*Manufacture of ornamental metallic chains.*"—*Dated 25th March,* 1865.

This invention consists in the manufacture of ornamental chains from sheet metal without the use of solder, the said improvements being specially applicable to the manufacture of guard chains, Albert chains, and chains for other articles of jewellery.

846. W. Miller, *Glasgow,* "*Presses for cotton and wool.*"—*Dated 25th March,* 1865.

This invention consists of an improved arrangement or construction of press for cotton and wool with which a given power is made to effect the required compression with a considerably diminished hydrostatic pressure, that is to say, the aggregate pressure required is produced with a considerably less pressure per square inch, thus avoiding the great strain on, and rapid wear of, the cup leather packings and pump details accompanying the excessive pressure necessitated by the arrangements hitherto in use.—*Not proceeded with.*

848. E. H. Smith, *Sherwood, U.S.,* "*Sewing machines.*"—*Dated 25th March,* 1865.

For the purpose of reciprocating the needle the inventor makes use of a crank or eccentric, and to actuate the shuttle, which is also reciprocating, he employs a crank and vibrating lever in combination. He has the actuating mechanism of the needle and shuttle arranged in such a manner that the reciprocations of the parts of each shall be the reverse of those of the other, thereby neutralising the tendency to vibration. He also has the said mechanism so arranged that at each upward draught upon the needle thread the shuttle thread shall be slackened by the return motion of the shuttle, or otherwise, sufficiently to allow a loop of the needle thread to be drawn above the cloth, such loop being afterwards drawn down and into the cloth by the movement of the said shuttle.—*Not proceeded with.*

849. R. W. Barnes, *Manchester,* "*Apparatus for ascertaining the state of sewers, tunnels, drifts, or other subterranean work.*"—*Dated 25th March,* 1865.

This invention has for its main object the examination or the ascertaining of the state of sewers, tunnels, drifts, or other subterraneous work, without the person who is conducting the inspection having to be in close proximity to, or in the immediate vicinity of, such work, and consists, First, in the use and application of a lantern which is constructed with an outer and inner casing, so that the space between the said casings forms one or more chambers or passages for the requisite amount of air to support the flame of the lamp, and which quantity of air is supplied through the top part or roof of the lantern in order that, when necessary, the said lantern may be sunk in water until the flame of the lamp is on a level with, or below the surface of, the water. A cavity of a triangular, rectangular, polygonal, or other suitable shape is formed between the outer and inner casings of the lantern, the ends of which cavity are open for the purpose of enabling a staff or rod (hereafter described) to be passed through; or an equivalent for the said cavity may be constructed on the outside of the lantern for the same purpose, and such lantern may or may not be provided with a reflector. The Second part of this invention relates to what may be called the reflecting apparatus, which consists of a suitable framework provided with a similar shaped cavity to the one in the lantern hereinbefore described, which is also for the purpose of enabling a staff or rod to be passed therethrough, in which framework a reflector made of metal, or any other suitable material, is mounted, and so arranged as to be adjustable to any required angle upon its own axis by means of a tangent screw or other suitable means. Thirdly, this invention consists of a staff or rod made of metal, wood, or any other suitable material, and which, for the sake of portability, it is preferred to hinge together in parts, so that it may be doubled up into a portable form; and to insure rigidity when opened out to its full length internal bolts (the handles of which are flush with the outer surface of the staff or rod) may be inserted longitudinally at the end of every one of such parts, so that when such bolts are pushed out or locked they will effectually and rigidly lock and fasten the parts together in a straight line; it is also advisable to graduate or mark divisions upon the said staff or rod.—*Not proceeded with.*

853. W. Betts, *Wharf-road, London,* "*Protective labels for bottles, jars, &c.*"—*Dated 25th March,* 1865.

The patentee claims the application and use of protective lables which are a magnified or enlarged facsimile or copy of the head of the capsule, and the device or design thereon covering the bottle, jar, or other similar vessel to which such label is to be applied, with a view to the prevention of fraud, as described.

856. J. Todd, *Greenwich,* "*Machinery for planing and shaping metals.*"—*Dated 27th March,* 1865.

This invention consists of machines, constructed in the manner hereinafter described, to plane in one direction singly, or in opposite directions alternately, at pleasure. The patentee makes the said improved machines with an extra pair or two pairs of uprights or standards, fixed to or upon the bed of the machine at any required or convenient distance apart; to each pair of standards, and between the same, he fits a cross slide which can be raised and lowered at pleasure in the usual way. Upon each of these cross slides he mounts one or more slide saddles and tool holders; the slide saddles move laterally upon the cross slides, the points of the cutting tools being towards each other. The travelling table is made to move backwards and forwards by gearing constructed and adapted therefor, connected with, and giving motion to, a rack screw, or other mechanical arrangement suitable for producing the slow cutting and quick return motions for the single cut in one direction, or the uniform backward and forward motions for the double cut in opposite directions, so that the said improved machines, by simply raising one of the cross slides, can be made to answer the purpose of an ordinary single-action machine; and, if the double cut is required, by setting both cross slides to the required height, and at the same time giving the table the uniform backward and forward motions, the same machine becomes a double-action machine, the metal on the table, as it passes backwards and forwards, being acted upon by each tool or tools in opposite directions alternately, thereby becoming thoroughly planed.

861. C. J. L. Leffler, *Broad-street-buildings, London,* "*Casting ingots of steel and malleable iron.*"—*Dated 27th March,* 1865.

The patentee claims arranging moulding apparatus for casting ingots in the manner described, whereby a series of inclined moulds are brought into communication with a central mould, and the molten metal which is poured into the central mould is caused to fill those moulds simultaneously.

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

(*From our own Correspondent.*)

On 'Change in Wolverhampton on Wednesday: *Prices of Iron Firm: Long Contracts not Accepted*—On 'Change in Birmingham Yesterday: *Orders in Good Supply at most of the Works: Demand for Bridge Plates: Short Supply of Puddled Iron: Restrictive Operations by Puddlers*—Pig Iron: *Makers Well Off: Rates Strong*—The New Rival Railway Schemes: *Liberal Support by Ironmasters: "The South Staffordshire and London Independent Railway Company;" The Late Lord Palmerston on Cheap Transit*—Meeting Between the Ironmasters and the Railway Companies: *The Discussion: Speculations on the Result: Extra Charges for Damageable Iron*—Coal: *Improving*—Hardware Trades: *Increased Attention to Art*—The Forthcoming Marriage of the Earl of Dudley: *Preparations at Dudley*—Increased Exports.

In Wolverhampton, on Wednesday, there was only a thin attendance of the trade, and the business transacted was comparatively insignificant. The reports from the works were, however, tolerably satisfactory, and prices were firm for both pig and finished iron, with an indisposition on the part of sellers, in both departments of the trade, to enter into long contracts.

Yesterday (Thursday) the reports brought to 'Change in Birmingham from the different ironworks in South Staffordshire were of a varied description. There are works that are short of orders for sheets as well as plates, and which are unable to keep their machinery in operation scarcely half-time; but such cases are the exception. Generally the works are well supplied with orders, yet the number to hand this week have been below that of last week. At the same time there are specifications in the market of considerable worth, one being for upwards of 4,000 tons of plates; but the delivery is desired to extend over a longer period than meets the approval of makers in the present condition of the market. The iron, it is understood, is intended for bridge-building purposes. North Staffordshire continues to receive valuable orders from America, and the order-books of firms in that district are rapidly filling. Small orders only have reached South Staffordshire during the past week from the States, and they have been chiefly for strip iron. First-class firms are very short of puddled iron, owing, they believe, to the policy of the puddlers, who will not allow stocks to be acquired. Through this short supply some mills, for which there are orders, can be worked only part time. It is easy to understand how very tantalising this state of things is felt to be. The short supply is immediately traceable, in some degree, to the resolve come to by the men, not a great while ago, to refrain from working more than five heats on the Saturday. The reduction of this one heat a week becomes serious when it is extended over a large number of puddling furnaces, and when, as now, it is increased by short production on account of an alleged insufficient supply of underhands, and the like.

Pigs are not selling widely, but the transactions that are taking place are at sellers' terms. Makers refuse to book orders at present quotations for more than three months' forward delivery.

"The South Staffordshire and London Independent Railway Company," which is one of the schemes by which extra accommodation at lower rates is hoped to be obtained for ironmasters and merchants doing business with London, is being liberally supported by individual firms; and, inasmuch as nearly the whole of the £2,000 required to enable the company to commence operations, with a view to the making of the contemplated twenty-eight miles, is said to be promised, it is believed to be certain that the existing companies will soon have two rivals in committee. This scheme is sent out as requiring a capital of £800,000. The shares are £10 each, and half the subscribed capital is said to have been already taken up; but no allotment is to take place until the Act of Parliament has been obtained. The prospectus says:—"It being indispensible that the support of the district should be manifested as acknowledging the necessity and advantage of a cheaper system of freights for iron and other goods, it has been suggested that, as the expense of proceedings (survey, &c.), preliminary to obtaining the Act of Parliament, will amount to £2,000, or thereabouts, of which £1,000 has already been subscribed by the parties to the undertaking, the remaining sum of £1,000 should be raised in the district, by a subscription to shares to the amount (on the first deposit), or as a guarantee fund, the liability on which will be limited to the amount subscribed. The subscribers to shares as well as to the guarantee fund will be entitled, upon the passing of the Act of Parliament, to a preference allotment in shares equivalent to the first deposit." Four names appear as directors. This line is in connection with the East and West Junction Railway, the first sod of which was cut by Lady Palmerston, at Towcester, in August last year—a line, the history of which is remarkable, because of its being the only one in whose behalf the lamented Premier ever appeared in committee. At the luncheon which followed the ceremony in which Lady Palmerston took the leading part, Lord Palmerston made some characteristic remarks on the benefits of railway locomotion, certain of which are especially interesting because of their applicability to the necessity for the introduction of the South Staffordshire and London scheme. His lordship said: "It is impossible to overrate the importance of railways to any country, and the effect which they exercise on the prospects of a manufacturing nation like this. The prosperity of our manufactures depends upon our being able to command markets. Those markets can be only commanded by cheapness and quality. What is it that regulates the price of commodities in the market? It is, first, the cost of production; next, the cost of carriage to the place where the articles are to be sold; and, thirdly, the interest on the capital employed." "The cost of carriage" regulates the price of South Staffordshire iron in the London market; and because the present cost is too high, therefore are the ironmasters disposed, if necessary, to come forward with the £1,000 required of them in order that the steps may be taken whereby that cost may be brought within a reasonable limit. The gentlemen who form the committee of the Ironmasters' Association have not appended their names to the list of guarantors, because they desire to stand unpledged to any new scheme until the railway companies here have "pronounced" upon the application which the iron trade are now making to them.

The meeting between the ironmasters' committee and the railway and canal authorities took place in Birmingham on Tuesday, at the Queen's Hotel. The iron trade were represented by its leading members, and the London and North-Western and the Great Western Companies sent a deputation from their respective boards of Directors. The Grand Junction Canal Company was also represented. The ironmasters laid a statement of their case before the meeting. It comprised the facts which have already appeared in these columns. The discussion which followed resulted in the deputations promising to give the subject their early consideration. There can be no doubt that the two railway companies and the canal company will agree upon a reduction, and it is not thought to be improbable that 2s. 6d. a ton will be taken off present rates. That, however, is at present purely conjectural. It would not surprise us if it should ultimately transpire that there is some difference of opinion existing at the present time between the two railway companies and the canal company, by whom the carrying is now done, as to the terms which should respectively apply in the event of a reduction being determined upon. Some time ago the companies referred to were not combined in their arrangements, and scarcely 10s. was the price charged for conveying a ton of iron from South Staffordshire to London; but a compact was afterwards entered into, whereby the present rates were charged. At the reconciliation, however, it is understood to have been agreed by the railway companies that the canal carrier should charge 1s. a ton less than themselves, and the difference has ever since existed. Out of doors it is now believed that the railway companies desire that a uniform rate should be determined upon, as well by the canal companies as themselves. The heavy tariff of 17s. 6d. is not all that is complained of by the ironmasters, even in respect of charges. That sum is not all that is charged upon a large quantity of the finished iron that is sent from South Staffordshire to London. Upon hoops, sheets, and the like, which class of iron is characterised as "damageable," the companies charge an extra rate of 2s. 6d. a ton, making the total charge 20s. This extra rate, the ironmasters say, is excessive—much more than covers the risks which the carriers incur. The subject of complaint was prominently noticed in the interview on Tuesday, when the railway authorities defended their charges by stating that claims for very heavy damages were often made upon them by ironmasters, on account of depreciation by exposure to weather, whilst in the company's possession. The ironmasters maintained that such claims were exceptional, and expressed their readiness to pay 1s. 6d. a ton, which was the extra tariff charged for iron conveyed from South Staffordshire to Liverpool, which, they said, would be more than a fair insurance on the risk incurred by the companies. The ironmasters notified that they met the carriers unprejudiced, and without having, up to that time, associated themselves with any opposing scheme.

The second rival scheme, to which we have adverted above, is that of the Midland Company, who are understood to have fully made up their minds to apply for the full powers to make the connecting link between Water Orton and Walsall.

Coal is improving in demand. In the East Worcestershire district the colliers are being kept in almost full employment.

The hardware trades of the West Midlands are still characterised by a very fair amount of animation. In Birmingham there is activity in almost every department. The condition of the home demand is in every way healthy, and the inquiries from the foreign markets are large, the American demand especially being encouraging. The West Indian and the Continental trade also remains good. In Wolverhampton briskness prevails in the leading branches. The subject of art as it is applied to manufacture is exciting additional attention amongst the leading hardware firms of that town. This has been chiefly brought about by the visits of Dr. Dresser to this part of the manufacturing world. Manufacturers are beginning to observe the great demand for goods which, instead of being gorgeously or profusely painted as heretofore, are now sent out embellished with some neat design. Dr. Dresser visits Birmingham once a month; and he is expected to take the entire art management of one of the leading Wolverhampton establishments, and has been engaged by two or three firms to meet certain of their men once a month. At Bilston and Willenhall there is no change since our last; and in other parts of the district trade is generally active. Some symptoms of dissatisfaction are again observable amongst the nail-makers and the operatives employed in the chain and cable districts of South Staffordshire.

The people of Dudley are making arrangements for receiving the first Countess of Dudley with due honour, a committee having been appointed by the town council to carry out the necessary steps for that purpose, and to collect subscriptions for a town's gift.

The official report of the exports of British manufactures and produce in September will not be issued until next week, but we may state that the tables will show a very large increase in the exports from Liverpool as compared with September last year.

WALES AND THE ADJOINING COUNTIES.

(*From our own Correspondent.*)

The Iron Trade of the District: *Slight Lull in the American Demand: The Alabama Claims: The Reconstruction of the Southern Railways determined upon: The Eastern Trade: Indian Lines to be Doubled: Brisk Continental Inquiry: The Home Trade tolerably active: Advance of 2s. 6d. per ton in Pig Iron*—Tin Plates: *1s. Advance asked: Works in Regular Employ*—Steam and House Coal Trades—Joint-Stock Enterprise: *The Blaendare Colliery: Dunraven Collieries Company*—Trade of Cardiff for the First Nine Months of the Year and the Corresponding Period of 1864 and 1863—Gloucester Wagon Company (Limited): *Issue of New Shares*—Failure of Levick and Simpson: *Meeting of Creditors Adjourned*—The Chairmanship of the Great Western Railway: *Rumoured Election of Mr. D. Gooch, M.P.: Probable Salary of the Chairman*—The Proceedings Against the Tredegar Iron Company for Alleged Infringements of the Mines Inspection Act: *Dismissal of one Charge: Further adjournment.*

Since last week's report the iron trade of the district remains without any material change. Some of the houses that do business with America have experienced a slight lull in the inquiry during the last few days, owing mainly to the alarm which the Alabama claims have caused in certain quarters. The speculations of the newspapers as to the probability of a rupture, not only with this country but with France as well, which are by no means warranted by the despatches which have passed between the respective governments, have tended to bring about this alarm, and hence sellers and buyers are more cautious in entering into transactions. Still there is, comparatively speaking, a large trade doing with the States, and unless the calculations and predictions of experienced persons are sadly at fault it is likely to be considerably increased before the close of the year, and a complete revival is looked forward to next spring. The immediate reconstruction of the Southern railways has, it appears, been determined upon, and to carry out this it is clear that the greater part of the supply of iron must come from Great Britain. The shipments to Bombay, Madras, and the other eastern markets continue small, and there is no doubt that it will take a long time before confidence is completely restored. The announcement made in a previous report that the existing Indian lines are to be doubled is confirmed, but no contracts have as yet been given out, and none are expected until the commencement of the new year. There is a good inquiry for railway iron from Russia, Sweden, Italy, and other continental countries, and an occasional specification is received on colonial account. In the home trade there is no change to report, all branches being tolerably active, and there is a fair demand for nearly all descriptions and qualities excepting plates. For pig iron an advance of 2s. 6d. per ton is asked, and so independent are the makers, in consequence of the large orders in hand, that they will book no transaction below the quoted prices.

Tin plates maintain previous quotations, and some makers are asking 32s. per box for charcoal, I.C., delivered at Liverpool, being 1s. above what was determined upon at the Quarterly Meeting. There is now no scarcity of water at any of the works, and they are, as a rule, in regular employ. The advance in quotations and the high rates for money have slightly affected the home demand, but not to any appreciable extent, as makers were previously so well supplied with orders.

The steam and house coal trades are in a fairly satisfactory state. House is in better demand on home and inland account, and the collieries are in more regular employ than for a long time. Locomotive coke commands an average inquiry, and the usual vitality is evinced at the Patent Fuel Works.

Joint-stock enterprise is gradually extending in the district. The Blaendare Colliery, Pontypool, has just passed into the hands of a limited liability company, composed principally of Manchester and Liverpool capitalists. The company has been got up privately, and Mr. Wightman, the former proprietor, will continue as manager. It is announced that the Dunraven coal has just been placed on the Admiralty list, a fact which cannot fail to considerably enhance the value of the property. It will be remembered that this is one of the collieries which is about to be transferred to a joint-stock company, under the title of the Dunraven Collieries Company (Limited).

During the nine months ending September 30 last, the total exports from Cardiff were as follow:—1,081,418 tons coal, 119,104 tons iron, 31,150 tons preserved coal, and 6,844 tons coke. In 1864, for the same period, the exports reached 1,090,499 tons coal, and 127,351 tons iron, and in 1863 the shipments over sea were 1,067,583 tons coal, and 136,060 tons iron. The falling off in the continental demand during the summer months was the cause of the slight decrease this year as compared with 1864, but it is believed that in the twelve months an increase will be shown. A considerable quantity of iron that was formerly shipped at the port is now taken by rail to Liverpool and London for exportation, and this, coupled with the limited American inquiry, has reduced the exports from 136,060 tons in the first nine months of 1863, to 119,104 tons in the same period this year.

The Gloucester Wagon Company (Limited) have issued the whole of their new share capital, the applications for shares being far in excess of the number to be allotted. The company's works are in full employ, and the contracts in hand, together with the large rentals coming in, will no doubt return to the shareholders handsome dividends.

The meeting of the creditors of Messrs. Levick and Simpson, Blaina Ironworks, and Messrs. F. Levick and Co., London, which was to have been held last week, is adjourned for a month. Nothing has yet transpired as to what course the inspectors will recommend.

In The Engineer of October 13th it was announced that there was a rumour in this district that Mr. D. Gooch, M.P., was about to be elected chairman of the Great Western, Sir Watkin W. Wynn, M.P., who is a life director, being disposed to vacate his seat at the board in his favour, and thus qualify him for election. The rumour is now fully confirmed, in so far that Sir Watkin W. Wynn has nominated Mr. Gooch to fill his seat at the board; but Mr. Gooch will not accept the position of chairman unless there is an understanding that he should be elected a director by the shareholders. It is stated that a salary of from £5,000 to £10,000 a year will be paid to the future chairman.

The proceedings instituted against the Tredegar Iron Company for breaches of the Mines' Inspection Act were resumed on Tuesday at a special petty session held at Tredegar. It will be remembered that the case for the prosecution was closed at the previous sitting (see The Engineer of October 13th), and on Tuesday Mr. Smith addressed the Court for the defendants at great length. He replied to the charges of recklessness brought against Mr. Bevan, the manager, and referred to the statistics which had been produced, and which proved that the number of fatal accidents at Tredegar was far less, in proportion to the coal raised, than was the case in other districts. Mr. Brough, the Government inspector, visited the collieries periodically, and he never found fault with the ventilation, and, in fact, the inspector in his evidence said the means of ventilation were ample. The charge of not having adequately ventilated the colliery where the explosion took place therefore narrowed itself into a very small compass, and that was as to whether the heading where the gas accumulated was a working place within the meaning of the Act on the day of the explosion. He held it was not a working place, as the evidence proved that cross timbers had been put up, being the usual danger signal; proper fencing secured the mouth of the cross hole. It was proved beyond a doubt that the gas was fired through the recklessness of some one in disregarding these danger marks; and after taking all the circumstances into consideration he contended that the charge of inadequate ventilation completely failed. Mr. Simons, in reply, held that the question raised by Mr. James as to whether the heading was a working place or not on the morning of the explosion was a point of law to be decided by a superior court. The facts adduced by the prosecution, that there had been an accumulation of gas, and that it was not immediately cleared as directed by the Act, were admitted, and he, consequently, claimed a conviction. The magistrates, after a consultation, decided that the heading was not a working place on the morning of the explosion, and dismissed the summons. Mr. Simons applied for a case for the opinion of the Court of Queen's Bench, which was granted. The second charge against the company was that of not having securely fenced off the heading where gas had accumulated, as prescribed by the rules under the Act of Parliament. The evidence was the same as in the previous case. Mr. James announced that he had several witnesses to call, and as it would be impossible to get through the evidence on Tuesday, the proceedings was adjourned for a fortnight.

SCOTLAND—ITS TRADE AND OPERATIONS.

(*From our own Correspondent.*)

The Glasgow Pig Iron Market—The Malleable Iron Makers—Contracts for Vessels—Glasgow Mechanics' Institution—Launch of the Venezia—Testing of the Engines of the Abdul-Aziz—Launch of the Malta—Trial Trip of the Erl-King—Launch of the Mandigo—Launch by the Marine Shipbuilding Company (Limited).

During the past week a large business has been done in Glasgow in pig iron, prices gradually advancing, and the market very buoyant. Sellers, 58s. 6d. cash; buyers, 58s. 4½d. cash. No. 1 G.M.B., 58s.; No. 3, 51s. 6d.; Middlesbro' Warrants, 52s. to 52s. 3d. cash.

The malleable ironworks are still full of orders. Plates are firm but remaining at old prices, while bar iron is slightly up in price. They have as much work in hand as they can well turn out.

Messrs. Robert Duncan and Co., shipbuilders, Port-Glasgow, have just completed a contract with Robert Little, Esq., for the building of a screw steamer of 750 tons for the Mediterranean trade; the engines and boilers are to be made and fitted on board by Messrs. Rankine and Blackmore, engineers, Greenock. Messrs. Caird and Co., engineers and shipbuilders, Greenock, have completed a contract with the Messrs. Burns, of Glasgow and Liverpool, to construct for them a large paddle-wheel steamer to run between Glasgow and Belfast, from the same model as the Buffalo, Wolf, and Llama. The Arabia, a steam vessel of 2,400 tons, which was originally built for the Cunard Company, by Messrs. Robert Steele and Company, shipbuilders, Greenock—and which, for some reason or other, has been lying past in the East India Harbour, Greenock—has been purchased by a firm in Port-Glasgow, and is to be fitted for sea immediately.

The lectures in connection with the Glasgow Mechanics' Institution were commenced for the season last week, the introductory lecture on chemistry was delivered by Dr. Wallace, subject, "Gun Cotton," and the natural philosophy class was opened by a lecture upon electricity by Mr. J. P. Smith, C.E. David Moore, engineer, president of the institution, occupied the chair.

A fine screw steamship of 650 tons, named the Venezia, was launched on the 18th inst., by Messrs. Stephen and Sons, shipbuilders, Kelvinhaugh, Glasgow, for Messrs. Handyside and Henderson; the engines are made and are being put on board by the Finnieston Steamship Works Company, Glasgow. She is intended for the Mediterranean trade.

The Turkish ram Abdul-Aziz, of which we gave an account last week, left her moorings at Port-Glasgow on the 19th inst., and proceeded down channel for the purpose of testing her engines. So soon as her fittings are completed, the official trial trip will take place.

Another of those magnificent steamships for which Messrs. Burns and MacIver have become famous, was successfully launched for them on the 19th inst., from the building yard of Messrs. James and George Thomson, shipbuilders, Glasgow. Her principal dimensions are as follow:—Length of keel and forerake, 300ft.; breadth of beam, 39ft; depth, 26½ft The engines, which are oscillating and geared, are 350-horse power nominal, with surface condensers, are made, and will be put on board by the builders.

The Erl-King, a screw steamer, built and fitted with engines and boilers by Messrs. A. and I. Inglis, engineers and shipbuilders, Glasgow, made her official trial trip on the 20th inst., when the distance between the Cloch and Cumbrae lights was run in 67 min., being equal to 12·24 knots, or 14·1 miles per hour, on a mean draught of 17ft. 6in., the speed attained being fully one knot per hour over that contracted for. Her principal dimensions are:—Length, 250ft.; breadth, 34½ft.: depth, 22ft. 9in. Her engines, which are 200-horse power nominal, have surface condensers, and, during the run, gave an indicated power of 1,200 horses. She is fitted with hoistingg ear for lifting the propeller out of the water when under canvas alone.

On Friday last the Mandigo, a screw steamer for the African Steamship Company, was launched from the building yard of Messrs. Randolph, Elder, and Co., engineers and shipbuilders, Glasgow. She is 1,300 tons. A particular description will be given when she makes her trial trip.

On Saturday last the Marine Shipbuilding Company (Limited), launched from their shipbuilding yard, Ladyburn, Port-Glasgow-road, near Greenock, a paddle steamer built with steel frames and plates. Her dimensions are:—Length, 250½ft.; breadth, 28ft.; depth, 12ft.; tonnage, 620 tons; horse-power, 250.

NOTES FROM THE NORTHERN AND EASTERN COUNTIES.

(*From our own Correspondent.*)

Liverpool: *London and North-Western Railway*—North-Eastern District: *Millfield Engine Ironworks*: *New Warehouse at Sunderland*: *State of Trade*: *Stockton*—State of Trade: *South Yorkshire*: *Leeds*: *Sheffield*—Railway Communication in the Valley of the Dent.

We commence, as usual, with Liverpool. The London and North-Western Railway Company are at the present time engaged in the construction of works of very considerable magnitude at their several Liverpool stations. In consequence of the great and continuous increase of traffic to and from Liverpool, both as regards passengers and goods, the limited size of their present stations has been found altogether unequal to the full carrying out of the enormous demands made upon them. The enlargement of the Lime-street station, which is about to be carried out on a scale of great magnitude, and in order to accomplish the object aimed at, an immense outlay in the purchase of property in the neighbourhood has necessarily had to be incurred. Whilst the works at the Lime-street station are proceeding, very extensive alterations and re-arrangements are also going forward at Edge-hill, which is regarded as the great central goods station of the company. The company are further engaged in making an addition to the tunnel between Edge-hill and Wapping, as also in extensive alterations within the Park-lane entrance. "Perhaps, however," says the *Liverpool Albion*, "the most important work now being executed, under the auspices of the company, is the new railway between Ditton and Aston, on the old main London line, a few miles beyond Warrington, this project involving nothing less than crossing the Mersey, opposite Runcorn, by an immense bridge of gigantic proportions. It had long been felt by the London and North-Western Company that the original route between this town and London, by way of Warrington, was not only circuitous, but was likewise attended by the various other inconveniences which are always inseparable from a line situated as the present route between Liverpool and London is, at the point where it leaves the old Liverpool and Manchester line at what is known as the Warrington Junction; but the desirability of an independent route to London has made itself manifest on other grounds than those above-named, for the trains between Liverpool and Manchester direct, as well as Preston and other places northwards, were so numerous that the line was constantly occupied, and the frequent detentions at the Warrington Junction were not only found inconvenient, but in some respects dangerous. The company, therefore, had long thought it of importance that a more direct and independent line between Liverpool and London was necessary, whereby the distance between Liverpool and the metropolis would be reduced, whilst at the same time the old Liverpool and Manchester line would be left more free and unfettered for the working of its own local traffic. The company, on more than one occasion, applied to Parliament before obtaining powers; but they were at length successful in carrying the bill which enabled them to embark in the great works now in progress. The line of which we are now speaking commences close to the Ditton station of the company's Garston and Warrington Railway, about five miles beyond Garston. At this point it diverges from the Garston line, being carried in the direction of Ditton Marsh, by an embankment of about a mile in length, having an incline of one in 121. It then continues over Ditton Marsh by a viaduct of fifty-nine arches, and thence proceeds over West Bank, and after passing over six piers with openings of 60ft. in height, it approaches the north-east bank of the Mersey at Runcorn Ferry, which it crosses to Runcorn, by an enormous bridge consisting of three wrought iron trellis girder openings, 305ft. each in width, and 75ft. in height, on the under side of the girders, above the level of the river at high water, thus admitting of any vessel of ordinary size to pass under the bridge without any obstacle being interposed. On the Lancashire as well as on the Cheshire side of the river at Runcorn, these girders are supported by huge abutments crowned with castellated turrets, rising to a height of nearly 40ft. above the railway level, while in the river the girders are also supported and carried over by immense stone piers, upon which they rest. Having passed over the Mersey to the Cheshire side at Runcorn, the railway is carried forward through the town of Runcorn, by a viaduct of thirty-two arches passing over the Duke of Bridgewater's canal, a short distance on the west side of the Runcorn Church, near which there is a branch line of a mile in length, which is being carried down to the Duke's Dock. After leaving Runcorn the line proceeds by light excavations and embankments, and finally joins the main London and North-Western Railway at Aston, a short distance from the Preston Brook station, the entire length of the line being between twelve and thirteen miles, and the distance between Liverpool and London by this line being reduced to the extent of eight miles. As may be imagined from the foregoing description, the works on this line, more especially the bridge over the Mersey, are of great magnitude, and it is expected that they will not be completed in less than two years from the present time. Mr. James Holme, of this town, is the contractor for the Ditton embankment, which is now nearly completed. For the rest of the works the contractors are Messrs. Brassey and Ogilvie, who are proceeding with the energy and activity for which this eminent firm is so well known and distinguished. The viaduct over the Ditton Marsh is almost completed, nearly the whole of the fifty-nine arches having been keyed in, as well as the thirty-two arches comprising the viaduct, passing through the town of Runcorn; but the monster bridge over the Mersey is an engineering undertaking of no ordinary character, and will necessarily occupy a considerable amount of time and labour before it is finished. The works are, however, being energetically carried forward, an enormous number of artisans in various departments being engaged upon them. That part of the bridge nearest completion is the Cheshire abutment, which has already been carried to the level of the girders above high water mark, namely, seventy-five feet. The masonry of the Cheshire pier is also considerably advanced, and nearly ready to receive the girders. The works on the Lancashire side are not so far advanced, but the coffer dams, both for the Lancashire abutment and also for the Lancashire pier, have been completed, and the excavation necessary before the masonry can be commenced is now going forward. The piers of the six 60-feet openings on the north bank of the river, to which we have already alluded, are also advanced to a considerable height above high water. The staging for fixing the girders is exceedingly massive, containing several thousand feet of enormous balks of timber. This staging has, to a great extent, been erected on the Cheshire side of the river."

From the north-eastern district we learn that the Millfield Engine Ironworks, Sunderland, will shortly be transferred into a limited liability company. Mr. Leeman, of York, Mr. Close, and Mr. William Gray will be directors. Mr. Close will be managing director, and his son secretary. The shares have not come into market. They are of £20 each, and will be offered to the friends of the directors. On Saturday a new warehouse at the South Dock, Sunderland, was opened for the warehousing of grain, by the lifting of the first batch of a cargo of grain brought by the Verbena, of Whitby, from the Black Sea. By a continuation of the shafting from the old warehouse, the two friction hoists of the new one are worked. From all the facts that come under our notice, we are led to the conclusion that the north-eastern district is enjoying a large measure of solid material prosperity. In the South Durham and Cleveland district there are now 14 blast furnaces building, of which 12 are nearly completed. The last return as to the position of the existing furnaces exhibits the following results:—

Places and Owners.	In.	Out.	Total.
Eston—Bolckow, Vaughan, and Co. (Limited)	9	—	9
„ Clay Lane Co.	6	—	6
„ South Bank Co.	4	2	6
Cargo Fleet—Jones, Dunning, and Co.	3	—	3
„ Cochrane and Co.	4	—	4
„ Gilkes, Wilson, Pease, and Co.	5	2	7
Middlesbro'—Bolckow, Vaughan, and Co.	4	—	4
„ Hopkins and Co. (Limited)	2	—	2
Lloyd and Co.	4	—	4
Port Clarence—Bell Brothers	6	—	6
Norton—Warner, Lucas, and Barnett	3	—	3
Stockton—Houldsworth and Co.	3	—	3
Ferryhill—Rosedale Iron Co. (Limited)	6	—	6
Newport—B. Samuelson	3	—	3
Thornaby—W. Whitwell and Co.	3	—	3
Fighting Cocks—Middleton Iron Company (Limited)	2	—	2
Darlington—South Durham Co.	2	1	3
Witton Park—Bolckow, Vaughan, and Co. (Limited)	4	—	4
Stanhope—Weardale Iron Co. (Limited)	—	1	1
Towlow—Weardale Iron Co. (Limited)	4	1	5
Consett—Derwent Iron Co. (Limited)	6	12	18
Total	83	19	102

At North Stockton the Rail Mill Company are just opening their puddling furnaces.

With regard to the South Yorkshire coal trade, it may be noted that there has been a very large tonnage over the South Yorkshire system to Hexthorpe, both for the London and country markets, and house coal is in especial demand for the metropolis. The trade to Grimsby for the northern ports will soon close, owing to the approach of winter. Merchants there are, therefore, pushing the trade as much as possible, and trade was never brisker than it is at this moment. The trade to Hull, *via* Keadby, is also brisk. Coke is still in demand for the Lincolnshire iron district, in fact all that can be made here is not sufficient, and large orders are going to the north. The ironworks in Lincolnshire are looking forward to the opening of the Trent and Ancholme line with great anxiety, as the traffic is only indifferently carried on round by Woodburn Junction and Barnetby. This of course will be remedied as soon as the Trent and Ancholme opens. The men have been working steadily at the various collieries, but some of the colliery proprietors have had deputations from the workmen asking for an advance of wages. The Leeds forges are still turning out a fair quantity of iron. The machine and tool makers are also busy, as is the locomotive business, in which line a new company is shortly about to be launched. Trade at Sheffield is on the whole spoken of favourably. There is a large demand for cutlery for America, and the orders for tools for that market rather increase. From Canada there are only a few interim season orders. There are still pretty general complaints that the foreign orders received through Birmingham factors are small. The home markets continue to improve, so far as cutlery, tools, and plated ware are concerned. The stove-grate trade, as usual at this season, is becoming duller, and there is less doing in agricultural implements, except for the Australian market. The heavy trades are a shade more active in some branches, the railway orders continuing large. The home houses are doing a fair business in steel, but the foreign demand is still small.

A meeting has been held to promote the construction of a line of railway down the valley of the Dent.

PRICES CURRENT OF TIMBER.

Per load—	1864. £	s.	£	s.	1865. £	s.	£	s.
Teak	11	0	13	0	12	10	13	10
Quebec, red pine	3	5	4	15	3	10	4	15
yellow pine	2	15	3	10	3	10	4	0
St. John, N.B., yel.	0	0	0	0	6	0	0	0
Quebec, oak, white	5	5	6	0	6	10	7	0
birch	3	10	4	10	3	10	4	10
Memel	0	0	0	0	0	0	0	0
elm	3	10	5	0	3	10	5	0
Dantzic, oak	3	0	6	0	3	10	6	10
fir	2	10	3	10	2	15	4	0
Memel, fir	3	10	3	15	3	15	4	0
Riga	3	5	3	10	3	10	3	15
Swedish	2	9	2	14	2	10	2	15
Masts, Queb. rd. pine	6	10	8	10	5	10	6	10
yl. pine	5	0	6	0	5	10	6	10
rd. pine	0	0	0	0	0	0	0	0
Lathwood, Dantz. fm	7	10	8	0	7	10	8	10
St. Peters	8	10	9	10	8	10	9	10
Deals, per C., 12ft. by 3 by 9in.								
Quebec, wht. spruce	13	0	17	0	15	10	18	0
St. Jhn, wht. spruce	12	0	14	0	13	0	15	0

Per load—	1864. £	s.	£	s.	1865. £	s.	£	s.
Yel. pine per reduced C.								
Canada, 1st quality	16	10	19	0	17	0	18	10
2nd do.	12	0	14	0	11	0	12	10
Archangel, yellow	13	10	14	10	13	10	14	10
St. Petersbg. yel.	11	0	13	0	11	10	13	0
Finland	8	0	10	10	8	10	10	10
Memel	10	0	15	0	10	0	15	0
Gothenburg, yel.	10	0	11	0	10	0	11	0
white	9	0	9	10	9	0	9	10
Gefle, yellow	10	10	11	10	10	10	11	10
Soderhamn	9	10	11	0	9	10	11	5
Christiania, per C 12ft. by 3 by 9 in. yellow	18	0	23	0	18	0	23	0
Deck plank, Dntz per 40ft. 3in.	0	14	1	8	0	14	1	6
Staves, per standard M.								
Quebec, pipe	60	0	65	0	60	0	65	0
puncheon	18	0	19	0	18	0	20	0
Baltic crown pipe	170	0	190	0	220	0	250	0

The Credit Foncier and Mobilier of England.—A prospectus has just been put in circulation by the Credit Foncier and Mobilier Company of England, of an issue of 100,000 new shares of £20 each, to be allotted as follows:—50,000 shares to the present shareholders, and 50,000 shares to the general public. When the above issue is completed, the subscribed capital will consist of 200,000 shares of £20 each, £4,000,000; the paid-up capital, £1,000,000; the general reserve fund, £500,000; the dividend reserve fund, £100,000. The results of the operations of this company have been so satisfactory that, as will be seen by the half-yearly report just issued, a dividend and bonus, up to the 30th September, at the rate of 40 per cent. per annum has been declared, being the same dividend and bonus as was paid for the previous half-year.